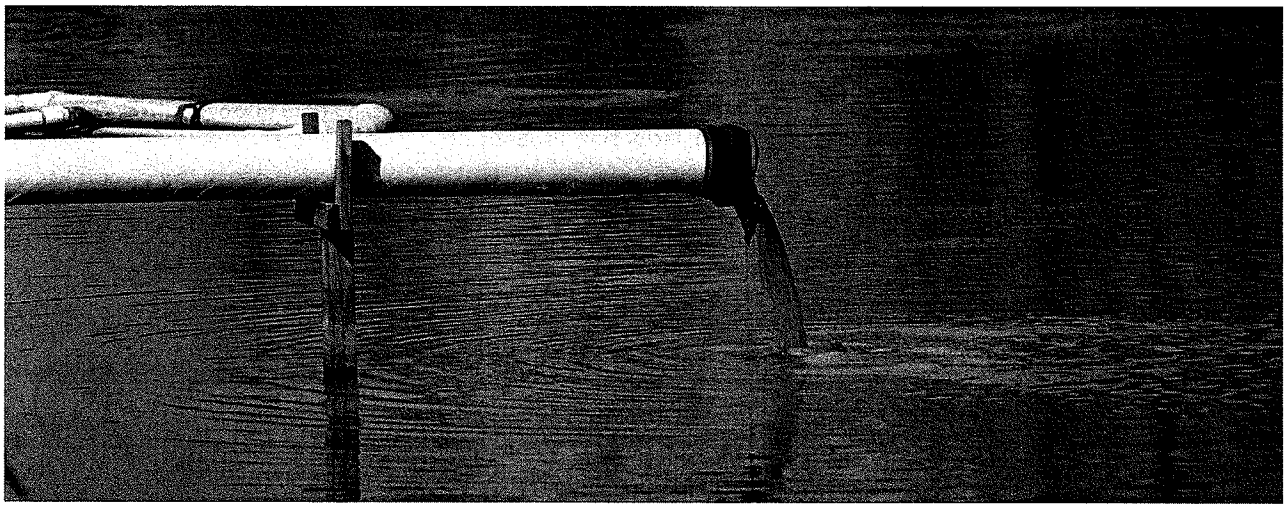
APPENDIX B

ehp ENVIRONMENTAL HEALTH PERSPECTIVES

CAFOs and Environmental Justice: The Case of North Carolina



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News Topics: Air Pollution, Antibiotic Resistance, Dust, Community Health, Economics, Health Disparities, Industry Issues, Innovative Technologies, Laws, Regulations, and Policy, Livestock Issues, Farming, Respiratory Health, Waste Disposal, Water Pollution

On the coastal plain of eastern North Carolina, families in certain rural communities daily must deal with the piercing, acrid odor of hog manure—reminiscent of rotten eggs and ammonia—wafting from nearby industrial hog farms. On bad days, the odor invades homes, and people are often forced to cover their mouths and noses when stepping outside. Sometimes, residents say, a fine mist of manure sprinkles nearby homes, cars, and even laundry left on the line to dry.[1]

Today's industrial-scale farms—called concentrated animal feeding operations (CAFOs)—house thousands of animals whose waste is periodically applied to "spray fields" of Bermuda grass or feed crops.[2,3] The waste can contain pathogens, heavy metals, and antibiotic-resistant bacteria,[4,5] and the spray can reach nearby homes and drinking water sources. The odor plume, which often pervades nearby communities, contains respiratory and eye irritants including hydrogen sulfide and ammonia.[6,7,8] A growing body of research suggests these emissions may contribute not only to mucosal irritation[9] and respiratory ailments[10] in nearby residents but also decreased quality of life,[11] mental stress,[12,13] and elevated blood pressure.[14]

The home of a minority family in Kenansville, North Carolina, situated next to a concentrated animal feeding operation, or CAFO. Dust, odors, and manure

Although the Midwest is the traditional home for hogs, with Iowa still the top-producing state, North Carolina went from fifteenth to second in hog production between the mid-1980s and mid-1990s.[15] This explosive growth resulted in thousands of CAFOs located in the eastern half of the state—squarely in the so-called Black Belt, a crescent-shaped band throughout the South where slaves worked on plantations.[16,17] After emancipation many freed slaves continued to work as sharecroppers and tenant farmers. A century later, black residents of this region still experience high rates of poverty, poor health care, low educational attainment, unemployment, and substandard housing.[18,19]

The clustering of North Carolina's hog CAFOs in low-income, minority communities—and the health impacts that accompany them—has raised concerns of environmental injustice and environmental racism.[20] As one pair of investigators explained, "[P]eople of color and the poor living in rural communities lacking the political capacity to resist are said to shoulder the adverse socio-economic, environmental, or health related effects of swine waste externalities

residents' homes, including their laundry.

Although North Carolina is not the only area with environmental justice concerns vis-à-vis CAFOs, it has become one of the best studied.

Environmental Injustice?

One of the misunderstandings about environmental racism, in particular, is that the term suggests malicious or at least discriminatory intent in terms of locating hazards. Although that may exist in some cases, several studies have argued that industry or government simply followed the "path of least resistance" in choosing sites where people were less likely to object or land was cheap.[22,23] The situation nevertheless results in environmental injustice if minority populations are disproportionately affected, no matter the reason.[24]

This resident of Kenansville usually wears a facemask when he's in his yard because of the dust from the neighboring CAFO. Most studies suggest that communities already have high levels of poverty and large percentages of minority residents when CAFOs are built there. People who can afford to move away often do.

From a scientific perspective, hundreds of studies have documented disparities in the location of environmental hazards relative to race and class, and, further, in the extent and timeliness of remediative actions.[25,26,27,28] "Environmental justice science [seeks to] understand how burden disparities lead to exposure, risk, and health disparities," says Sacoby Wilson, a University of Maryland environmental health professor.

Debates still exist over the relative importance of race versus socioeconomic status[29] and whether hazards are disproportionately sited in regions where minorities and impoverished people live, or whether communities change after polluting facilities move in. Most studies suggest the former.[22,30] However, research also suggests that people who can afford to move away from environmental hazards often do, increasing disparities.[30]

East Carolina University sociology professor Bob Edwards says he had heard environmental justice groups claiming disparities in the siting of hog farms and industry proponents denying them when he realized it was an empirical question. "There was no real research at the time," he says. So in 2000 he began a study with collaborator Anthony E. Ladd of the Loyola University Department of Sociology. They found that even when controlling for regional differences, urbanization level, property value, and attributes of the labor force, eastern North Carolina counties with larger minority populations were home to greater concentrations of hog waste, a function of hog population density, compared with more urbanized counties with a higher percentage of white residents.[21] Another North Carolina study later reported nine times more hog CAFOs in areas where there was more poverty and higher percentages of nonwhite people even after adjusting for population density as a measure of rural location and cheaper land.[20]

Another Kenansville resident stands in his front yard, feet from the CAFO across the street. Donn Young, the North Carolina–based photographer who took these images, says of his time in Kenansville, "I encountered problems with my eyes—itchy, watering, something akin to allergies." To the people who live there, CAFOs are simply a fact of everyday life.

Edwards has also reported that large hog operations forced small farmers out of business.[31] As the industry consolidated, the primary slaughterhouse in North Carolina refused to accept hogs in lots of fewer than 1,000.[32] With the exception of the slaughterhouse, the industry does not create many working-class jobs and sometimes creates major rifts in the social fabric of communities between proponents and opponents of local CAFOs.[31,33,34,35]

What Is Environmental Justice?

Environmental justice refers to both a social movement and a field of scientific research. As a movement, it is a marriage of civil rights and environmentalism, emerging in 1982 when black citizens lay down on the road to stop the government from dumping 120 million pounds of soil contaminated with polychlorinated biphenyls in Warren County, North Carolina.[74] Although the Warren County waste site ultimately was established,[75,76] the protests captured the nation's attention.

The study of environmental justice began in earnest in 1983, when the Government Accountability Office (then known as the General Accounting Office) investigated the racial composition of communities near four hazardous waste sites in the Southeast, three of which were located in predominantly black communities where at least 26% of the population lived below the poverty level.[77] In 1987 the first national study to analyze the issue with multivariate statistics found that even after controlling for household income, housing values, amount of hazardous waste generated in an area, and other factors, the percentage of minority residents in a zip code proved the greatest predictor of hazardous waste facility siting. Zip codes with hazardous waste sites had double the percentage of minority residents compared with those with none, and zip codes with more than one facility had triple the percentage of minority residents.[74]

By the early 1990s, the federal government first acknowledged environmental justice with a working group that published the report *Environmental Equity: Reducing Risks for All Communities*.[78] Soon after, the Environmental Protection Agency created the Office of Environmental Equity, since renamed the Office of Environmental Justice. The agency defines environmental justice as "the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies."[79]

A Brief History of Swine

For centuries, animal husbandry operated much like a farm in a cartoon: pigs wallowing in mud, chickens wandering about pecking the ground, and cows grazing on grass, with a barn to store hay and feed. Farms were largely sustainable; they generally did not deplete the soil, water, or land resources needed to maintain the farm for the next generation. The waste from the animals helped grow the next year's crops.

Today, the vast majority of America's 1 billion–plus food animals slaughtered annually[36] are raised in CAFOs.[37] John Ikerd, professor emeritus of agricultural economics at the University of Missouri, says farms have changed over his long career in three main ways. First, today's farms specialize in growing one crop or in one phase of production; in the hog industry there are facilities for breeding sows, raising piglets to about 40 pounds, and finishing operations, where animals are raised to the point of slaughter. Second, large corporations ("integrators") contract with individual farmers to raise animals and set precise standards for what the animals eat, their housing conditions, and the antibiotics and hormones they receive. Finally, there's been a consolidation of control and ownership that, as mentioned, has forced small farmers out of business and altered local economies and communities.[31,32]

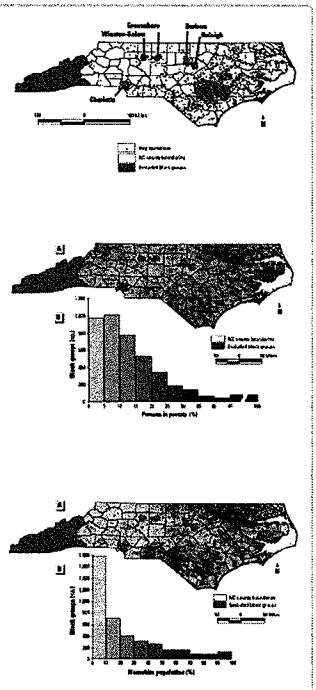
The hog industry in North Carolina changed rapidly starting in the 1970s, when Wendell Murphy applied the CAFO model, already used for poultry, to swine.[38] As a successful hog farmer, Murphy was elected to the North Carolina House of Representatives in 1983 and to the state Senate in 1988, where he sponsored and helped to pass legislation—dubbed "Murphy's laws"—that eliminated sales tax on hog farm equipment and prevented local authorities from using zoning authority to deal with odor issues.[39,40]

The industry's rapid growth in the state followed the passage of these bills, causing a major shift in the state's hog farming. In 1982 every county in North Carolina but one had a commercial hog farm; by 1997, 95% of hog farms were located in the eastern counties of the coastal plain.[32]

Today the North Carolina hog herd, all told, numbers around 9–10 million animals annually, according to the state Department of Agriculture and Consumer Services.[41] This results in an enormous amount of manure, with each hog producing an estimated four to eight times as much feces as a human.[32,42] In 2008 the Government Accountability Office reported that some 7.5 million hogs in five eastern North Carolina counties produced an estimated 15.5 million tons of waste per year, and that in one year a single 80,000-head facility could create 1.5 times the waste of the city of Philadelphia.[43]

The lagoons in which this waste is stored contain pathogens such as *Salmonella*, insecticides, antimicrobial agents and other pharmaceuticals, and nutrients that cause widespread pollution and impairment of watersheds across the coastal plain.[44,45,46] Much concern has been raised over antibiotic-resistant bacteria that result from CAFO animals' near-continual exposure to subtherapeutic doses of antibiotics as an inexpensive means to prevent disease and promote growth.[47,48]

Whereas human sewage is treated with chemical and mechanical filtration before being released into the environment, CAFOs channel waste from hog houses into pits or lagoons, where it is stored untreated until it is applied to land. All lagoons leach to some degree,[49,50,51] and during hurricanes and storms they can overflow or burst, spilling raw sewage onto the landscape and into waterways. In 1995 an eight-acre lagoon ruptured, spilling 22 million gallons of manure into North Carolina's New River, killing millions of fish and other organisms; other spills followed that summer.[52,53] Even without spills, ammonia and nitrates may seep into groundwater, especially in the coastal plain where the water table is near the surface.[32,54]

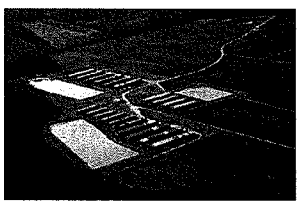


Maps from an older study show distributions of poverty, minority residents, and hog CAFOs in North Carolina as of 1998–2000. Little has changed appreciably since then.

Source: Wing et al. (2000)[20]

Odors, Plumes, and Toxics

Although more research is needed on the impact of CAFO emissions on susceptible groups of people,[10] studies have linked hog odors and air pollution from the associated odor plume with adverse effects on health and quality of life.[55] Wilson, who has documented environmental justice issues surrounding hog farms in North Carolina and Mississippi, explains that CAFO emissions go beyond bad smells. "It's much more complex than that," he says. "You have exposures through air, water, and soil. You have ... inhalation, ingestion, and dermal exposures. People have been exposed to multiple chemicals: hydrogen sulfide, particulate matter, endotoxins, nitrogenous compounds. Then you have a plume that moves; what gets into the air gets into the water. You have runoff from spray fields. These are complex exposure profiles."



CAFOs apply accumulated animal waste to spray fields of Bermuda grass or field crops located around the barns and lagoons.

© 2013 Donn Young Photography

University of North Carolina epidemiology professor Steve Wing and colleagues have reported that waste odor frequently prevents local residents from spending time outdoors, opening windows, putting laundry out to dry, or inviting visitors over.[9,56] In the Community Health Effects of Industrial Hog Operations study, a repeated-measures, community-driven project, Wing and colleagues enrolled 102 individuals in 16 communities to sit outside twice a day, recording odor strength and symptoms such as eye irritation and difficulty breathing. Participants self-monitored aspects of their physical health, including

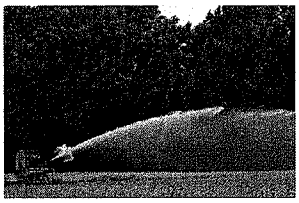
CAFOs like this one in Princeton, North Carolina.

on levels of hydrogen sulfide, endotoxin, coarse particulate matter (PM_{10}), and semivolatile compounds in particle phase within each neighborhood.

The researchers found that hydrogen sulfide levels were strongly related to odor.[57] Furthermore, measures of odor, endotoxin, hydrogen sulfide, and PM_{10} were associated, variously, with increased respiratory difficulty, sore throat, chest tightness, nausea, and eye irritation,[58] whereas hydrogen sulfide and semivolatile particles were linked to reports of feeling stressed, annoyed, nervous, and anxious.[13]

Most recently, Wing reported associations between blood pressure increases and increased odor and hydrogen sulfide.[14] "In this primarily African-American population, in a region that is known historically as the Stroke Belt because of very high rates of death from cerebrovascular disease, we don't need environmental exposures that are leading to additional blood pressure increases," Wing says.

Because these communities are typically impoverished and lack political clout, they often have little means to fight back.[59] "It creates a major burden on communities when they have few legal protections," says Wilson. However, getting communities involved in data collection has empowered citizens.[59] "When we train residents to do sampling, they understand the science of the process," says Wilson. "They can go to the town council, they can go to the media, they can explain it. That's powerful. It helps build up a community's ability to be more involved in decision making."



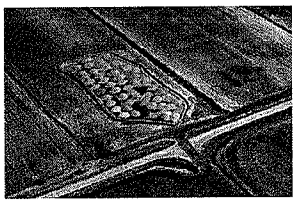
Hog waste being applied to sprayfields near Warsaw, North Carolina. Nutrients, pathogens, heavy metals, and other potentially toxic agents in the waste can make their way into local watersheds, with implications for drinking water and aquatic ecosystems.

Who Looks After Residents' Health?

The shift to CAFOs happened so fast that regulations and laws protecting human health and the environment have not caught up with the changing face of animal husbandry. A 2013 report revealed that despite the highly localized health impacts associated with CAFOs, local and state health departments generally do not have jurisdiction over them; instead, that responsibility is typically held by state environmental or natural resource agencies.[60] Jillian Fry, a researcher at the Johns Hopkins Center for a Livable Future who was lead author on that report, says, "The agencies responsible for regulating CAFOs—their mission is not to protect human health."

Fry says the study was inspired by a CAFO expansion meeting she attended with a colleague. A proponent of the expansion stood up at the meeting and stated that if hog farms caused health concerns, the health department would make the community aware; therefore, there was nothing to worry about. "I knew ... that the health department was not involved, so we wanted to see what the situation was in other parts of the country," Fry says.

She and her colleagues interviewed health department staff in eight states and found that most health departments did not deal with CAFO issues. Either they lacked the jurisdiction, had no budget or expertise, or were dealing with political pressure. Fry says, "Even if a health department thinks this is a really important issue, we're hearing from a lot of them, 'We're aware of the science, we know of the problem, but it's the political barriers.'"



Piles of what is believed to be poultry litter in a field near New Bern, North Carolina. A state moratorium on new hog CAFOs has resulted in the construction of more poultry CAFOs, according to researcher Steve Wing.

The survey also found that community members did not get very far with inquiries. "We asked community members, 'Was there ever a time you contacted a health department and they addressed your complaint?' They all said no," says Fry. "They were almost always referred to another agency, or maybe they would look into it and hit a barrier."

An Eye to the Future

With accumulating scientific evidence over the environmental and community health impacts of hog CAFOs and extensive media coverage of ruptured lagoons, opposition crescendoed in the mid-1990s. In 1997 North Carolina passed a law prohibiting the expansion of existing hog operations and placing a temporary moratorium on new hog CAFOs,[61] although permits in the hopper were approved. The moratorium became permanent in 2007 with the Swine Farm Environmental Performance Standards Act, which banned new lagoons and mandated that any new or expanded CAFOs must use environmentally superior technologies (ESTs) to substantially reduce emissions and prevent waste discharges into surface and ground waters.[62] The 2007 law provided for a substantial cost-share for operators to upgrade their lagoons and implement ESTs, yet only 11 of 2,200 have applied, and only 8 have participated.[63,64]

Although the act limited growth of new hog facilities, it didn't clean up existing ones, says Wing. Local residents still deal daily with odor and pollutants in the vicinity of hog farms. The moratorium also catalyzed other changes whose impact is yet to be fully realized. "More poultry facilities have been built," Wing says. "That brings up other issues such as the spread of microbes between species."

Another milestone occurred when Smithfield Foods, Inc., entered into an agreement with the state Attorney General in 2000 after dozens of lagoons ruptured during Hurricane Floyd, resulting in Clean Water Act violations.[65] Smithfield Foods agreed to pay $15 million toward research on ESTs and $50 million toward environmental enhancement.[66,67] Premium Standard Farms, a subsidiary of Smithfield Foods, later voluntarily added $2.1 million toward the agreement for EST research and development.[68] If an EST were found to be both economically feasible and environmentally superior in five categories, the companies agreed to implement it at each of the farms they owned, although not at farms they subcontracted. (Mike Williams, director of the Animal and Poultry Waste Management Center at North Carolina State University and supervisor of the agreement, says an estimated 5

—met all five environmental standards, but it was deemed uneconomical. Improvements made during phase 2 reduced the cost but not enough to meet the economic criteria. The project is now in the final weeks of phase 3. "If the process shows that it does meet bona fide EST status and economic criteria, then the agreement states [farms have a certain] amount of time to implement," Williams says.

In 2011 the state passed a bill that allows hog CAFOs to upgrade their buildings without needing to upgrade their waste management systems or use ESTs, counter to the previous decade's mandates.[69] Some critics have called this a loophole, given that the 2007 law stipulated hog farmers were supposed to implement ESTs if they wanted to increase herd size or install new buildings.[70]

At the same time, the handful of pioneers who are implementing ESTs are creating what could be the future of hog farming.[71] In one of those projects, Google has partnered with Duke University and Duke Energy to turn Yadkin County's Loyd Ray Farms into a sustainable operation that generates renewable energy and carbon offsets.[72] The 8,600-head finishing farm captures methane from its hog waste using an anaerobic digester. The methane provides fuel to run a microturbine that powers part of the farm and supports components that reduce odors, nutrients, pathogens, and heavy metals. Google and Duke University share the carbon credits, while Duke Energy receives renewable energy certificates (credits for generating renewable energy that are sold separately from the actual electricity produced[73]). Although projects like these so far make up only a tiny fraction of the market, their experimental approach could lead the way toward hog farms becoming better neighbors.

Erratum

The June 2013 News article "CAFOs and Environmental Justice: The Case of North Carolina" [Environ Health Perspect 121:A182–A189 (2013)] previously referred to farms that companies "co-own with farmers." These farms should have been referred to as "company-owned." EHP *regrets the error.*

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Understanding Concentrated Animal Feeding Operations and Their Impact on Communities

N A L B O H

ENVIRONMENTAL HEALTH

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Foreword

The National Association of Local Boards of Health (NALBOH) is pleased to provide *Understanding Concentrated Animal Feeding Operations and Their Impact on Communities* to assist local boards of health who have concerns about concentrated animal feeding operations (CAFOs) or large industrial animal farms in their communities. The Environmental Health Services Branch of the Centers for Disease Control and Prevention (CDC), National Center for Environmental Health (NCEH) encouraged the development of this product and provided technical oversight and financial support. This publication was supported by Cooperative Agreement Number 5U38HM000512. Its contents are solely the responsibility of the authors and do not necessarily represent the official views of the CDC.

The mission of NALBOH is to strengthen boards of health, enabling them to promote and protect the health of their communities, through education, technical assistance, and advocacy. Boards of health are responsible for fulfilling three public health core functions: assessment, policy development, and assurance. For a health agency, this includes overseeing and ensuring that there are sufficient resources, effective policies and procedures, partnerships with other organizations and agencies, and regular evaluation of an agency's services.

NALBOH is confident that *Understanding Concentrated Animal Feeding Operations and Their Impact on Communities* will help local board of health members understand their role in developing ways to mitigate potential problems associated with CAFOs. We trust that the information provided in this guide will enable board of health members to develop and sustain monitoring programs, investigate developing policy related to CAFOs, and create partnerships with other local and state agencies and officials to improve the health and well-being of communities everywhere.

A special thanks to Jeffrey Neistadt (NALBOH's Director – Education and Training), NALBOH's Environmental Health subcommittee, and any local board of health members and health department staff who were contacted during the development of this document for their contributions and support.

Notes

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Introduction

Livestock farming has undergone a significant transformation in the past few decades. Production has shifted from smaller, family-owned farms to large farms that often have corporate contracts. Most meat and dairy products now are produced on large farms with single species buildings or open-air pens (MacDonald & McBride, 2009). Modern farms have also become much more efficient. Since 1960, milk production has doubled, meat production has tripled, and egg production has quadrupled (Pew Commission on Industrial Animal Farm Production, 2009). Improvements to animal breeding, mechanical innovations, and the introduction of specially formulated feeds and animal pharmaceuticals have all increased the efficiency and productivity of animal agriculture. It also takes much less time to raise a fully grown animal. For example, in 1920, a chicken took approximately 16 weeks to reach 2.2 lbs., whereas now they can reach 5 lbs. in 7 weeks (Pew, 2009).

New technologies have allowed farmers to reduce costs, which mean bigger profits on less land and capital. The current agricultural system rewards larger farms with lower costs, which results in greater profit and more incentive to increase farm size.

AFO vs. CAFO

A CAFO is a specific type of large-scale industrial agricultural facility that raises animals, usually at high-density, for the consumption of meat, eggs, or milk. To be considered a CAFO, a farm must first be categorized as an animal feeding operation (AFO). An AFO is a lot or facility where animals are kept confined and fed or maintained for 45 or more days per year, and crops, vegetation, or forage growth are not sustained over a normal growing period (Environmental Protection Agency [EPA], 2009). CAFOs are classified by the type and number of animals they contain, and the way they discharge waste into the water supply. CAFOs are AFOs that contain at least a certain number of animals, or have a number of animals that fall within a range and have waste materials that come into contact with the water supply. This contact can either be through a pipe that carries manure or wastewater to surface water, or by animal contact with surface water that runs through their confined area. (See Appendix A)

History

AFOs were first identified as potential pollutants in the 1972 Clean Water Act. Section 502 identified "feedlots" as "point sources" for pollution along with other industries, such as fertilizer manufacturing. Consequently, a permit program entitled the National Pollutant Discharge Elimination System (NPDES) was created which set effluent limitation guidelines and standards (ELGs) for CAFOs. CAFOs have since been regulated by NPDES or a state equivalent since the mid-1970s. The definitions of what was considered an AFO or CAFO were created by the EPA for the NPDES process in 1976. These regulations remained in effect for more than 25 years, but increases and changes to farm size and production methods required an update to the permit system.

The regulations guiding CAFO permits and operations were revised in 2003. New inclusions in the 2003 regulations were that all CAFOs had to apply for a NPDES permit even if they only discharged in the event of a large storm. Large poultry operations were included in the regulations, regardless of their waste disposal system, and all CAFOs that held a NPDES permit were required to develop and implement a nutrient management plan. These plans had CAFOs identify ways to treat or process waste in a way that maintained nutrient levels at the appropriate amount.

The 2003 CAFO rule was subsequently challenged in court. A Second Circuit Court of Appeals decision required alteration to the CAFO permitting system. In *Waterkeeper et al. vs. the EPA*, the court directed the EPA to remove the requirement for all CAFOs to apply for NPDES. Instead, the court required that nutrient management plans be submitted with the permit application, reviewed by officials and the public, and the terms of the plan be incorporated into the permit.

As a result of this court decision, the CAFO rule was again updated. The current final CAFO rule, which was revised in 2008, requires that only CAFOs which discharge or propose to discharge waste apply for permits. The EPA has also provided clarification in the discussion surrounding the rule on how CAFOs should assess whether they discharge or propose to discharge. There is also the opportunity to receive a no discharge certification for CAFOs that do not discharge or propose to discharge. This certification demonstrates that the CAFO is not required to acquire a permit. And while CAFOs were required to create nutrient management plans under the 2003 rule, these plans were now included with permit applications, and had a built-in time period for public review and comment.

Benefits of CAFOs

When properly managed, located, and monitored, CAFOs can provide a low-cost source of meat, milk, and eggs, due to efficient feeding and housing of animals, increased facility size, and animal specialization. When CAFOs are proposed in a local area, it is usually argued that they will enhance the local economy and increase employment. The effects of using local materials, feed, and livestock are argued to ripple throughout the economy, and increased tax expenditures will lead to increase funds for schools and infrastructure.

Environmental Health Effects

The most pressing public health issue associated with CAFOs stems from the amount of manure they produce. CAFO manure contains a variety of potential contaminants. It can contain plant nutrients such as nitrogen and phosphorus, pathogens such as *E. coli*, growth hormones, antibiotics, chemicals used as additives to the manure or to clean equipment, animal blood, silage leachate from corn feed, or copper sulfate used in footbaths for cows.

Depending on the type and number of animals in the farm, manure production can range between 2,800 tons and 1.6 million tons a year (Government Accountability Office [GAO], 2008). Large farms can produce more waste than some U.S. cities—a feeding operation with 800,000 pigs could produce over 1.6 million tons of waste a year. That amount is one and a half times more than the annual sanitary waste produced by the city of Philadelphia, Pennsylvania (GAO, 2008). Annually, it is estimated that livestock animals in the U.S. produce each year somewhere between 3 and 20 times more manure than people in the U.S. produce, or as much as 1.2–1.37 billion tons of waste (EPA, 2005). Though sewage treatment plants are required for human waste, no such treatment facility exists for livestock waste.

While manure is valuable to the farming industry, in quantities this large it becomes problematic. Many farms no longer grow their own feed, so they cannot use all the manure they produce as fertilizer. CAFOs must find a way to manage the amount of manure produced by their animals. Ground application of untreated manure is one of the most common disposal methods due to its low cost. It has limitations, however, such as the inability to apply manure while the ground is frozen. There are also limits as to how many nutrients from manure a land area can handle. Over application of livestock wastes can overload

soil with macronutrients like nitrogen and phosphorous and micronutrients that have been added to animal feed like heavy metals (Burkholder et al., 2007). Other manure management strategies include pumping liquefied manure onto spray fields, trucking it off-site, or storing it until it can be used or treated. Manure can be stored in deep pits under the buildings that hold animals, in clay or concrete pits, treatment lagoons, or holding ponds.

Animal feeding operations are developing in close proximity in some states, and fields where manure is applied have become clustered. When manure is applied too frequently or in too large a quantity to an area, nutrients overwhelm the absorptive capacity of the soil, and either run off or are leached into the groundwater. Storage units can break or become faulty, or rainwater can cause holding lagoons to overflow. While CAFOs are required to have permits that limit the levels of manure discharge, handling the large amounts of manure inevitably causes accidental releases which have the ability to potentially impact humans.

The increased clustering and growth of CAFOs has led to growing environmental problems in many communities. The excess production of manure and problems with storage or manure management can affect ground and surface water quality. Emissions from degrading manure and livestock digestive processes produce air pollutants that often affect ambient air quality in communities surrounding CAFOs. CAFOs can also be the source of greenhouse gases, which contribute to global climate change.

All of the environmental problems with CAFOs have direct impact on human health and welfare for communities that contain large industrial farms. As the following sections demonstrate, human health can suffer because of contaminated air and degraded water quality, or from diseases spread from farms. Quality of life can suffer because of odors or insect vectors surrounding farms, and property values can drop, affecting the financial stability of a community. One study found that 82.8% of those living near and 89.5% of those living far from CAFOs believed that their property values decreased, and 92.2% of those living near and 78.3% of those living far from CAFOs believed the odor from manure was a problem. The study found that real estate values had not dropped and odor infestations were not validated by local governmental staff in the areas. However, the concerns show that CAFOs remain contentious in communities (Schmalzried and Fallon, 2007). CAFOs are an excellent example of how environmental problems can directly impact human and community well-being.

Groundwater

Groundwater can be contaminated by CAFOs through runoff from land application of manure, leaching from manure that has been improperly spread on land, or through leaks or breaks in storage or containment units. The EPA's 2000 National Water Quality Inventory found that 29 states specifically identified animal feeding operations, not just concentrated animal feeding operations, as contributing to water quality impairment (Congressional Research Service, 2008). A study of private water wells in Idaho detected levels of veterinary antibiotics, as well as elevated levels of nitrates (Batt, Snow, & Algo, 2006). Groundwater is a major source of drinking water in the United States. The EPA estimates that 53% of the population relies on groundwater for drinking water, often at much higher rates in rural areas (EPA, 2004). Unlike surface water, groundwater contamination sources are more difficult to monitor. The extent and source of contamination are often harder to pinpoint in groundwater than surface water contamination. Regular testing of household water wells for total and fecal coliform bacteria is a crucial element in monitoring groundwater quality, and can be the first step in discovering contamination issues related to CAFO discharge. Groundwater contamination can also affect surface water (Spellman &

Whiting, 2007). Contaminated groundwater can move laterally and eventually enter surface water, such as rivers or streams.

When groundwater is contaminated by pathogenic organisms, a serious threat to drinking water can occur. Pathogens survive longer in groundwater than surface water due to lower temperatures and protection from the sun. Even if the contamination appears to be a single episode, viruses could become attached to sediment near groundwater and continue to leach slowly into groundwater. One pollution event by a CAFO could become a lingering source of viral contamination for groundwater (EPA, 2005).

Groundwater can still be at risk for contamination after a CAFO has closed and its lagoons are empty. When given increased air exposure, ammonia in soil transforms into nitrates. Nitrates are highly mobile in soil, and will reach groundwater quicker than ammonia. It can be dangerous to ignore contaminated soil. The amount of pollution found in groundwater after contamination depends on the proximity of the aquifer to the CAFO, the size of the CAFO, whether storage units or pits are lined, the type of subsoil, and the depth of the groundwater.

If a CAFO has contaminated a water system, community members should be concerned about nitrates and nitrate poisoning. Elevated nitrates in drinking water can be especially harmful to infants, leading to blue baby syndrome and possible death. Nitrates oxidize iron in hemoglobin in red blood cells to methemoglobin. Most people convert methemoglobin back to hemoglobin fairly quickly, but infants do not convert back as fast. This hinders the ability of the infant's blood to carry oxygen, leading to a blue or purple appearance in affected infants. However, infants are not the only ones who can be affected by excess nitrates in water. Low blood oxygen in adults can lead to birth defects, miscarriages, and poor general health. Nitrates have also been speculated to be linked to higher rates of stomach and esophageal cancer (Bowman, Mueller, & Smith, 2000). In general, private water wells are at higher risk of nitrate contamination than public water supplies.

Surface Water

The agriculture sector, including CAFOs, is the leading contributor of pollutants to lakes, rivers, and reservoirs. It has been found that states with high concentrations of CAFOs experience on average 20 to 30 serious water quality problems per year as a result of manure management problems (EPA, 2001). This pollution can be caused by surface discharges or other types of discharges. Surface discharges can be caused by heavy storms or floods that cause storage lagoons to overfill, running off into nearby bodies of water. Pollutants can also travel over land or through surface drainage systems to nearby bodies of water, be discharged through manmade ditches or flushing systems found in CAFOs, or come into contact with surface water that passes directly through the farming area. Soil erosion can contribute to water pollution, as some pollutants can bond to eroded soil and travel to watersheds (EPA, 2001). Other types of discharges occur when pollutants travel to surface water through other mediums, such as groundwater or air.

Contamination in surface water can cause nitrates and other nutrients to build up. Ammonia is often found in surface waters surrounding CAFOs. Ammonia causes oxygen depletion from water, which itself can kill aquatic life. Ammonia also converts into nitrates, which can cause nutrient overloads in surface waters (EPA, 1998). Excessive nutrient concentrations, such as nitrogen or phosphorus, can lead to eutrophication and make water inhabitable to fish or indigenous aquatic life (Sierra Club Michigan Chapter, n.d.). Nutrient over-enrichment causes algal blooms, or a rapid increase of algae growth in an aquatic environment (Science Daily, n.d.). Algal blooms can cause a spiral of environmental problems to an aquatic system. Large groups of algae can block sunlight from underwater plant life, which are

habitats for much aquatic life. When algae growth increases in surface water, it can also dominate other resources and cause plants to die. The dead plants provide fuel for bacteria to grow and increased bacteria use more of the water's oxygen supply. Oxygen depletion once again causes indigenous aquatic life to die. Some algal blooms can contain toxic algae and other microorganisms, including *Pfiesteria*, which has caused large fish kills in North Carolina, Maryland, and the Chesapeake Bay area (Spellman & Whiting, 2007). Eutrophication can cause serious problems in surface waters and disrupt the ecological balance.

Water tests have also uncovered hormones in surface waters around CAFOs (Burkholder et al., 2007). Studies show that these hormones alter the reproductive habits of aquatic species living in these waters, including a significant decrease in the fertility of female fish. CAFO runoff can also lead to the presence of fecal bacteria or pathogens in surface water. One study showed that protozoa such as *Cryptosporidium parvum* and *Giardia* were found in over 80% of surface water sites tested (Spellman & Whiting, 2007). Fecal bacteria pollution in water from manure land application is also responsible for many beach closures and shellfish restrictions.

Air Quality

In addition to polluting ground and surface water, CAFOs also contribute to the reduction of air quality in areas surrounding industrial farms. Animal feeding operations produce several types of air emissions, including gaseous and particulate substances, and CAFOs produce even more emissions due to their size. The primary cause of gaseous emissions is the decomposition of animal manure, while particulate substances are caused by the movement of animals. The type, amount, and rate of emissions created depends on what state the manure is in (solid, slurry, or liquid), and how it is treated or contained after it is excreted. Sometimes manure is "stabilized" in anaerobic lagoons, which reduces volatile solids and controls odor before land application.

The most typical pollutants found in air surrounding CAFOs are ammonia, hydrogen sulfide, methane, and particulate matter, all of which have varying human health risks. Table 1 on page 6 provides information on these pollutants.

Most manure produced by CAFOs is applied to land eventually and this land application can result in air emissions (Merkel, 2002). The primary cause of emission through land application is the volatilization of ammonia when the manure is applied to land. However, nitrous oxide is also created when nitrogen that has been applied to land undergoes nitrification and denitrification. Emissions caused by land application occur in two phases: one immediately following land application and one that occurs later and over a longer period as substances in the soil break down. Land application is not the only way CAFOs can emit harmful air emissions—ventilation systems in CAFO buildings can also release dangerous contaminants. A study by Iowa State University, which was a result of a lawsuit settlement between the Sierra Club and Tyson Chicken, found that two chicken houses in western Kentucky emitted over 10 tons of ammonia in the year they were monitored (Burns et al., 2007).

Most studies that examine the health effects of CAFO air emissions focus on farm workers, however some have studied the effect on area schools and children. While all community members are at risk from lowered air quality, children take in 20-50% more air than adults, making them more susceptible to lung disease and health effects (Gleinman, 2000). Researchers in North Carolina found that the closer children live to a CAFO, the greater the risk of asthma symptoms (Barrett, 2006). Of the 226 schools that were included in the study, 26% stated that there were noticeable odors from CAFOs outdoors, while 8% stated

Table 1 Typical pollutants found in air surrounding CAFOs.

CAFO Emissions	Source	Traits	Health Risks
Ammonia	Formed when microbes decompose undigested organic nitrogen compounds in manure	Colorless, sharp pungent odor	Respiratory irritant, chemical burns to the respiratory tract, skin, and eyes, severe cough, chronic lung disease
Hydrogen Sulfide	Anaerobic bacterial decomposition of protein and other sulfur containing organic matter	Odor of rotten eggs	Inflammation of the moist membranes of eye and respiratory tract, olfactory neuron loss, death
Methane	Microbial degradation of organic matter under anaerobic conditions	Colorless, odorless, highly flammable	No health risks. Is a greenhouse gas and contributes to climate change.
Particulate Matter	Feed, bedding materials, dry manure, unpaved soil surfaces, animal dander, poultry feathers	Comprised of fecal matter, feed materials, pollen, bacteria, fungi, skin cells, silicates	Chronic bronchitis, chronic respiratory symptoms, declines in lung function, organic dust toxic syndrome

they experience odors from CAFOs inside the schools. Schools that were closer to CAFOs were often attended by students of lower socioeconomic status (Mirabelli, Wing, Marshall, & Wilcosky, 2006).

There is consistent evidence suggesting that factory farms increase asthma in neighboring communities, as indicated by children having higher rates of asthma (Sigurdarson & Kline, 2006; Mirabelli et al., 2006). CAFOs emit particulate matter and suspended dust, which is linked to asthma and bronchitis. Smaller particles can actually be absorbed by the body and can have systemic effects, including cardiac arrest. If people are exposed to particulate matter over a long time, it can lead to decreased lung function (Michigan Department of Environmental Quality [MDEQ] Toxics Steering Group [TSG], 2006). CAFOs also emit ammonia, which is rapidly absorbed by the upper airways in the body. This can cause severe coughing and mucous build-up, and if severe enough, scarring of the airways. Particulate matter may lead to more severe health consequences for those exposed by their occupation. Farm workers can develop acute and chronic bronchitis, chronic obstructive airways disease, and interstitial lung disease. Repeated exposure to CAFO emissions can increase the likelihood of respiratory diseases. Occupational asthma, acute and chronic bronchitis, and organic dust toxic syndrome can be as high as 50% in factory farm workers

(Horrigan, Lawrence, & Walker, 2002). Other health effects of CAFO air emissions can be headaches, respiratory problems, eye irritation, nausea, weakness, and chest tightness.

There is evidence that CAFOs affect the ambient air quality of a community. There are three laws that potentially govern CAFO air emissions—the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, also known as the Superfund Act), the Emergency Planning & Community Right to Know Act (EPCRA), and the Clean Air Act (CAA). However, the EPA passed a rule that exempts all CAFOs from reporting emissions under CERCLA. Only CAFOs that are classified as large are required to report any emission event of 100 pounds of ammonia or hydrogen sulfide or more during a 24-hour period locally or to the state under EPCRA (Michigan State University Extension, n.d.). The EPA has also instituted a voluntary Air Quality Compliance Agreement in which they will monitor some CAFO air emissions, and will not sue offenders but instead charge a small civil penalty. These changes have attracted criticism from environmental and community leaders who state that the EPA has yielded to influence from the livestock industry. The changes also leave ambiguity as to whether emission standards and air quality near CAFOs are being monitored.

Greenhouse Gas and Climate Change

Aside from the possibility of lowering air quality in the areas around them, CAFOs also emit greenhouse gases, and therefore contribute to climate change. Globally, livestock operations are responsible for approximately 18% of greenhouse gas production and over 7% of U.S. greenhouse gas emissions (Massey & Ulmer, 2008). While carbon dioxide is often considered the primary greenhouse gas of concern, manure emits methane and nitrous oxide which are 23 and 300 times more potent as greenhouse gases than carbon dioxide, respectively. The EPA attributes manure management as the fourth leading source of nitrous oxide emissions and the fifth leading source of methane emissions (EPA, 2009).

The type of manure storage system used contributes to the production of greenhouse gases. Many CAFOs store their excess manure in lagoons or pits, where they break down anaerobically (in the absence of oxygen), which exacerbates methane production. Manure that is applied to land or soil has more exposure to oxygen and therefore does not produce as much methane. Ruminant livestock, such as cows, sheep, or goats, also contribute to methane production through their digestive processes. These livestock have a special stomach called a rumen that allows them to digest tough grains or plants that would otherwise be unusable. It is during this process, called enteric fermentation, that methane is produced. The U.S. cattle industry is one of the primary methane producers. Livestock production and meat and dairy consumption has been increasing in the United States, so it can only be assumed that these greenhouse gas emissions will also rise and continue to contribute to climate change.

Odors

One of the most common complaints associated with CAFOs are the odors produced. The odors that CAFOs emit are a complex mixture of ammonia, hydrogen sulfide, and carbon dioxide, as well as volatile and semi-volatile organic compounds (Heederik et al., 2007). These odors are worse than smells formerly associated with smaller livestock farms. The anaerobic reaction that occurs when manure is stored in pits or lagoons for long amounts of time is the primary cause of the smells. Odors from waste are carried away from farm areas on dust and other air particles. Depending on things like weather conditions and farming techniques, CAFO odors can be smelled from as much as 5 or 6 miles away, although 3 miles is a more common distance (State Environmental Resource Center, 2004).

Because CAFOs typically produce malodors, many communities want to monitor emissions and odors. Quantifying odor from industrial farming can be challenging because it is a mixture of free and particle-bound compounds, which can make it hard to identify what specifically is causing the odor. Collecting data on specific gases, such as hydrogen sulfide, can be used as a proxy for odor levels.

CAFO odors can cause severe lifestyle changes for individuals in the surrounding communities and can alter many daily activities. When odors are severe, people may choose to keep their windows closed, even in high temperatures when there is no air conditioning. People also may choose to not let their children play outside and may even keep them home from school. Mental health deterioration and an increased sensitization to smells can also result from living in close proximity to odors from CAFOs. Odor can cause negative mood states, such as tension, depression, or anger, and possibly neurophysiciatric abnormalities, such as impaired balance or memory. People who live close to factory farms can develop CAFO-related post traumatic stress disorder, including anxiety about declining quality of life (Donham et al., 2007).

Ten states use direct regulations to control odors emitted by CAFOs. They prohibit odor emissions greater than a set standard. States with direct regulations use scentometers, which measure how many times an odor has to be doused with clean air before the smell is undetectable. An additional 34 states have indirect methods to reduce CAFO odors. These include: setbacks, which specify how far CAFO structures have to be from other buildings; permits, which are the most typical way of regulating CAFOs; public comment or involvement periods; and operator or manure placement training.

Insect Vectors

CAFOs and their waste can be breeding grounds for insect vectors. Houseflies, stable flies, and mosquitoes are the most common insects associated with CAFOs. Houseflies breed in manure, while stable and other flies breed in decaying organic material, such as livestock bedding. Mosquitoes breed in standing water, and water on the edges of manure lagoons can cause mosquito infestations to rise. Flies can change from eggs to adults in only 10 days, which means that substances in which flies breed need to be cleaned up regularly.

Flies are typically considered only nuisances, although insects can agitate livestock and decrease animal health. The John Hopkins Bloomberg School of Public Health found evidence that houseflies near poultry operations may contribute to the dispersion of drug-resistant bacteria (Center for Livable Future, 2009). Since flies are attracted to and eat human food, there is a potential for spreading bacteria or pathogens to humans, including microbes that can cause dysentery and diarrhea (Bowman et al., 2000). Mosquitoes spread zoonotic diseases, such as West Nile virus, St. Louis encephalitis, and equine encephalitis.

Residences closest to the feeding operations experience a much higher fly population than average homes. To lower the rates of insects and any accompanying disease threats, standing water should be cleaned or emptied weekly, and manure or decaying organic matter should be removed twice weekly (Purdue Extension, 2007). For more specific insect vector information, please refer to NALBOH's vector guide (*Vector Control Strategies for Local Boards of Health*).

Pathogens

Pathogens are parasites, bacterium, or viruses that are capable of causing disease or infection in animals or humans. The major source of pathogens from CAFOs is in animal manure. There are over 150 pathogens in manure that could impact human health. Many of these pathogens are concerning because

they can cause severe diarrhea. Healthy people who are exposed to pathogens can generally recover quickly, but those who have weakened immune systems are at increased risk for severe illness or death. Those at higher risk include infants or young children, pregnant women, the elderly, and those who are immunosuppressed, HIV positive, or have had chemotherapy. This risk group now roughly compromises 20% of the U.S. population.

Table 2 Select pathogens found in animal manure.

Pathogen	Disease	Symptoms
Bacillus anthracis	Anthrax	Skin sores, headache, fever, chills, nausea, vomiting
Escherichia coli	Colibacilosis, Coliform mastitis-metris	Diarrhea, abdominal gas
Leptospira pomona	Leptospirosis	Abdominal pain, muscle pain, vomiting, fever
Listeria monocytogenes	Listerosis	Fever, fatigue, nausea, vomiting, diarrhea
Salmonella species	Salmonellosis	Abdominal pain, diarrhea, nausea, chills, fever, headache
Clostirdum tetani	Tetanus	Violent muscle spasms, lockjaw, difficulty breathing
Histoplasma capsulatum	Histoplasmosis	Fever, chills, muscle ache, cough rash, joint pain and stiffness
Microsporum and *Trichophyton*	Ringworm	Itching, rash
Giardia lamblia	Giardiasis	Diarrhea, abdominal pain, abdominal gas, nausea, vomiting, fever
Cryptosporidium species	Cryptosporidosis	Diarrhea, dehydration, weakness, abdominal cramping

Sources of infection from pathogens include focal-oral transmission, inhalation, drinking water, or incidental water consumption during recreational water activities. The potential for transfer of pathogens among animals is higher in confinement, as there are more animals in a smaller amount of space. Healthy or asymptomatic animals may carry microbial agents that can infect humans, who can then spread that infection throughout a community, before the infection is discovered among animals.

When water is contaminated by pathogens, it can lead to widespread outbreaks of illness. Salmonellosis, cryptosporidiosis, and giardiasis can cause nausea, vomiting, fever, diarrhea, muscle pain, and death, among other symptoms. *E.coli* is another serious pathogen, and can be life-threatening for the young, elderly, and immunocompromised. It can cause bloody diarrhea and kidney failure. Since many CAFO use sub-therapeutic antibiotics with their animals, there is also the possibility that disease-resistant bacteria can emerge in areas surrounding CAFOs. Bacteria that cannot be treated by antibiotics can have very serious effects on human health, potentially even causing death (Pew Charitable Trusts, n.d.).

There is also the possibility of novel (or new) viruses developing. These viruses generate through mutation or recombinant events that can result in more efficient human-to-human transmission. There has been some speculation that the novel H1N1 virus outbreak in 2009 originated in swine CAFOs in Mexico. However, that claim has never been substantiated. CAFOs are not required to test for novel viruses, since they are not on the list of mandatory reportable illness to the World Organization for Animal Health.

Antibiotics

Antibiotics are commonly administered in animal feed in the United States. Antibiotics are included at low levels in animal feed to reduce the chance for infection and to eliminate the need for animals to expend energy fighting off bacteria, with the assumption that saved energy will be translated into growth. The main purposes of using non-therapeutic doses of antimicrobials in animal feed is so that animals will grow faster, produce more meat, and avoid illnesses. Supporters of antibiotic use say that it allows animals to digest their food more efficiently, get the most benefit from it, and grow into strong and healthy animals.

The trend of using antibiotics in food has increased with the greater numbers of animals held in confinement. The more animals that are kept in close quarters, the more likely it is that infection or bacteria can spread among the animals. Seventy percent of all antibiotics and related drugs used in the U.S. each year are given to beef cattle, hogs, and chickens as feed additives. Nearly half of the antibiotics used are nearly identical to ones given to humans (Kaufman, 2000).

There is strong evidence that the use of antibiotics in animal feed is contributing to an increase in antibiotic-resistant microbes and causing antibiotics to be less effective for humans (Kaufman, 2000). Resistant strains of pathogenic bacteria in animals, which can be transferred to humans thought the handling or eating of meat, have increased recently. This is a serious threat to human health because fewer options exist to help people overcome disease when infected with antibiotic-resistant pathogens. The antibiotics often are not fully metabolized by animals, and can be present in their manure. If manure pollutes a water supply, antibiotics can also leech into groundwater or surface water.

Because of this concern for human health, there is a growing movement to eliminate the non-therapeutic use of antibiotics with animals. In 2001, the American Medical Association approved a resolution to ban all low-level use of antibiotics. The USDA has developed guidelines to limit low-level use, and some major meat buyers (such as McDonald's) have stopped using meat that was given antibiotics that are also used for humans. The World Health Organization is also widely opposed to the use of antibiotics, calling for a cease of their low-level use in 2003. Some U.S. legislators are seeking to ban the routine use of antibiotics with livestock, and there has been legislation proposed to solidify a ban. The Preservation of Antibiotics for Medical Treatment Act (PAMTA), which was introduced in 2009, has the support of over 350 health.

consumer, and environmental groups (H.R. 1549/S. 619). The act, if passed, would ban seven classes of antibiotics important to human health from being used in animals, and would restrict other antibiotics to therapeutic and some preventive uses.

Other Effects – Property Values

Most landowners fear that when CAFOs move into their community their property values will drop significantly. There is evidence that CAFOs do affect property values. The reasons for this are many: the fear of loss of amenities, the risk of air or water pollution, and the increased possibility of nuisances related to odors or insects. CAFOs are typically viewed as a negative externality that can't be solved or cured. There may be stigma that is attached to living by a CAFO.

The most certain fact regarding CAFOs and property values are that the closer a property is to a CAFO, the more likely it will be that the value of the property will drop. The exact impact of CAFOs fluctuates depending on location and local specifics. Studies have found differing results of rates of property value decrease. One study shows that property value declines can range from a decrease of 6.6% within a 3-mile radius of a CAFO to an 88% decrease within 1/10 of a mile from a CAFO (Dakota Rural Action, 2006). Another study found that property value decreases are negligible beyond 2 miles away from a CAFO (Purdue Extension, 2008). A third study found that negative effects are largest for properties that are downwind and closest to livestock (Herriges, Secchi, & Babcock, 2005). The size and type of the feeding operation can affect property value as well. Decreases in property values can also cause property tax rates to drop, which can place stress on local government budgets.

Considerations for Boards of Health

Right-to-Farm Laws

With all of the potential environmental and public health effects from CAFOs, community members and health officials often resort to taking legal action against these industrial animal farms. However, there are some protections for farms in place that can make lawsuits hard to navigate. Right-to-farm laws were created to address conflicts between farmers and non-farming neighbors. They seek to override common laws of nuisance, which forbid people to use their property in ways that are harmful to others, and protect farmers from unreasonable controls on farming.

All 50 states have some form of right-to-farm laws, but most only offer legal protections to farms if they meet certain specifications. Generally, they must be in compliance with all environmental regulations, be properly run, and be present in a region first before suburban developments, often a year before the plaintiff moves to that area. These right-to-farm laws were originally created in the late 1970s and early 1980s to protect family farms from suburban sprawl, at a time when large industrial farms were not the norm. As industrial farms grew in size and number, the agribusiness industry lobbied for and achieved the passage of stricter laws in the 1990s, many of which are now being challenged in court by homeowners and small family farmers. Opponents to these laws argue that they deprive them of their use of property and therefore violate the Fifth Amendment to the Constitution.

Some state courts have overturned their strict right-to-farm laws, such as Iowa, Michigan, Minnesota, and Kansas. Others such as Vermont have rewritten their laws. Vermont's updated right-to-farm bill

protects established farm practices as long as there is not a substantial adverse effect on health, safety, or welfare.

Boards of health need to be aware of what legal protection their state offers farms. Right-to-farm laws can hinder nuisance complaints brought about by community members. State laws can prevent local government or health officials from regulating industrial farms.

Board of Health Involvement with CAFOs

Boards of health are responsible for fulfilling the three public health core functions: assessment, policy development, and assurance. Boards of health can fulfill these functions through addressing problems stemming from CAFOs in their communities. Specific public health services that can tackled regarding CAFOs include monitoring health status, investigating health problems, developing policies, enforcing regulations, informing and educating people about CAFOs, and mobilizing community partnerships to spread awareness about environmental health issues related to CAFOs.

Assessment: Board of health members should ensure that there is an effective method in place for collecting and tracking public complaints about CAFOs and large animal farms. Since environmental health specialists at local health departments are often responsible for investigating complaints, the board of health must take measures to ensure that they are properly trained and educated about CAFOs. It is possible that the board of health may be responsible or choose to do some investigations itself. Schmalzried and Fallon (2008) advocate that local health districts adopt a proactive approach for addressing public concerns about CAFOs, stating that health districts can offer some services that may help ease public frustration with CAFOs. A fly trapping program can establish a baseline for the average number of flies present prior to the start-up of CAFOs or large animal farms, which can then establish if a fly nuisance exists in the area. Testing for water quality and quantity can provide evidence if CAFOs are suspected of affecting private water supplies. Boards of health can also monitor exposure incidences that occur in emergency rooms to determine if migrant or farm workers are developing any adverse health conditions as a result of their work environments. Establishing these programs benefit both members of the community and provide information to future animal farm operators, and local boards of health should recommend them if they've been receiving complaints about CAFOs.

Policy Development: Boards of health in many states can adopt health-based regulations about CAFOs, however, they may be met with some resistance. Humbolt County, Iowa, adopted four health-based ordinances concerning CAFOs that became models for regulations in other states, but the Iowa Supreme Court ruled the ordinances were irreconcilable with state laws. Boards of health that choose to regulate CAFOs can also be subject to pressure from outside forces, including possible lawsuits or withdrawal of funding. Boards of health should also consider working with other local officials to institute regulations on CAFOs, such as zoning ordinances.

Assurance: Boards of health can execute the assurance function by advocating for or educating about better environmental practices with CAFOs. Board members may receive complaints from the public about CAFOs, and boards can hold public meetings to receive complaints and hear public testimony about farms. If boards of health are not capable of regulating industrial farms in their communities, they can still try to collaborate with other local agencies that have jurisdiction. Board of health members can educate other local agencies and public officials about CAFOs and spread awareness about the environmental and health hazards. They can request a public hearing with the permitting agency of the

CAFOs, and the Iowa State Association of Counties wanted to review air quality issues. Officials in Cerro Gordo County originally began working on a regulation that required inspections and was based on public health concerns, since farms were already exempt from any regulations related to zoning. However, Iowa state senators soon introduced legislation that passed and prevented any animal feeding operations from being regulated from a public health angle as well.

As Iowans were now prevented from regulating animal feeding operations in terms of zoning or public health, officials in Cerro Gordo County decided to place a moratorium on the construction of new animal feeding operations in that county. They wanted to temporarily stop the growth of animal feeding operations until they could get better science about their effects. Cerro Gordo County Ordinance #40, the "Animal Confinement Moratorium Ordinance," went into effect on May 14, 2002. Since the moratorium did not address public health or zoning, officials were able to get around the rules and still have a way to temporarily control animal feeding operation growth in their county. The ordinance placed "a 1-year moratorium on any new construction, expansion, or activity occurring on land used for the production, care, feeding, or housing of animals." The ordinance also afforded "local public health officials adequate time to appropriately assess health and environmental concerns that may be related to confined animal feeding operations and concentration of animals; establish objective measurable standards of enforcement; exercise the Board of Health's responsibility to protect and improve the health of the public; refrain from impacting farm operators unfairly; and provide penalties for violations of the provisions hereof pursuant to Chapter 137, Code of Iowa" (Cerro Gordo County, 2002).

The moratorium was first adopted by the Cerro Gordo County Board of Health. It was then presented to the county board of supervisors by the health director on behalf of the board of health. Before the board of health adopted the moratorium, they held an investigative meeting in which representatives from the Iowa Farm Bureau and other industry spokespeople exchanged opinions on the issue of animal feeding operations. The moratorium was created through a collaboration between local and county officials—health department staff, the board of health, and the board of supervisors. The moratorium did not receive any help or backing from state officials, who were concerned about the political nature of the ordinance. However it did receive backing from a *Globe Gazette* editorial.

The moratorium was immediately met with resistance from state officials. The Cerro Gordo County Board of Supervisors was contacted by a local legislator, and the Iowa Farm Bureau stated they would challenge the county budget. The Iowa Farm Bureau threatened to take the county to court. There were concerns over the cost of a court trial, which was estimated to be as high as $60,000. The county attorney doubted the legality of the moratorium and ultimately recommended removing it. The moratorium was in effect until June of 2005, when it was repealed by the county board of supervisors.

Since the moratorium was repealed there have been a few hog farms built in Cerro Gordo County, but the decline in pork prices has prevented any large growth of hog farms. Health officials believe that if the county had not implemented the animal confinement moratorium, there would have been many more farms built in their county, since many hog farms were built in counties south of Cerro Gordo County. There is now a process for siting new animal confinement operations in Iowa that uses a Master Matrix scoring system. The Cerro Gordo County Board of Supervisors tracks the Master Matrix system, but so far no animal feeding operations in Iowa who have applied using this system have been denied the right to build.

CAFO to express their concerns about the potential health effects. They can also work with agricultural and farm representatives to teach better environmental practices and pollution reduction techniques.

In many states, boards of health are empowered to adopt more stringent rules than the state law if it is necessary to protect public health. Board of health members should examine their state laws before they take any action regarding CAFOs to determine the most appropriate course of action. Any process should include an investigative period to gather evidence, public hearings, and a time for public review of draft policies.

Board of Health Case Studies

Tewksbury Board of Health, Massachusetts

Locals have complained about Krochmal Farms, a pig farm, for many years, but complaints have increased recently. The addition of a hog finishing facility to the farm coincided with the time that community member complaints grew. Most complaints are centered on the odor coming from the farm. The complaints were originally just logged when phone calls were received; however, the health department added a data tracking system as the number of complaints increased. After a complaint is received, the sanitarian or health director does a site visit to investigate.

The health director in Tewksbury filed an order of prohibition against the farm, which is allowed under Massachusetts law 111, section 143, for anything that threatens public health. The order of prohibition was appealed and the matter was taken to the board of health for a grievance hearing. The board of health hearing included months of testimony about the pig farm. The board of health is also doing a site assignment, which determines if a location is appropriate for treating, storing, or disposing of waste, including agricultural waste. The site assignment process includes both the Department of Environmental Protection (DEP) and the local board of health. The board of health holds a public hearing process, while the DEP reviews the site assignment application. The board of health grants the site assignment only if it is concurrently approved by the DEP.

The health director in Tewksbury points out that the only laws the board of health is able to regulate the farm under are nuisance laws. There have been efforts by the community to do a home rule petition to address the air quality and pest management complaints. The home rule petition is currently working its way through the Massachusetts state house. The status of the petition is unknown.

The board of health has tried to work directly with the pig farm to manage complaints. The farm contains manure composting facilities and the health district has requested advance notice to warn the community before manure is treated or applied to the soil. The farm has adopted a new manure management system. This system uses Rapp technology to control odors and reduce ammonia and hydrogen sulfide levels. However, questions still remain as to whether this addition will fully solve the odor issue. Typically, systems using Rapp technology include an oil cap that floats on manure holding pools and helps seal odors inside. These techniques have been researched and proven to reduce odors. However, the Tewksbury farm did not install the oil cap, and it is unknown whether the exclusion of the cap will hinder the technology's ability to reduce odors.

The complaints about the farm primarily concern the odor that emanates from the farm. The complaints do include mention of health side effects, including nausea and burning eyes. The health director has also heard concerns about potential environmental effects from the pig manure. Community members are

Conclusion

Concentrated animal feeding operations or large industrial animal farms can cause a myriad of environmental and public health problems. While they can be maintained and operated properly, it is important to ensure that they are routinely monitored to avoid harm to the surrounding community. While states have differing abilities to regulate CAFOs, there are still actions that boards of health can and should take. These actions can be as complex as passing ordinances or regulations directed at CAFOs or can be simply increasing water and air quality testing in the areas surrounding CAFOs. Since CAFOs have such an impact locally, boards of health are an appropriate means for action. Boards of health should take an active role with CAFOs, including collaboration with other state and local agencies, to mitigate the impact that CAFOs or large industrial farms have on the public health of their communities.

worried the manure runoff is entering and contaminating Sutton Brook, since there has been flooding in that area. There has been no confirmation of this occurring. The board of health is aware that the farm has a nutrient management plan, but they are not allowed to request and find out what is incorporated in that plan.

The Tewksbury piggery is technically not classified as a CAFO, though it is believed to be the largest pig farm in the commonwealth of Massachusetts. The area around it has become densely populated and the community members state that they just want to live peacefully with the farm. The board of health has submitted multiple grant applications to study the health effects associated with the farm. After the site assignment process is complete, the board of health will decide how it will regulate the farm. At the beginning of 2010, the board of health was still working on drafting regulations for the pig farms.

Wood County Board of Health, Ohio

Wood County, Ohio, contains two existing large dairy farms, both of which were proposed in 2001 to be expanded to over 1500 cows each. It is also the site for three other proposed dairy farms. There is a large community effort that supports restricting the operation and expansion of these farms, mainly represented by the community group Wood County Citizens Opposed to Factory Farms. The Wood County Board of Health became involved in investigating these dairy farms through this community group and other local officials. The Trustees of Liberty Township requested assistance from the Wood County Board of Health in supporting a moratorium on factory farm operations until local regulations were in effect. The trustees believed that manure runoff from the farms could contaminate local waterways, lower the ground water table, increase the presence of insect vectors, and devalue local properties.

The Wood County Health Director, in cooperation with the board of health, contacted nearby counties to determine what actions they had taken against farms in their communities. While the health director and board of health investigated action in the form of a nuisance regulation against the farms, they were advised that nuisance lawsuits filed against farms in Ohio were held to a tough standard, and they would be forced to demonstrate with scientific proof that the farms have a substantial adverse effect on health. They found that no other board of health in Ohio had opted to regulate farming operations and relied on the enforcement of existing state laws.

The board of health held a public forum to hear public opinion regarding the industrial farms. Ultimately, the Wood County Board of Health took actions other than regulations to help protect the health and environment of its community. They helped community members protect the safety of their water wells by offering free and low cost water well testing and inspections. They tested area ditch and water ways for fecal coliform bacteria, phosphorous, and nitrates to monitor the impact of farm runoff. They also purchased fly traps to monitor and count fly types to determine if the farms have caused an increase in insect vectors. Board of health members also met with state officials from the Ohio EPA in an effort to facilitate cooperation regarding the factory farms. While the Wood County Board of Health and Health Department chose not to institute any local regulations, they continue to monitor the situation and respond to community complaints.

Cerro Gordo County Board of Health, Iowa

Officials in Cerro Gordo County, Iowa, began looking into regulating animal feeding operations after the number of hog farms in Iowa started to grow. Floods in North Carolina and new regulations in Colorado meant that many hog farms began relocating to Iowa. Many citizens had concerns over the effects of

Appendix A: Regulatory Definitions of Large CAFOs, Medium CAFOs, and Small CAFOs

Animal Sector	Size Thresholds (number of animals)		
	Large CAFOs	Medium CAFOs[1]	Small CAFOs[2]
Cattle or cow/calf pairs	1,000 or more	300-999	Less than 300
Mature dairy cattle	700 or more	200-699	Less than 200
Veal calves	1,000 or more	300-999	Less than 300
Swine (over 55 pounds)	2,500 or more	750-2,500	Less than 750
Swine (under 55 pounds)	10,000 or more	3,000-9,999	Less than 3,000
Horses	500 or more	150-499	Less than 150
Sheep or lambs	10,000 or more	3,000-9,999	Less than 3,000
Turkeys	55,000 or more	16,500-54,999	Less than 16,500
Laying hens or broilers[3]	30,000 or more	9,000-29,999	Less than 9,000
Chickens other than laying hens[4]	125,000 or more	37,500-124,999	Less than 37,500
Laying hens[4]	82,000 or more	25,000-81,999	Less than 25,000
Ducks[4]	30,000 or more	10,000-29,999	Less than 10,000
Ducks[3]	5,000 or more	1,500-4,999	Less than 1,500

Data: Environmental Protection Agency

1. Must also meet one of two "method of discharge" criteria to be defined as a CAFO or must be designated.
2. Never a CAFO by regulatory definition, but may be designated as a CAFO on a case-by-case basis.
3. Liquid manure handling system
4. Other than a liquid manure handling system

Appendix B: Additional Resources

American Public Health Association. *Precautionary moratorium on new concentrated animal feed operations*. http://www.apha.org/advocacy/policy/policysearch/default.htm?id=1243

Center for a Livable Future. http://www.livablefutureblog.com/

Environmental Health Sciences Research Center. *Iowa concentrated animal feeding operation air quality study*. http://www.public-health.uiowa.edu/ehsrc/CAFOstudy.htm

Environmental Protection Agency. *Animal feeding operations*. http://cfpub.epa.gov/npdes/home.cfm?program_id=7

Food and Water Watch. http://www.foodandwaterwatch.org/

Impacts of CAFOs on Rural Communities. http://web.missouri.edu/fikerdj/papers/Indiana%20-%20CAFOs%20%20Communities.htm#_ftn1

Land Stewardship Project. http://www.landstewardshipproject.org/index.html

Midwest Environmental Advocates. http://www.midwestadvocates.org/

National Agriculture Law Center. *Animal feeding operations reading room*. http://www.nationalaglawcenter.org/readingrooms/afos

National Association of Local Boards of Health. *Vector control strategies for local boards of health*. http://www.nalboh.org/publications.htm

Pew Charitable Trusts. *Human health and industrial farming*. http://www.saveantibiotics.org/index.html

Pew Commission on Industrial Animal Farm Production. http://www.ncifap.org/

Purdue Extension. *Concentrated animal feeding operations*. http://www.ansc.purdue.edu/CAFO/

State Environmental Resource Center. http://serconline.org

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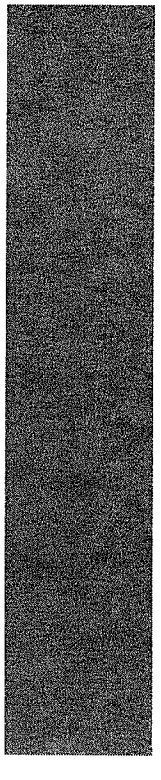
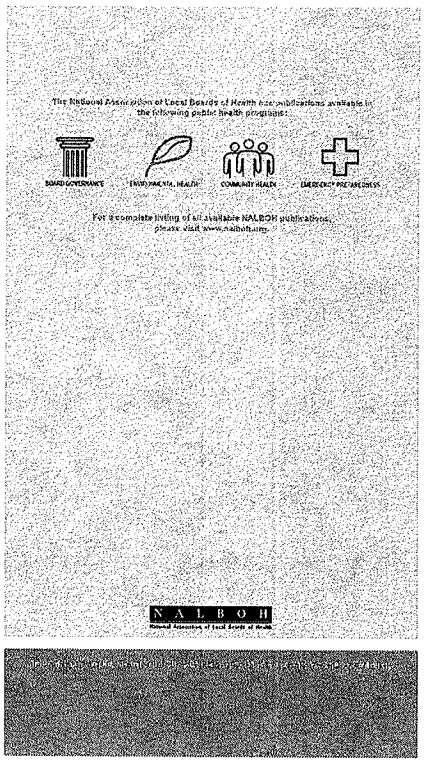




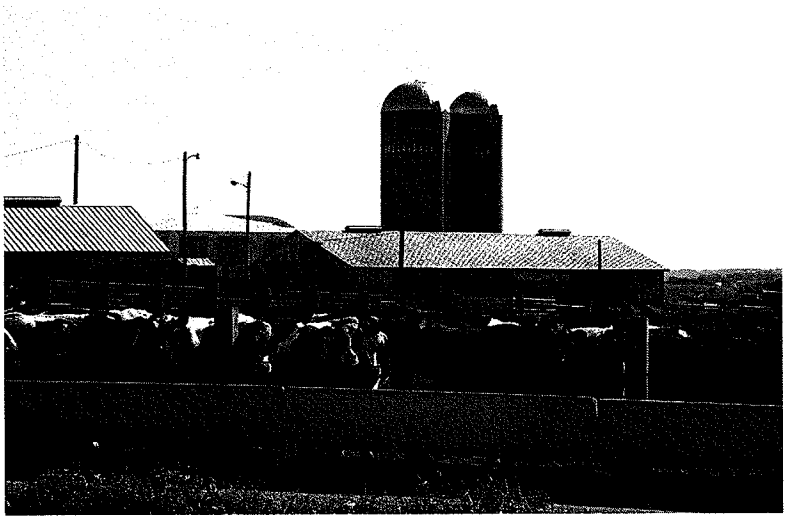
Iowa Center for Public Affairs Journalism | (http://iowawatch.org/2013/05/30/large-livestock-farms-spread-across-iowa-threatening-waterways/)

BUSINESS & CONSUMER AFFAIRS

May 30, 2013

Large Livestock Farms Spread Across Iowa, Threatening Waterways

By Bridget Huber/FairWarning and Lauren Mills/IowaWatch



Lauren Mills/IowaWatch

A cattle feedlot outside Anamosa, Iowa, on Friday, May 17.

A major environmental threat has emerged as factory farms take over more and more of the nation's livestock production: Pollution from the waste produced by the immense crush of animals.

Iowa has more of the massive livestock feeding lots, known as concentrated animal feeding operations, or CAFOs, than any other state and has come under fire for lax regulations.

Environmental groups that sued the Iowa Department of Natural Resources, which is responsible for regulating the facilities in the state, are starting to see results. A bill passed by both the Iowa House and Senate (http://coolice.legis.iowa.gov/Cool-ICE/default.asp?Category=billinfo&Service=Billbook&menu=false&hbill=sf435&ga=85) would fund seven additional CAFO inspectors as part of a goal to inspect all of Iowa's CAFOs by 2018. But activists say the improvements are only small steps and much more needs to be done to protect Iowa waterways.

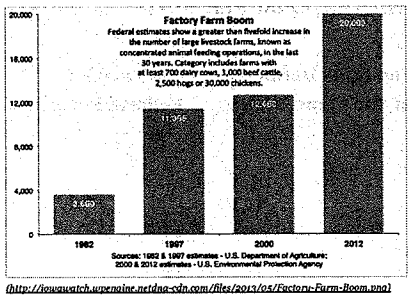
The U.S. Environmental Protection Agency estimates that America's livestock create three times as much excreta as the human population. By the agency's reckoning (http://www.google.com/url?q=http%3A%2F%2Fnepis.epa.gov%2FAdobe%2FPDF%2F901V0100.pdf&sa=D&sntz=1&usg=AFQjCNHksafXaWXT9zCNFVl048iHJu2M-A), a dairy farm with 2,500 cows – which is large, but not exceptional – can generate as much waste as the people in a city the size of Miami.

Yet unlike human waste, which often receives sophisticated treatment, animal waste commonly goes untreated. It typically is held in underground pits or vast manure lagoons, and then spread on cropland as fertilizer.

Some spills have made national headlines, with reports of millions of gallons of waste polluting rivers. In 1995, heavy rains led to a North Carolina swine manure spill that sent 25 million gallons of waste into a river. Just last month, a Minnesota dairy farm spilled (http://minnesota.publicradio.org/display/web/2013/04/16/environment/manure-spill-probe) up to 1 million gallons of manure, fouling two nearby trout streams.

More routinely, as the U.S. Department of Agriculture has said (http://webarchives.cdlib.org/sw1vh5dg3r/http://ers.usda.gov/AmberWaves/Feb03/Features/ManagingManure.htm), large farms generate more manure than the farms can handle, so they spread too much on nearby fields. From there, the material – which the EPA says often contains hormones, pathogens and toxic metals — can run off and contaminate streams, rivers and wells.

Environmental advocates documented 800 manure spills in Iowa since 1995. The number of impaired waterways has increased along with the CAFO boom. In 1987, 215 waterways were labeled as impaired by the Iowa DNR. The number jumped (http://www.iowadnr.gov/Environment/WaterQuality/WaterMonitoring/ImpairedWaters.aspx) to 642 in 2012.



(http://iowawatch.wpengine.netdna-cdn.com/files/2013/05/Factory-Farm-Boom.png)

FairWarning.org graphic

In Iowa's Mitchell County, a 2009 spill (https://programs.iowadnr.gov/hazardousspills/IncidentEvents.aspx?PageMode=1) from a hog confinement killed more than 150,000 fish after spreading into a nearby creek. The producer had pumped 29,000 gallons of manure onto the ground in an effort to lower levels in his manure pit. Documents from the Iowa Department of Natural Resources show the manure flowed through a cornfield, then a pasture before entering Otter Creek. The producer was ordered to pay $315 and 7 cents per fish killed.

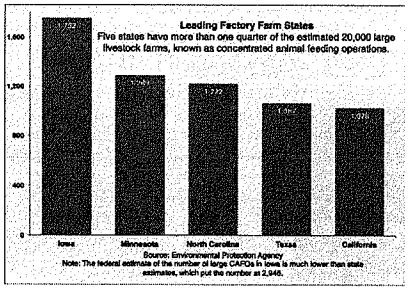
In a report (http://iaenvironment.org/waterQuality/spills.php#map) by the Iowa Environmental Council, Sioux County weighed in with the most manure spills between 2001 and 2011. During that time 23 manure spills reached waterways in Sioux County. Six resulted in fish kills, with an estimated 116,551 fish killed.

FEDERAL PERMITS

Under the Clean Water Act, industrial operations like factories and sewage treatment plants that discharge through pipes are considered "point sources" of pollution. They are required to get a permit that sets limits on pollution and, in many cases, imposes a water testing regime.

It's a different story for massive livestock farms – what the government calls concentrated animal feeding operations, or CAFOs. Although they also are defined under the law as point sources, federal court rulings have frustrated EPA efforts to regulate them.

About 45 percent of the nation's CAFOs have discharge permits, even though the EPA estimates 75 percent actually are polluting. And even when CAFOs get permits, critics say, their performance in controlling pollution is hard to track and their permit restrictions are tough to enforce.



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FairWarning.org graphic

Each state enforces the Clean Water Act differently. It is the EPA's job to oversee state programs, but there's a great deal of variability in the effectiveness of states' enforcement of clean water laws.

Some, like Michigan and Minnesota, receive high marks from environmental groups for instituting stricter standards than the federal government. But other states such as Iowa, Illinois and Georgia, have poorer records.

In 2007 three community and environmental groups — Iowa Citizens for Community Improvement, the Iowa Chapter of the Sierra Club and the Washington, D.C.-based Environmental Integrity Project — asked the EPA to revoke the Iowa's authority to enforce the Clean Water Act. They said the state's program was less stringent than the federal one and failed to issue necessary permits or investigate Clean Water Act violations or seek adequate penalties for violations.

The EPA still had not responded to the petition in 2011 when the groups gave notice of an intent to sue (http://www.environmentalintegrity.org/documents/EIPNoticeofUnreasonableDelayRespondingtoIowaPetition8.18.2011.pdf) the EPA, saying the agency unreasonably had delayed addressing the problem. The agency responded by launching an investigation, reviewing the state agency's files on large livestock farms and scrutinizing enforcement and compliance data.

The EPA found (http://epa.gov/region7/water/pdf/ia_cafo_preliminary_report.pdf) that the state DNR was not issuing permits as required under federal law or conducting inspections of unpermitted facilities to determine if they needed permits. The EPA also determined that the state agency frequently failed to take appropriate action when it found violations. In 49 percent of cases reviewed the DNR either did not follow its own enforcement policies or failed to act altogether.

In response, Iowa's DNR released a draft work plan (http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0CDEQFjAA&url=http%3A%2F%2Fwww.epa.gov%2Fregion07%2Fwater%2Fpdf%2Fia_cafo_draft_workplan.pdf&ei=vmalUemvIMLIyAGzpoBo&usg=AFQjCNE05AyPrvS3asNjbEt0qIWwbmkdxQ&sig2=e5VojDju8ZnOWwsTwJUnQ&bvm=bv.47008514,d.aWc&cad=rja) listing planned improvements. It also pledged to inspect all large livestock farms in the state by the end of 2018 — an estimated 8,000 CAFOs.

Gene Tinker, animal feeding operations coordinator for the DNR, said some inspections have been carried out every year but the petition "ramped up the speed" of inspections.

Staff will inspect feedlots looking for any signs of runoff that could carry waste into rivers. The inspectors will also check to see if the facility should be required to hold a federal permit based on the number of animals held and the proximity of waterways, he said.

Currently, only 131 of Iowa's 3,055 large factory farms have permits under the clean water act, data (https://docs.google.com/document/d/1houbzJanXP8dzWbGxe75RF-ZH2e_GoJgAuzbPLKMUg/edit#) from the EPA shows.

CAFOS WITH NATIONAL PERMITS IN EPA REGION 7

State	Number of Facilities Defined as CAFOs Under the Clean Water Act	CAFOs with Federal Permits	% of CAFOs with Federal Permits
Iowa	3,055	131	4.3%
Kansas	446	446	100%
Missouri	554	27	4.9%
Nebraska	862	374	43%

Region 7 Totals	4,917	978	19.9%

Source: U.S. EPA

Tinker said the reason for the low numbers is because most of Iowa's feedlots are confinements, meaning the animals are kept in a roofed building. Confinements are not allowed to discharge waste into a waterway. Because no amount of discharge is allowed, the facilities do not need permits, Tinker said.

Open feedlots keep animals confined in an unroofed space, usually a large pen with no vegetation on the ground. For open feedlots, small waste discharges during large storms is acceptable, provided the operator has a federal permit called the National Pollutant Discharge Elimination System.

Tinker said staff used to visit confinement feedlots every three to four years, but staff limitations brought an end to that practice. Feedlots with federal permits must be inspected every five years. Staff also perform spot inspections and investigate complaints.

Originally, DNR officials recommended 13 additional inspectors in order to reach the 2018 goal before the legislative bill that passed this year, Gov. Terry Branstad's signature, established funding for seven. Tinker said DNR leaders hope to meet inspection deadlines despite the smaller staff.

(http://iowawatch.wpengine.netdna-cdn.com/files/2013/05/IMG_8712.jpg)

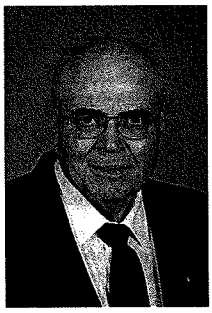
Lauren Mills/IowaWatch

Cattle gather at the trough at an open feedlot close to Anamosa, Iowa, on Friday, May 17.

Iowa's DNR has not added inspectors since 2007. In 2012, the department had the equivalent of 15.25 full-time inspectors, each of whom conducted 27 inspections that met federal guidelines. Even with additional staff, inspectors would have to significantly increase the number of inspections in order to visit the roughly 1,600 facilities every year and keep on target for the 2018 goal.

Rep. Jack Drake, R-Griswold, chairman of the Agriculture and Natural Resources Budget committee, said he hopes the additional inspectors enable the DNR to reach the goal. The department's progress will be taken into consideration next year when legislators prepare the fiscal year 2015 budget, Drake said.

The inspections also are in line with other efforts by the state to reduce runoff of nutrients, such as nitrogen, which are found in manure and are responsible partially for the creation of the dead zone in the Gulf of Mexico, Drake said.



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Rep. Jack Drake, R-Griswold

"We've made quite a push this year to reduce the nutrients going into our rivers and streams," he said.

Jess Mazour, the rural project organizer with Iowa Citizens for Community Improvement, one of the groups that petitioned the EPA, said the seven inspectors is a "small victory," but not enough.

"You can have 20 inspectors, you can have 50 inspectors, but they have to have the power to enforce the regulations. The hands-off, voluntary approach is not working. If it were we would not have a water emergency in this state," Mazour said.

The draft work plan has not yet been made final by the EPA, but Tinker said the DNR isn't waiting for the ink to dry before heading out for inspections.

"We are currently working on some of the items in the work plan because it needs to be done regardless of when it is signed. We have staff out inspecting feedlots today to determine whether or not a (federal) permit would be needed," Tinker said.

REGULATIONS STALL AT THE FEDERAL LEVEL

EPA officials, who declined to be interviewed for this story, have worried for many years about pollution problems from CAFOs and say they have stepped up enforcement (http://www.epa.gov/compliance/data/planning/initiatives/2011cafo.html) in recent years.

But the agency's plans to regulate more large livestock farms were shot down twice by federal courts over the last decade. Then last July – amid continuing industry opposition and while regulation was a sensitive topic in the presidential campaign — the agency quietly withdrew a proposal to collect information from large livestock farms.

Promises for stricter regulation cropped up during campaigns for the 2008 election as well.

For Chris Peterson, an Iowa hog farmer, promises made by then-candidate Barack Obama on the 2007 campaign trail were music to his ears:

"We'll tell ConAgra it's not the Department of Agribusiness, it's the Department of Agriculture," Obama had said.

Obama promised, in a white paper (http://www.miafseme.org/PDF%20Files/ObamaBlueprintForChange.pdf), to strictly regulate large livestock farms, which he said "pollute the environment" and "jeopardize public health."

Over the years, Peterson had watched with growing alarm as large factory farms ballooned, making Iowa the nation's largest pork producer. He'd barely hung on when the large meat companies came in, wrested control of the market and drop-kicked the price of pork, causing 30 to 40 thousand small and mid-sized pork farmers to leave the business in a span of a couple of years.

Along with the boom in pork production came a spike in water pollution and manure spills and growing concerns about the health effects of antibiotics federal to livestock animals.

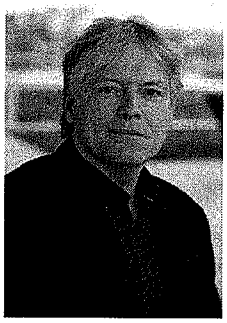
Petersen was relieved to see that Obama had a plan that promised stricter regulations, better enforcement of environmental law and a limit to government funds for certain federal subsidies. It hit all the points that community activists could have asked.

"It was words that came right out of the peoples' mouth," Petersen said.

Today, Petersen's hopes have faded. President Obama's administration has failed to make good on candidate Obama's promises to get tough on the industrial livestock sector. The result is that the EPA remains largely in the dark about such basic facts as which operations are potentially the biggest polluters and where they are located.

"It's basically the Wild West out there when it comes to CAFOs," said Scott Edwards, an attorney for the advocacy group Food and Water Watch.

Despite his disappointment, Petersen said he still believes Obama and regulators at the EPA and U.S. Department of Agriculture are well-meaning but up against a formidable industry. "They all have good hearts," he said, "but meanwhile, they're running into the buzz saw of big agriculture and big money."



(http://iowawatch.wpengine.netdna-cdn.com/files/2013/05/ScottEdwards-200x300.jpg)

Scott Edwards, Food and Water Watch

INDUSTRY PERSPECTIVE

Industry groups say those who call for tighter regulation rely on outdated data and ignore evidence of the progress the industry has made through improved technology and farming practices.

Michael Formica, chief environmental counsel for the National Pork Producers' Council (http://www.nppc.org/), said most of the waste in newer swine farms goes into deep pits that aren't vulnerable to overflow the way manure lagoons are. He added that few farms endanger waterways by applying too much manure on fields.

"The value of the nutrients in the manure is worth way too much for people not to want to harness it and utilize it," he said.

Federal estimates vary, but EPA officials believe 20,000 large U.S. farms qualify as CAFOs. That would be up more than fivefold since 1982, when agriculture officials concluded that 3,600 farms were big enough to meet the federal definition of a CAFO.

The EPA's definition of a large CAFO includes livestock operations that confine at least 700 dairy cows, 2,500 pigs weighing more than 55 pounds, 125,000 meat chickens, 30,000 laying hens or 1,000 beef cattle.

The EPA says at least 29 states cite animal agriculture as a contributor to water quality problems.

In February, the agency released a report (http://water.epa.gov/type/rsl/monitoring/riverssurvey/upload/NRSA0809_Report_Final_508Compliant_130228.pdf) that found 55 percent of U.S. streams and rivers were in "poor condition for aquatic life" and cited pollution from livestock and crop farms as a leading factor. Agricultural runoff is partly to blame for a so-called dead zone in the Gulf of Mexico that was the size of New Jersey in 2011, according to the National Oceanic and Atmospheric Administration (http://www.noaanews.noaa.gov/stories2011/20110804_deadzone.html).

UNWELCOME NEIGHBORS

For people who live near big livestock farms, like Lori Nelson, there's also the problem of stench.

Nelson grew up on a farm and still keeps some animals near Bayard, Iowa, on two rural acres that, when she bought it, were peaceful, surrounded by soy fields. But seven years ago, she got some unwelcome neighbors — two large hog farms housing a total of 5,000 animals.

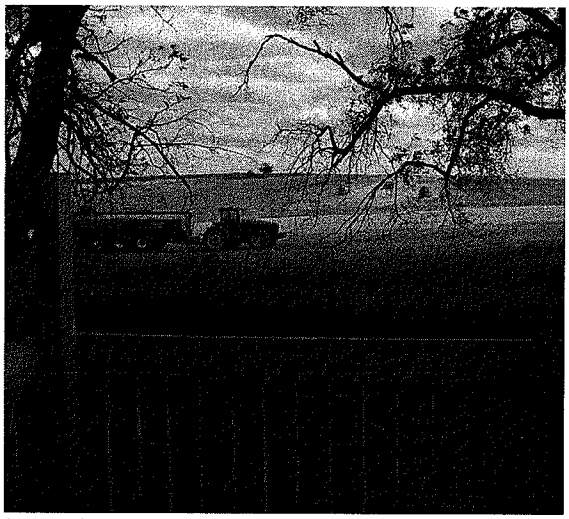
That many hogs produce as much waste as 15,000 people and, on bad days, the nose-burning smell is enough to send Nelson and her husband running from their cars to the house. It was also enough to convert Nelson into an unlikely activist. She is working to halt the spread of industrial livestock farms in Iowa.

Nelson no longer drinks from her well for fear of contamination. She said manure from the swine farms often is spread to the edge of a tributary to the Raccoon River — a river whose levels of potentially harmful nitrates found in fertilizers and manure runoff hit record levels in May.

Nelson figures she has no hope of selling her own place. Its value tanked when the hogs moved in; she said wouldn't get what she owes on the property now. Even if she could move to another rural area, there's no guarantee a CAFO wouldn't move in next door.

"There's no place to go. It seems like anywhere you go, you're eventually going to be surrounded by a factory farm," she said.

Federal reviews have found (http://www.gao.gov/new.items/d03285.pdf) that some state authorities in charge of



(http://iowawatch.wpengine.netdna-cdn.com/files/2013/05/NelsonManure.jpg)

Provided by Lori Nelson

enforcing the Clean Water Act are doing a poor job, and that the EPA's oversight of these programs has fallen short.

A tractor spreads manure on a field near Lori Nelson's Bayard, Iowa, home.

At the same time, industry groups and their lawmaker allies in a handful of states are pushing to insulate the livestock industry from scrutiny from citizens, environmental and animal welfare groups and regulators.

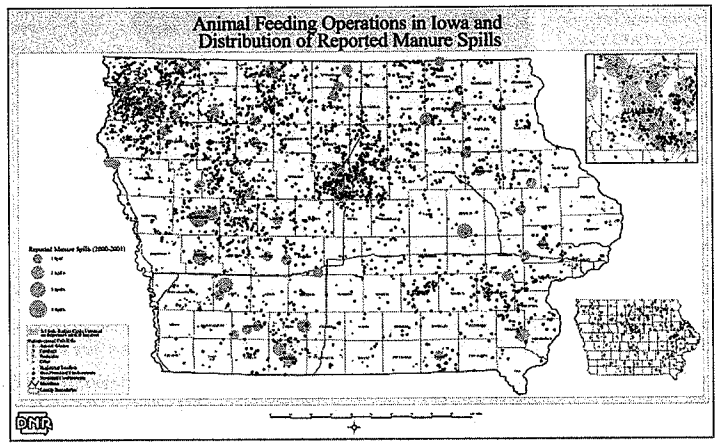
Some are trying to enshrine "Right to Farm" provisions in state constitutions, even though similar laws are already on the books in every state. In other cases they are trying to criminalize activists' undercover investigations at livestock farms.

"The industry obviously has a lot of money and (is) very important to the American economy and American people. Trying to regulate farms is a politically dangerous thing to do in the U.S." said Kathy Hessler, a law professor at Lewis & Clark Law School in Portland, Ore.

"CATCH ME IF YOU CAN"

The EPA's concerns about CAFOs go back at least to 1998, when the Clinton Administration, in a document called the Clean Water Action Plan (http://nepis.epa.gov/Exe/ZyNET.exe/20004J7S.TXT?ZyActionD=ZyDocument&Client=EPA&Index=1995+Thru+1999&Docs=&Query=&Time=&EndTime=&SearchMethod=1&TocRestrict=n&Toc=&TocEntry=&QField=&QFieldYear=&QFieldMonth=&QFieldDay=&IntQFieldOp=0&ExtQFieldOp=0&XmlQuery=&File=D%3A%5Czyfiles%5CIndex%20Data%5C95thru99%5CTxt%5C00000012%5C20004J7S.txt&User=ANONYMOUS&Password=anonymous&SortMethod=h%7C-&MaximumDocuments=1&FuzzyDegree=0&ImageQuality=r75g8/r75g8/x150y150g16/i425&Display=p%7Cf&DefSeekPage=x&SearchBack=ZyActionL&BackDesc=Results%20page&MaximumPages=1&ZyEntry=1&SeekPage=x&ZyPURL), concluded that pollution from factories and treatment plants had been dramatically reduced. But it said that pollution from farms, including livestock operations, remained a serious problem. *[Ed. note: The year for the Clean Water Action Plan was incorrect in an earlier version of this story. It since has been corrected to 1998.]*

Still, it wasn't until 2003 when the EPA, prodded by a lawsuit from



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Source: Iowa Department of Natural Resources

Maps shows the locations of manure spills in Iowa between 2000 and 2001.

environmental groups, issued a new rule intended to require all large livestock farms to get Clean Water Act permits unless they could demonstrate that they had no potential to pollute.

This blanket requirement would have vastly expanded the number of operations with permits. The agency justified the move by saying there were many documented instances of pollution from CAFOs lacking federal permits and that these farms might escape detection because they — unlike more easily monitored polluters, such as factories or water treatment plants — discharge only intermittently (during rain, for example).

That plan, however, was quickly contested in court. Industry groups argued the agency could require permits only for factory farms that were actually discharging into waterways — meaning those that acknowledge polluting or have been found by inspectors to pollute. The EPA's authority, they argued, did not extend to potential polluters. In 2005, a federal judge ruled (http://caselaw.findlaw.com/us-2nd-circuit/1059289.html) in the industry's favor.

EPA came back in 2008 with a dialed-back rule.

This time around, the agency would not require all CAFOs to get permits. Only those confirmed to be discharging into waterways or those that, as the agency put it, "proposed to discharge" would need a permit. Or, permits would be needed for those in a second category of CAFOs that, the EPA said, were "designed, constructed, operated, or maintained such that a discharge would occur" — in other words, ones that inevitably would pollute.

Once again, industry groups filed suit, arguing, as they did in the challenge to the 2003 rule, that the EPA could require permits only of "actual discharges." A federal court agreed (http://www.ca5.uscourts.gov/opinions/pub/08/08-61093-CV0.wpd.pdf), vacating in 2011 the section of the rule dealing with the second category of CAFOs.

The rulings, environmentalists say, left the EPA in what some called a "catch me if you can" situation—able to do little without proving, after the fact, that a farm has polluted.

A BITTER DEFEAT

Then the EPA, prodded by a lawsuit from environmental groups, unveiled a comparatively modest plan to learn more about the scope of the problem. It proposed collecting basic information about large livestock farms, a potential starting point for stepped up oversight.

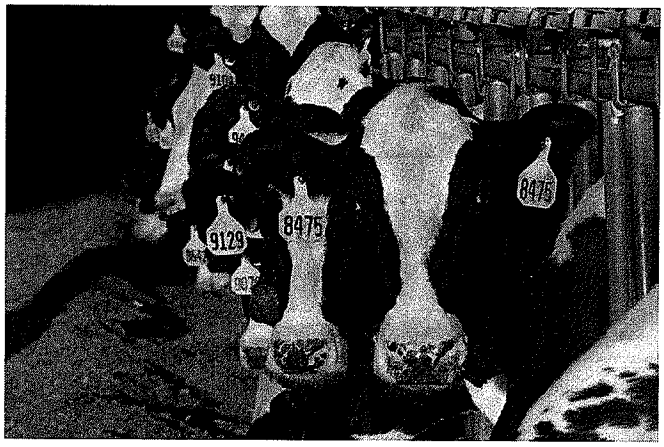
The move was intended to address a key weakness in the EPA's ability to regulate large livestock farms — there is no national database showing where these farms are located, who owns them and whether they are polluting. A report (http://www.gao.gov/assets/200/280229.pdf) critical of the agency in 2008 from the Government Accountability Office called the EPA's limited data "inconsistent and inaccurate."

Initially, the EPA agreed to ask (http://www.caes.uga.edu/extension/water/documents/settlementagreement.pdf) owners or operators of large CAFOs to submit 14 pieces of information, including names, addresses and geographic coordinates.

But by the time the agency released the proposal for comment in October 2011, it was reduced to two watered down options — one to require less information, and the other to require reporting only by farmers in certain watersheds.

Talking points (http://www.fairwarning.org/?attachment_id=65698) prepared by the EPA for a meeting between officials of the agency and the U.S. Department of Agriculture, contained in a document obtained by FairWarning through a Freedom of Information Act request, indicated that the changes followed "concerns raised both by industry and USDA."

The Office of Management and Budget, a White House agency that reviews proposed regulations, also played a role. For example, documents (http://www.fairwarning.org/?attachment_id=65600) show that the OMB suggested that the EPA change some requirements, such as allowing an "authorized representative" of a farm to provide his or her name instead of a CAFO owner to protect the operation's privacy.



(http://iowawatch.wpengine.netdna-cdn.com/files/2013/05/cows.jpg)

Kate Golden/Wisconsin Center for Investigative Journalism

Cows at a large Wisconsin dairy farm.

Even so, the meat industry and its congressional allies objected. One of their main arguments was that collecting and making the information publicly available would pose a security threat to farmers and the U.S. food supply.

A letter (http://www.tcfa.org/Newsletter/2012_links/cafo_reporting_rule_comments.pdf) signed by dozens of industry groups and sent to the OMB cited allegedly illegal acts by animal rights groups, including incidents in which hens and turkeys were set free.

It is "absolutely incomprehensible that, while other parts of the federal government are trying to protect the security of our food supply, OMB would even consider allowing EPA to undermine these efforts by making public the locations of animal production facilities," the letter read.

On July 13 – less than four months before the presidential election and while the Obama Administration was being hammered as too zealous about regulation — the EPA quietly withdrew the proposal.

For environmental groups, it was a bitter defeat.

The "information-gathering rule was supposed to lift the veil on CAFOs," said Edwards, of Food and Water Watch. "Instead the EPA just got up and walked away."

Rena Steinzor, a University of Maryland law professor and president of the Center for Progressive Reform, is among those who believe the EPA likely was pressured by the White House to withdraw the rule. "You don't just write a rule and then say, 'Oops, we made a mistake,'" she said.

The White House did not respond to repeated requests for comment.

In place of an information-gathering rule, the U.S. Environmental Protection Agency settled for collecting data from existing sources—a solution the agency earlier said wouldn't work. An EPA-commissioned assessment of state and federal resources available online showed large gaps in the available data.

FairWarning (www.fairwarning.org (www.fairwarning.org)) is a Los Angeles-based nonprofit investigative news organization focused on public health and safety issues.

READ MORE: What environmentalists and industry leaders say in the battle over data collection, and other matters (http://iowawatch.org/2013/05/30/environmentalists-and-industry-battle-over-data-collection-other-matters/)

WHAT CAN WE LEARN ABOUT ANTIMICROBIAL-RESISTANT SKIN INFECTIONS IN ANIMALS FROM ANTIMICROBIAL-RESISTANT INFECTIONS IN HUMANS: LOTS OF PROBLEMS AND A FEW SOLUTIONS

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Superficial bacterial folliculitis or superficial pyoderma and otitis externa are both very common clinical presentations in small animal practice and consequently treating skin or ear infections has been a common reason for prescribing antibiotics in veterinary medicine. However, resistant skin infections are an increasingly common challenge in veterinary medicine. Studies around the world, with varying populations, have shown prevalence of methicillin resistance in *Staphylococcus* species isolated from bacterial skin lesions of dogs to be as high as 37% to 40% of cultured cases. Why are we seeing resistance more commonly? What can we do to minimize resistance developing in our veterinary patients? What can we learn from what is happening in human medicine?

HUMAN PERSPECTIVE

A 78-year-old man with an enlarged prostate and symptoms of urinary infection comes to the infectious diseases clinic and is seen by an infectious diseases physician trainee. For the past

10 days, the patient had been taking a powerful antibiotic without any benefit. The patient had recently traveled to India and had no prior problems with his urinary system. A culture of his urine from 1 week ago grew a common bacteria frequently associated with urinary infections. However, lab testing showed that the bacteria, an "antibiotic-resistant super-bug," was resistant to virtually every antibiotic available. The above scenario is becoming all too common, not just in hospitals, but in nursing homes, daycare centers, and even in individuals living in the community.

How did we get into this situation where infections are growingly caused by resistant superbugs? Penicillin, the first extensively used antibiotic, was first used in World War II (WW II) for patients with wound infections, including postsurgical infections. However, just months after its use, penicillin-resistant bacteria were reported. After WW II, a mad race began to make new antibiotics faster than the bacteria could mutate and become resistant to them. From the 1940s through the 1960s we were winning the race, creating more and more new antibiotics and outsmarting the bacteria causing infections. In fact, in 1969 when the US surgeon general addressing Congress gave his opening address, he stated that "it was time to close the book on infectious diseases" because we were going to eradicate them from the developed world. No statement could have been more inaccurate. From the 1970s through the 1990s and into the new millennium, superbugs were developing and now we are faced with two daunting problems: the first is the fact that resistant superbugs are becoming resistant to antibiotics at a much faster rate than we can discover and develop new antibiotics, and second is that pharmaceutical industry has

dramatically slowed down their antibiotic-producing research programs in favor of making drugs for lifelong medical problems such as high blood pressure, high cholesterol, and heart disease.

The single biggest cause of resistant superbugs is the use of antibiotics in humans (Table 1). I teach my students in the first year of medical school that antibiotics are "dumb drugs" because they don't know where the infection is, they don't know that a patient has an infection in their eye or an infection in their lungs, or an infection in their skin. Every time a person takes an antibiotic, the antibiotic travels throughout the entire body and kills the normal, healthy "protective" bacteria on the skin, in the mouth and throat and in their bowels. As a result of people taking antibiotics to treat an infection, they inadvertently kill the normal bacteria and this can make them prone to select for superbugs or by creating a vacuum in their normal bacterial flora, allowing them to acquire a superbug from someone else. These newly made resistant organisms can now be transferred to other individuals or to inanimate objects (eg, towels) or potentially could also cause infection in that particular individual.

Antibiotics are overused not only in developed countries such as the United States and Canada but also in developing countries where they are frequently available over the counter without a prescription. These antibiotics are frequently of poor quality (reduced potency) allowing for selection of superbugs. Antibiotics are also frequently administered to animals, including pigs, cows, poultry, and fish, for growth promotion.

By administering antibiotics in animal feed, we can select out antibiotic-resistant organisms that are excreted in the feces, and these resistant organisms or their resistance genes can return

into our food supply through contaminated water and food. As well, the antibiotic residues in the animal's urine and feces can make their way into our food and water supply and expose us to further antibiotics.

Other factors associated with the development of superbugs include world travel, which allows the spread to resistant superbugs across the globe and the growing numbers of patients who have reduced immune systems due to medical advances such as transplants, cancer chemotherapy and extensive use of medical steroids. Without an immune system it is very difficult for an antibiotic to kill of superbugs.

So with all these resistant superbugs, are we doomed or is there hope? No, we are not doomed, although the situation is very serious. There is lots of hope, but we must act now and in a multipronged fashion (Table 2). We must continue to educate everyone that antibiotics should not be used to treat mild respiratory infections caused by viruses. Respiratory infections, such as coughs, colds, sore throats, stuffy noses, and acute bronchitis, are frequently caused by viruses, and treating these infections with antibiotics (which only kill bacteria) does not benefit the patient. In fact, using antibiotics in patients with viral respiratory infections may select resistant superbugs by killing the normal healthy bacteria.

Respiratory infections should be treated symptomatically with the result that the individual will be back to normal in about a week. Using acetaminophen (Tylenol), bed rest, and chicken soup will provide just as much benefit as antibiotics and will not damage the normal healthy protective bacteria. We also need to realize that washing our hands several times a day with soap

and water or convenient alcohol hand solutions is an excellent way to kill both viruses and bacteria, including superbugs that can colonize our hands when we touch other individuals or inanimate objects. We need to convince students in schools, children in day care centers, and staff and residents in nursing homes and hospitals that washing hands will prevent infections and will prevent the spread of viruses and superbugs. We also need to realize that using vaccines, such as the "flu shot" is an excellent way to not just prevent getting the "flu" but also to minimize the chances of spreading the "flu virus" to others. As more individuals get the "flu shot" and not the "flu," the less antibiotics will be required to treat viral respiratory infections, which means fewer normal bacteria will be killed and fewer superbugs selected.

We also need to work aggressively on discovering new therapies, such as novel antibiotics, and continue to study "probiotics," which are "healthy bacteria" that can be administered to overgrow the resistant superbugs that may be in our body (Table 2). We need to continue to do research on "phages," which are viruses that kill bacteria, to see how we can best to employ these biological weapons. More research needs to be undertaken to study how we can enhance our immune system to better prevent or respond to superbug infections.

Our group, called the Canadian Antibiotic Resistance Alliance (CARA), based at the University of Manitoba, College of Medicine in Winnipeg, Canada is working hard to find solutions to the problem of antibiotic-resistant superbug infections. Our website is www.canr.ca. No, we are not doomed, but the time to act is now and we all need to be involved in the solution.

Clearly, in veterinary medicine we have an important responsibility in global antibiotic stewardship and how we treat our patients with skin and ear infections is part of that responsibility. Numerous studies have shown that prior antibiotic administration in the preceding 6 to 12 months is a common risk factor among dogs and horses that have developed resistant strains of *Staphylococcus* species. Other identified risk factors in some studies include prior surgical procedures and hospitalization.

So what practice guidelines can we follow to try and ensure that we not only successfully manage our veterinary patients with skin or ear infections but also try to prevent adding to the growing problems we have with antimicrobial resistance in both veterinary and human medicine. The Antimicrobial Guidelines Working Group of the International Society for Companion Animal Infectious Diseases has published guidelines for the diagnosis and antimicrobial therapy of canine superficial bacterial folliculitis **Error! Hyperlink reference not valid.**.

It is vital to remember that in the vast majority of veterinary patients, skin and ear infections are occurring because there are underlying diseases that are risk factors that alter the microenvironment. Failure to identify and manage these risk factors such as allergic skin disease, concurrent ectoparasitism or concurrent endocrinopathies, creates a situation where skin or ear infections will recur and the patient is likely to be treated with sequential courses of antibiotics potentially providing the antibiotic pressure to select for resistant strains of bacteria.

Topical therapy is important in the management of skin infections and should be considered as the sole therapy in localized lesions of superficial skin infection or in early

management of mild, generalized lesions. Topical therapy is useful, adjunctive therapy when systemic antibiotics are used and it is particularly valuable as part of ongoing management to help prevent recurrence while underlying skin disease is being investigated. The topical therapy with the most evidence for efficacy is chlorhexidine. Successful topical therapy requires client education as contact time should be at least 10 minutes preferably with a hair coat that has been clipped short.

When systemic antimicrobial therapy is deemed to be required it is important to evaluate if the patient's history warrants first obtaining a bacterial culture so that the most appropriate or "right" antibiotic can be selected. Cultures should be obtained from any animal with a history of recurrent skin infections or repetitive administration of antimicrobial drugs or a prior documented history of multidrug resistant infection in that animal or in another pet in the same household. Obtaining a sample for culture for patients receiving systemic antimicrobial therapy at the time of evaluation should ALWAYS be considered for reasons listed in Table 3.

Samples for culture can be obtained from sampling intact pustules, crusts, epidermal collarettes, or papules. Ideally selecting an antibiotic for systemic administration is based on culture results. If there is no indication for culture and empiric antimicrobial therapy is going to be instituted, then reasonable antibiotics to consider include first generation cephalosporins, clindamycin, lincomycin, amoxicillin-clavulanate, and trimethoprim and ormetoprim-potentiated sulfonamides. Some third-generation cephalosporins (cefovecin and cefpodoxime) are often selected as firstline antibiotics, and a recent systematic review looking at the effectiveness of

systemic antimicrobial treatment in canine superficial and deep pyoderma found that there was good evidence for the use of subcutaneous cefovecin for superficial pyoderma. Second-line antibiotics should be selected based on culture and susceptibility testing. Antibiotics in this group include fluoroquinolones, doyxycycline, and chloramphenicol.

Antibiotics such as linezolid, teicoplanin, and vancomycin should NEVER be used for treating skin infections in veterinary medicine. These antibiotics should be reserved only for serious infections in human medicine if we are truly being responsible global antibiotic stewards. When systemic antimicrobial therapy is indicated in treating superficial bacterial folliculitis, antibiotic administration should continue for 7 days past resolution of clinical signs. Courses of antibiotics that are too short, are of an insufficient dose, or perhaps are not even indicated further increase the risk for selection of antimicrobial resistance when treating dermatologic cases in veterinary medicine. Issues with owner compliance or animal tolerance or temperament can result in situations in which inappropriate therapeutic management is occurring that can impact not only the success of therapy but potentially also could increase the risk for antimicrobial resistance.

Follow-up evaluation of veterinary patients with skin or ear infections is important so that it can be determined if there has been resolution of the skin or ear infection or if concerns about antimicrobial resistance has developed which would warrant culture and change in management strategies.

Hygiene should always be rigorously maintained in the clinic setting with protocols displayed, staff education, and efforts made to make hand sanitization possible at multiple locations. Owners should be advised of the importance of hand hygiene as well. Good antibiotic stewardship in veterinary dermatology involves carefully selecting which cases warrant systemic antimicrobial therapy and using an appropriate antibiotic at an appropriate dose and duration; using topical therapy as sole therapy or adjunctive therapy; identifying predis- posing, concurrent, or underlying skin diseases; and obtaining bacterial cultures whenever indicated.

Table 1: Causes of Antibiotic Resistance

- Overuse/abuse of antibiotics in humans
- Overuse/abuse of antibiotics in nonhumans
- Poor infection control
- Worldwide spread

Table 2: Potential Solutions to Infections Caused By Resistant Superbugs: Human Perspective

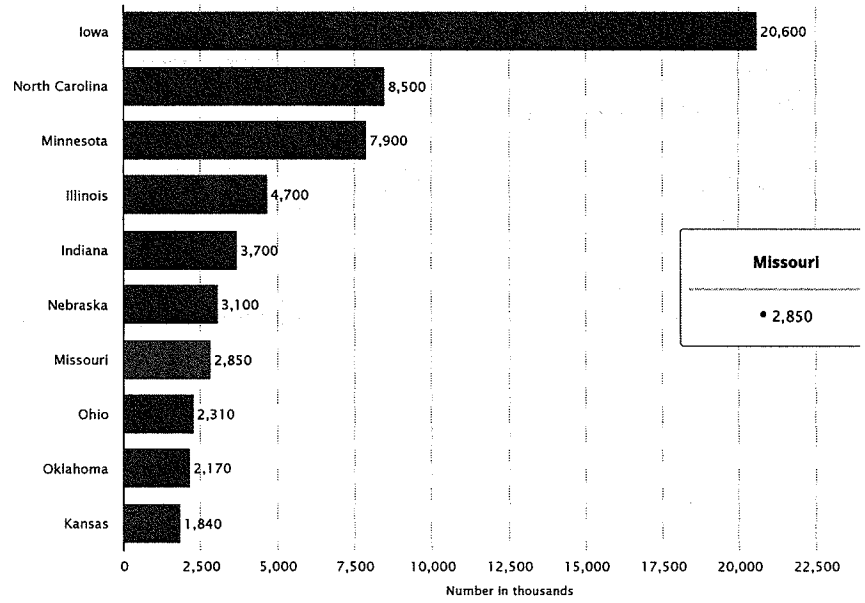
- Surveillance of resistant pathogens (www.can-r.ca)
- Infection control (wash those hands)
- Rapid diagnostics
- Treatment guidelines
- Appropriate antibiotic use (stewardship)
- New antibiotics/new therapies
- Probiotics
- Vaccination (*S. pneumoniae*)
- Bacteriophages

Table 3: Clinical Indications for Bacterial Culture of Skin Lesions in Veterinary Dermatology Patients Receiving Systemic Antimicrobial Therapy

- There has been less than 50% reduction in the extent of lesions within 2 weeks of initiating appropriate antimicrobial therapy.
- New lesions (papules, pustules, collarettes) still develop 2 weeks or more after initiation of appropriate antimicrobial drug therapy.
- Residual skin lesions compatible with bacterial skin infection are still present with visible cocci on cytologic samples after 6 weeks of appropriate antimicrobial drug therapy. Intracellular rods are seen on cytologic samples.

Top 10 U.S. states by inventory of hogs and pigs in 2015 (in 1,000s)*

This statistic shows the top 10 U.S. states based on the number of hogs and pigs in 2015. North Carolina came in second place, where the inventory stood at around 8.5 million hogs and pigs, as of March 1, 2015.



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Facts about Pollution from Livestock Farms

Giant livestock farms, which can house hundreds of thousands of pigs, chickens, or cows, produce vast amounts of manure, often generating the waste equivalent of a small city. A problem of this nature and scale is tough to imagine, and pollution from livestock farms seriously threatens humans, fish and ecosystems. Below are facts and statistics that tell the story.

Livestock pollution and public health

- California officials identify agriculture, including cows, as the major source of nitrate pollution in more than 100,000 square miles of polluted groundwater.
- In 1996 the Centers for Disease Control established a link between spontaneous abortions and high nitrate levels in Indiana drinking water wells located close to feedlots.
- High levels of nitrates in drinking water also increase the risk of methemoglobinemia, or "blue-baby syndrome," which can kill infants.
- Animal waste contains disease-causing pathogens, such as *Salmonella*, *E. coli*, *Cryptosporidium*, and fecal coliform, which can be 10 to 100 times more concentrated than in human waste. More than 40 diseases can be transferred to humans through manure.
- Manure from dairy cows is thought to have contributed to the disastrous *Cryptosporidium* contamination of Milwaukee's drinking water in 1993, which killed more than 100 people, made 400,000 sick and resulted in $37 million in lost wages and productivity.
- In this country, roughly 29 million pounds of antibiotics -- about 80 percent of the nation's antibiotics use in total -- are added to animal feed every year, mainly to speed livestock growth. This widespread use of antibiotics on animals contributes to the rise of resistant bacteria, making it harder to treat human illnesses.
- Large hog farms emit hydrogen sulfide, a gas that most often causes flu-like symptoms in humans, but at high concentrations can lead to brain damage. In 1998, the National Institute of Health reported that 19 people died as a result of hydrogen sulfide emissions from manure pits.

Livestock pollution and water pollution

- Huge open-air waste lagoons, often as big as several football fields, are prone to leaks and spills. In 1995 an eight-acre hog-waste lagoon in North Carolina burst, spilling 25 million gallons of manure into the New River. The spill killed about 10 million fish and closed 364,000 acres of coastal wetlands to shellfishing.
- In 2011, an Illinois hog farm spilled 200,000 gallons of manure into a creek, killing over 110,000 fish.
- In 2012, a California dairy left over 50 manure covered cow carcasses rotting around its property and polluting nearby waters.
- When Hurricane Floyd hit North Carolina in 1999, at least five manure lagoons burst and approximately 47 lagoons were completely flooded.
- Runoff of chicken and hog waste from factory farms in Maryland and North Carolina is believed to have contributed to outbreaks of *Pfiesteria piscicida*, killing millions of fish and causing skin irritation, short-term memory loss and other cognitive problems in local people.
- Nutrients in animal waste cause algal blooms, which use up oxygen in the water, contributing to a "dead zone" in the Gulf of Mexico where there's not enough oxygen to support aquatic life. The dead zone fluctuates in size each year, extending a record 8,500 square miles during the summer of 2002 and stretching over 7,700 square miles during the summer of 2010.
- Ammonia, a toxic form of nitrogen released in gas form during waste disposal, can be carried more than 300 miles through the air before being dumped back onto the ground or into the water, where it causes algal blooms and fish kills.

The growth of factory farms

- From 1980 to 2011, the number of hog operations in the U.S. dropped from 666,000 to roughly 69,000, yet the number of hogs sold remains almost the same.
- About 70% of U.S. beef cattle come from farms with at least 5,000 head of cattle.
- Ten large companies produce more than 90 percent of the nation's poultry.

last revised 2/21/2013

NM-1284

Assessment Tool
for New or Existing Animal Feeding Operations

Bridget Johnson and **Ron Wiederholt**
Area Specialists/Livestock Nutrient Management

This workbook is designed to help producers evaluate their current livestock facility and identify potential impacts their facility may have on waters of the state. Initially, one must determine if the livestock feeding operation is classified as an animal feeding operation (AFO). An AFO is a lot or facility (other than aquatic animal production facility) where the following conditions are met:

- Animals have been, are, or will be stabled or confined and fed or maintained for a total of 45 days or more in any 12-month period, **and**
- Crops, vegetation, forage growth or post-harvest residues are not sustained in the normal growing season over any portion of the lot or facility

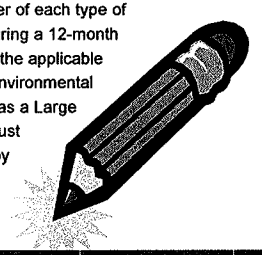
If your operation fits this definition, continue to Step 1 of the worksheet. You will find a table that identifies the three categories of animal feeding operations. A large, concentrated animal feeding operation (CAFO) is any animal feeding operation that stables or confines as many as or more than the number of animals specified in the Large CAFO column of the table in Step 1. If the facility is defined as large CAFO, the appropriate permit must be obtained from the North Dakota Department of Health by Dec. 31, 2006 and completion of either worksheet is not necessary. If the operation is defined as a medium or small AFO, continue to Step 2. Not all medium or small AFOs will require a permit. Those that do must submit the permit application to the North Dakota Department of Health by July 1, 2008.

The workbook has been developed through the efforts of the NDSU Extension Service and North Dakota Department of Health.

NDSU
Extension Service
North Dakota State University
Fargo, ND 58105
FEBRUARY 2005

■ Step 1

Complete the table below by inserting the maximum number of each type of livestock fed/housed within a facility for 45 days or more during a 12-month period. If the facility is defined as a Medium or Small AFO, the applicable worksheet should be completed to evaluate the potential environmental impacts associated with the facility. If the facility is defined as a Large CAFO, (see definition on page 3) the appropriate permit must be obtained from the North Dakota Department of Health by Dec. 31, 2006 and completion of either worksheet is not necessary.



Numbers of each livestock type	Maximum Number	Large CAFO	Medium AFO	Small AFO
Mature dairy cows		≥700	200-699	< 200
Veal calves		≥1,000	300-999	< 300
Cattle (not mature dairy cows or veal calves)		≥1,000	300-999	< 300
Swine (<55#)		≥10,000	3,000-9,999	< 3,000
Swine (>55#)		≥2,500	750-2,499	< 750
Horses		≥500	150-499	< 150
Sheep or lambs		≥10,000	3,000-9,999	< 3,000
Turkeys		≥55,000	16,500-54,999	< 16,500
Laying hens or broilers (liquid manure system)		≥30,000	9,000-29,999	< 9,000
Chickens (nonliquid manure system)		≥125,000	37,500-124,999	< 35,000
Laying hens (nonliquid manure system)		≥82,000	25,000-81,999	< 25,000
Ducks (liquid manure system)		≥5,000	1,500-4,999	< 1,500
Ducks (nonliquid manure system)		≥30,000	10,000-29,999	< 10,000

■ Step 2

Based on the definitions below, determine which worksheet best describes your livestock facility.

Complete the appropriate worksheet.

Definitions

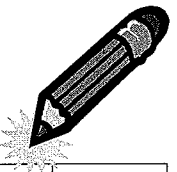
Housed Facility — Pens or similar confinement area that is protected from the environment.

Open lot — Pens or similar confinement areas with dirt, concrete or other paved or hard surface wherein animals or poultry are substantially or entirely exposed to the outside environment except for small portions of the total confinement area affording protection by windbreaks or small shade areas.

Surface Water — For the purpose of the following worksheets, surface water is defined as any stream, lake, reservoir or pond that contains water except for infrequent periods of severe drought. This includes streams that flow only as the result of direct precipitation and snow melt. Waters completely contained on an owner's property and that do not combine or effect a junction with natural surface or underground waters are not included.

Large CAFO — Any animal feeding operation that stables or confines as many or more than the numbers of animals specified in the table of Step 1.

■ Housed Facility Evaluation Worksheet



■ Assessment and prioritization of potential water quality impacts

	Points Available	Points Assessed
1. Based on the number of animals confined for more than 45 days, what is the facility size/type?		
Medium or Small AFO with a complete manure management system permitted by the North Dakota Department of Health	Evaluation is not applicable	
Medium AFO with the numbers in the upper 50 percentile of the animal range for a Medium AFO	10	
Medium AFO with the numbers in the lower 50 percentile of the animal range for a Medium AFO	5	
Small AFO	1	
2. Soil type according to USDA soil survey maps (Unified Soil Classification):		
Course-textured soils (SP, SW, GP, GM)	5	
Silt or loam soils (MH, ML, SM)	3	
Clay soils (CH, CL, SC)	1	
3. Liquid content of manure:		
High liquid content; manure does not stack	5	
Medium liquid content; manure stacks somewhat	3	
Low liquid content; manure stacks easily	1	
4. Feed storage (excludes hay and straw):		
Runoff from raw-fed material is **not** contained	5	
Runoff from raw-fed material is contained or no raw material is fed	1	
5. Type of manure handling practices:		
Stockpiled outside in an uncontained area and is **not** field applied annually	5	
Stockpiled in an uncontained area and field applied annually	3	
Stockpiled in an uncontained area and field applied more than once per year	1	
6. Depth to groundwater below facility:		
Less than 10 feet	10	
Between 10 and 25 feet	6	
Between 26 and 50 feet	3	
Greater than 50 feet	1	
7. Duration livestock are present within the facility:		
270-365 days/year	10	
180-269 days/year	7	
90-179 days/year	4	
Less than 90 days/year	1	

8. Distance to nearest surface water (see definition of surface water):		
Less than ½ mile	10	
Between ½ and 1 mile	6	
Between 1 and 2 miles	3	
Greater than 2 miles	1	
9. Average slope and general topography between the facility and nearest surface water:		
Located adjacent to or within the floodplain of a surface water	10	
Slopes are generally greater than 6% with well defined drainage pattern	6	
Slopes are generally between 3% and 6% with a moderately defined drainage pattern	3	
Slopes are generally less than 3% with poorly defined drainage pattern	1	
	TOTAL SCORE	

■ Potential water quality impacts associated with the animal feeding operations

Ranking	Score
High Potential	> 50
Medium Potential	25-50
Low Potential	< 25

■ Eligibility for a "No Potential to Pollute" designation from the N.D. Department of Health

Some Medium or Small AFOs may qualify for a "No Potential to Pollute" designation from the North Dakota Department of Health (NDDH). Large CAFOs are not eligible for this designation. The final determination of a facility's eligibility for a "No Potential to Pollute" designation can be made only by NDDH personnel. However, if a Medium or Small AFO has a **total** score of 25 or less, the facility may qualify for a "No Potential to Pollute" designation. In such cases, the NDDH should be contacted to provide a final determination on the facility's eligibility.

■ Comments on management options for facility:

■ Open Lot Evaluation Worksheet

■ Assessment and prioritization of potential water quality impacts

	Points Available	Points Assessed
1. Based on the number of animals confined for more than 45 days, what is the facility size/type?		
Medium or Small AFO with a complete manure management system permitted by the North Dakota Department of Health	Evaluation is not applicable	
Medium AFO with the numbers in the upper 50 percentile of the animal range for a Medium AFO	10	
Medium AFO with the numbers in the lower 50 percentile of the animal range for a Medium AFO	5	
Small AFO	1	
2. Soil type according to USDA soil survey maps (Unified Soil Classification):		
Course-textured soils (SP, SW, GP, GM)	5	
Silt or loam soils (MH, ML, SM)	3	
Clay soils (CH, CL, SC)	1	
3. Type of manure handling practices within the facility:		
Manure is **not** removed or field applied annually	5	
Stockpiled and field applied once per year	3	
Stockpiled and field applied more than once per year	1	
4. Bedding practices:		
No bedding material is used	5	
Animals are bedded only in harsh weather	3	
Animals are bedded on a regular basis	1	
5. Feed storage (excludes hay and straw):		
Runoff from raw-fed material is **not** contained	5	
Runoff from raw-fed material is contained or no raw material is fed	1	
6. Depth to groundwater below facility:		
Less than 10 feet	10	
Between 10 and 25 feet	6	
Between 26 and 50 feet	3	
Greater than 50 feet	1	
7. Duration livestock are present within the facility:		
270-365 days/year	10	
180-269 days/year	7	
90-179 days/year	4	
Less than 90 days/year	1	

8. Distance to nearest surface water (see definition of surface water):		
Less than ½ mile	10	
Between ½ and 1 mile	6	
Between 1 and 2 miles	3	
Greater than 2 miles	1	
9. Average slope and general topography between the facility and nearest surface water:		
Located adjacent to or within the floodplain of a surface water	10	
Slopes are generally greater than 6% with well defined drainage pattern	6	
Slopes are generally between 3% and 6% with a moderately defined drainage pattern	3	
Slopes are generally less than 3% with poorly defined drainage pattern	1	
	TOTAL SCORE	

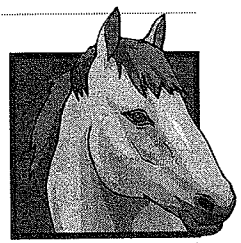
■ Potential water quality impacts associated with the animal feeding operations

Ranking	Score
High Potential	> 50
Medium Potential	25-50
Low Potential	< 25

■ Eligibility for a "No Potential to Pollute" designation from the N.D. Department of Health

Some Medium or Small AFOs may qualify for a "No Potential to Pollute" designation from the North Dakota Department of Health (NDDH). Large CAFOs are not eligible for this designation. The final determination of a facility's eligibility for a "No Potential to Pollute" designation can be made only by NDDH personnel. However, if a Medium or Small AFO has a **total** score of 25 or less, the facility may qualify for a "No Potential to Pollute" designation. In such cases, the NDDH should be contacted to provide a final determination on the facility's eligibility.

■ Comments on management options for facility:



For more information on this an other topics, see: www.ag.ndsu.edu

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A

MODEL ZONING ORDINANCE

FOR

ANIMAL FEEDING OPERATIONS

Developed by a

ZONING WORK GROUP

for Animal Feeding Operations

Final

March 2000

Facilitated by the

NORTH DAKOTA DEPARTMENT OF HEALTH

Environmental Health Section

P.O. Box 5520

Bismarck, North Dakota 58506-5520

AMENDED AND ADOPTED BY THE RENVILLE COUNTY COMMISSIONERS

JULY 23, 2002

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PREAMBLE

Public concern about odors produced by animal feeding operations and agricultural concern for rights to practice farming and ranching emerged within North Dakota during 1998. As remedies for these concerns, the 1999 North Dakota Legislative Assembly approved amendments to law that (1) limited the powers of local governments to prohibit or prevent the use of land or buildings for farming or ranching but allowed local governments to regulate the nature and scope of concentrated feeding operations, and (2) established a state standard for odors. The 1999 legislation was Senate Bills 2355 and 2365.

Subsequent to signing this legislation, Governor Edward T. Schafer issued Executive Order 1999-03, which reads in part:

> The Department of Health shall . . . take steps reasonably necessary to protect the environment of the state of North Dakota, according to its responsibilities under law; and,
>
> The Department shall establish a working group with interested political subdivisions, or their associations to develop model zoning regulations for the subdivisions to implement as they deem appropriate; . . .

The Department of Health arranged for and facilitated meetings of the work group and a committee of the work group. The work group was comprised of representatives of two livestock producer associations, three boards of county commissioners, two township officers associations, two city officers and the Department of Health. At times, several other people participated in meetings or assisted the work group, including county planners and land-use administrators.

This document is the product of the work group. It represents the consensus recommendation of the work group for zoning of concentrated feeding operations, sometimes referred to as feedlots or animal feeding operations. Its purpose is to:

Provide a reference, or model, for zoning and ordinances pertaining to concentrated feeding operations for use by the local governments across North Dakota.

Remind local governments of their roles in protecting public safety and health and in planning the uses, conservation and protection of natural resources, including land for farming and ranching.

Foster uniform zoning ordinances for concentrated feeding operations among counties and townships. Since regional differences in population density, climate, and soil and water resources occur across the state, local governments can revise the model as appropriate.

Avoid duplication among state environmental protection rules and local government zoning ordinances.

INTRODUCTORY COMMENTARY

A summary of the reasons for, and the content of, an ordinance for animal feeding operations.

DEVELOPER AWARENESS

As some counties or townships in North Dakota become increasingly urban, especially those that contain the larger population centers, there is a need to reduce the conflict between farms and ranches and rural property owners. Normal facets of farming and ranching must be recognized by new and potential rural property owners and developers who make these properties available for non-farming or non-ranching uses.

Counties and townships should consider preparing educational materials for potential property developers and buyers; the materials should explain that aspects of some normal activities of farming or ranching can be displeasing to non-farm or non-ranch occupants. For example, informational materials were developed by Spokane County and are available: "Code of the West: Agriculture, Access and Mother Nature." Long Range Planning Department, Public Works Building, 1116 W. Broadway, Spokane, WA.

Normal farming and ranching practices can create these conditions:

Animal production can cause odors, flies and noise.

Crop production can create road and field dust.

Applications of fertilizers and pesticides are common.

Slow-moving vehicles and extra-wide equipment are common on roadways.

Early morning or late evening truck traffic or chemical applications can occur.

State law places limitations on the ability of people affected by agricultural operations to bring nuisance actions to limit or stop such activities. (See N.D.C.C. chapter 42-04.)

LEGAL AUTHORITY

The North Dakota legislature has given political subdivisions the authority to enact local zoning ordinances for the purpose of promoting health, safety, morals, public convenience, general prosperity and public welfare. (See, for example, N.D.C.C. § 11-33-01, which is the county zoning authority.) In general, however, the law does not allow political subdivisions to enact any regulation or restriction that prohibits or prevents "the use of land or buildings for farming or ranching or any of the normal incidents of farming or ranching." (See, for example, N.D.C.C. § 11-33-02, subsection 1.)

The 1999 amendments to the law addressed an important legal question: whether concentrated feeding operations were "industrial" operations over which counties and townships could exercise their traditional zoning authority, or whether they were "farming" operations over which political subdivisions had no zoning authority? The legislature answered this question. First, it defined farming and ranching to include livestock "feeding"; second, it gave counties and townships authority to "regulate the nature and scope of concentrated feeding operations" permissible within their jurisdictions and to "set reasonable standards, based on the size of the operation" to govern its location. The legislation also forbids counties and townships from banning concentrated feeding operations from their jurisdictions and from prohibiting the reasonable diversification or expansion of farming or ranching operations. The amendments give counties and townships discretion to adopt their own standards regulating the size, nature and location of feedlots subject to the limitations outlined above. The amended law is provided in Appendix I.

FUNCTION OF AN ORDINANCE

There appears to be a misunderstanding among many people in North Dakota as to how zoning functions. Many believe that, because rural areas beyond incorporated cities have historically been agricultural production areas, they are zoned agriculture and are entitled to protection from encroachment of non-agricultural land use. This is not the case. Zoning authorities maintain that farming and ranching areas are not protected from encroachment until they are delineated in comprehensive land-use plans. Comprehensive land-use plans are required by law before adoption of land-use ordinances. Apparently, most rural areas of the state are not covered by comprehensive land-use plans; therefore, there is no protection from encroachment by incompatible land use.

If conflict in land use is to be constrained by local governments so as to protect the right to practice farming or ranching and to foster compatibility with nearby land use, local government officials choosing to adopt an ordinance for animal feeding operations must:

Adopt comprehensive land-use plans, which delineate land uses and specify land use objectives and policies.

Adopt separation distances (aka setbacks or reverse setbacks) that reflect qualifiable or quantifiable odor characteristics and odor dispersal. (Compliance with the odor provisions of 1999 SB2365 is not a defense in nuisance litigation, N.D.C.C. chapter 42-01.)

Identify those new land uses that do not conform to the objectives and policies for delineated agricultural areas so as to infringe on the rights of farming or ranching (not included in the model zoning ordinance for animal feeding operations).

Identify those new and existing animal feeding operations that, due to size (e.g., number of animal units), present safety hazards, affect natural resources, affect surrounding areas or other means of infringing on the rights of others.

MODEL LAND-USE POLICY

State laws which allow zoning by local governments require comprehensive plans that contain landuse goals, etc. Suggested goals, objectives and policies - for inclusion in a comprehensive land-use plan as deemed appropriate - are provided..

LAND-USE COORDINATION

Development within the zoning jurisdiction of a city shall be determined by that city. Development within the zoning jurisdiction of a county or township that may affect property within a city's zoning limits should be reviewed cooperatively by the board of county commissioners or the township board and the city.

ENVIRONMENT AND PUBLIC SAFETY AND HEALTH

Goal: Develop, adopt and administer zoning ordinances that are consistent with the objectives and policies of this comprehensive land use plan.

Objective A: Manage new development.

Policy A1: Encourage rural residential development, as needed, to locate areas that are in non-productive for farming or ranching.

Policy A2: Protect farming or ranching from non-agricultural development of land uses that would hinder the operations or productivity of farming or ranching. A proposed change in land use should not cause conflict with existing farming or ranching.

Objective B: Promote conservation of natural resources.

Policy B1: Encourage development in ways that conserve natural and agricultural resources. Developments or land use should not pose unacceptable exploitation of natural and agricultural resources or unacceptable risk of polluting air, land or water.

Policy B2: Encourage programs and activities that reduce and control soil erosion and that prevent the growth and spread of weeds.

Objective C: Promote public safety and health.

Policy C1: Encourage programs and activities that discourage siting of development in a flood way or flood plain and that reduce and prevent air, soil or water pollution.

MODEL AFO ZONING ORDINANCE

A suggested zoning ordinance pertaining to animal feeding operations is provided for use by local governments as deemed appropriate. A summary of the work group's discussions that governed substance of this model ordinance is included in a subsequent chapter of this document.

This land-use ordinance for animal feeding operations includes the following sections.

1. GENERAL PROVISIONS

1.1 DEFINITIONS

Terms used in this ordinance have the same meaning as given by the laws and rules of the state of North Dakota, specifically chapter 33-16-03 of the North Dakota Administrative Code. The definitions for these terms and for additional terms (bold print) are:

"Animal feeding operation" means a place where: livestock have been, are, or will be confined, concentrated and fed for 45 or more days in any 12 month period; pasture, crops, or other vegetation are not normally managed or sustained for grazing during the normal growing season; and, animal waste or *manure* accumulates. This term does not include an *animal wintering operation.* Adjoining animal feeding operations under common ownership are considered to be one animal feeding operation, if they use common areas or systems for *manure* handling.

"Animal wintering operation" means the confinement of cattle or sheep used or kept for breeding purposes in a feedlot or sheltered area at any time between October 15 and May 15 of each production cycle under circumstances in which these animals do not obtain a majority of their feed and nutrients from grazing. The term includes the

weaned offspring of cattle and sheep, but it does not include (1) breeding operations of more than 1,000 animal units or (2) weaned offspring which are kept longer than 120 days and that are not retained for breeding purposes.

"**Due process**" involves two essential elements; (1) notice and (2) an opportunity for a hearing. The notice must adequately describe the potential action that might affect the person(s) being notified and it must provide the person(s) a reasonable time to respond. If the person(s) request(s) a hearing, the hearing must be fair and allow the person(s) to present relevant evidence and arguments.

"Existing" means in place and operating on the date this ordinance is effective.

"Livestock" means any animal raised for food, raw materials or pleasure, including, but not limited to, beef and dairy cattle, bison, sheep, swine, poultry and horses. Livestock also includes fur animals raised for pelts.

"Manure" means fecal material and urine from livestock, as well as animal-housing wash water, bedding material, rainwater or snow melt that comes in contact with fecal material or urine.

"Operator" means an individual or group of individuals, a partnership, a corporation, a joint venture, or any other entity owning or controlling one or more *animal feeding operations* or *animal wintering operations.*

"**Shall**" means that the requirement is mandatory, rather than optional.

"Surface water" means *waters of the state* located on the ground surface such as lakes, reservoirs, rivers and creeks.

"Waters of the state" means all waters within the jurisdiction of this state, including all streams, lakes, ponds, impounding reservoirs, marshes, watercourses, waterways, and all other bodies or accumulations of water on or under the surface of the earth, natural or artificial, public or private, situated wholly or partly within or bordering upon the state, except those private waters that do not combine or effect a junction with natural surface or underground waters just defined.

1.2 EQUIVALENT ANIMAL NUMBERS

An "animal unit equivalent" is a unitless number developed from the nutrient and volume characteristics of *manure* for a specific *livestock* type. The term "animal units" is used to normalize the number of animals (e.g., head) for each specific *livestock* type which produce comparable bulk quantities of *manure*. The animal unit equivalents for types of *livestock* and the numbers of *livestock* for facility size thresholds of 300 animal units (a.u.), and so forth, are listed in the following table.

Equivalent Numbers of the Livestock (hd) for Four Sizes (a.u.)of Animal Feeding Operations

Livestock Type	Animal Unit Equivalent	300 a.u.	1,000 a.u.	2,000 a.u.	5,000 a.u.
1 horse	2.0	150 hd	500 hd	1,000 hd	2,500 hd
1 diary cow	1.33	225	750	1,500	3,750
1 mature beef	1.0	300	1,000	2,000	5,000
1 beef feeder - finishing	1.0	300	1,000	2,000	5,000
1 beef feeder - backgrounding	0.75	400	1,333	2,667	6,667
1 mature bison	1.0	300	1,000	2,000	5,000
1 bison feeder	1.0	300	1,000	2,000	5,000
1 swine, >55lbs	0.4	750	2,500	5,000	12,500
1 goose or duck	0.2	1,500	5,000	10,000	25,000
1 sheep	0.01	3,000	10,000	20,000	50,000
1 swine, nursery	0.01	3,000	10,000	20,000	50,000
1 turkey	0.0182	16,500	55,000	110,000	275,000
1 chicken	0.01	3,000	100,000	200,000	500,000

1.3 ENVIRONMENTAL PROTECTION

The *operator* of a new facility for animal feeding is expected to locate, construct, operate and maintain the facility so as to minimize, reduce or abate effects of pollution on environmental resources and on public safety and health. The *operator* of an existing facility is expected to operate and maintain the facility so as to minimize, reduce or abate effects of pollution on environmental resources and on public safety and health. Each *operator* shall comply with applicable state laws and rules, including the laws and rules administered by the North Dakota Department of Health and with any permits granted by that department.

1.4 ENFORCEMENT

In the event of a violation of this ordinance or a judgement on a civil action by the North Dakota Department of Health, the local unit of government, after due process, can order cessation of a facility for animal feeding within a reasonable period of time and until such time as the *operator* corrects or abates the cause(s) of the violation. If the cause(s) of the

violation are not remedied within a reasonable period of time as set by the local unit of government, the permit may be revoked.

1.5 SEVERABILITY

If any paragraph, sentence, clause or phrase of this ordinance is for any reason held to be invalid or unconstitutional by a court of competent jurisdiction, such decision shall not affect the validity of the remaining portion of this ordinance .

2. SETBACK REQUIREMENTS

2.1 WATER RESOURCE SETBACKS

The *operator* of a new *animal feeding operation* that has more than 1,000 animal **units (except for swine, 700 animal units shall be applicable)** shall not locate or establish that operation:

A. Within a delineated source water protection area for a public water system. The source water protection areas for water supply wells include the entire wellhead protection area. For the *surface-water* intakes of public water systems, source water protection areas include all or portions of the surface water that supplies the water for the public water system, including all or portions of the surface-water's shoreline.

B. Within 1,200 feet (365.6 meters) of a private ground water well which is not owned by the *operator* or within 1,500 feet (457.1 meters) of a public ground water well which does not have a delineated source water protection area.

C. Within 1,000 feet (304.7 meters) of surface water which is not included in a source water protection area.

2.2 ODOR SETBACKS

The *operator* of a new facility for an *animal feeding operation* shall not locate that operation within the extra territorial zoning jurisdiction of an incorporated city.

An owner of property shall locate and establish a residence, business, church, school, public park or zone for residential use so as to provide a separation distance from any *existing animal feeding operation.* The separation distances, or setbacks, are listed in the following table. An owner of property who is an *operator* may locate the owner's residence or business within the setbacks.

Number of Animal Units	Hog Operations	Other Animal Operations
fewer than 300	none	none
300 - 1000 (300-700 for swine)	0.50 mi (0.805 km)	0.50 mi (0.805 km)
1001 or more (701 or more for swine)	0.75 mi (1.207 km)	0.50 mi (0.805 km)
2001 or more (1401 or more for swine)	1.00 mi (1.609 km)	0.75 mi (1.207 km)
5001 or more (3501 or more for swine)	1.50 mi (2.414 km)	1.00 mi (1.609 km)

The *operator* of a new *animal feeding operation* shall locate the site of that operation from existing residences, businesses, churches, schools, public parks and areas of property that are zoned residential so as to exceed the corresponding listed setback from these places.

If notified in writing by an *operator* of a planned future expansion of an *animal feeding operation*, the local unit of government may implement the corresponding odor setback for a temporary time period not to exceed two years, after which time the setback will remain in effect only if the expansion was completed.

A local unit of government may, upon recommendation of the zoning commission or land use administrator, increase or decrease a setback distance for a new *animal feeding operation* after consideration of the proposed operation's plans, if it determines that a greater or lesser setback distance is necessary or acceptable, respectively, based upon site conditions or demonstrable safety, health, environmental or public welfare concerns.

3. CONDITIONAL USES

3.1 PERMIT PROCEDURES

3.1.A. Applicability.

The *operator* of a new *livestock* facility or an *existing livestock* facility, which meets the definition of an *animal feeding operation* and which is a conditional (or special) use of land as listed below, shall apply for and obtain a conditional (or special) use permit.

1. A new *animal feeding operation* that would be capable of handling, or that expands to handle, more than 1,000 animal units is a conditional (or special) use of land; **except for swine for which 700 animal units will apply**.

2. An *existing animal feeding operation* that expands to handle more than 1,000 animal units is a conditional (or special) use of land; **except for swine for which 700 animal units will apply.**

Whenever the capacity of an *animal feeding operation* is expanded to handle more than 2,000 or 5,000 animal units, (1,400 or 3,500 animal units for swine) the *operator* shall apply for a new conditional (or special) use permit.

3.1.B. Procedure.

The local unit of government may practice any or all of the provisions in the following subparagraphs in harmony with the permitting process of its general zoning regulations.

1. Application for a conditional use (or special use) permit shall be submitted to the local unit of government for tentative approval. The local unit of government shall notify the Department of Health that it has received such application.

2. The local unit of government shall notify by certified mail all property owners having property within the corresponding odor setback distance of a proposed new *animal feeding operation*. This notification must occur within 21 days of receiving the application. The approval process utilized by the local unit of government may include at least one advertised public hearing.

3. Following tentative approval or denial of the application by the local unit of government, the applicant shall be notified by letter of the decision, including conditions imposed, if any.

4. The applicant shall then forward its application for a conditional (or special) use permit, together with the tentative approval by the local government, to the North Dakota Department of Health.

5. Following a review by the Department of Health of the operator's application for a state permit, the Department of Health will notify the local unit of government of its decision.

6. The conditional (or special) use permit will become final following the granting of a permit by the Department of Health.

7. A conditional (or special) use permit granted to the operator of a new animal feeding operation shall be put into use within twenty-four (24) months, or the permit shall lapse and the operator may re-apply.

3.1.C. Application Requirements.

The application for a conditional use (or special use) permit to operate a facility for an *animal feeding operation* shall include a scaled site plan. If the facility will handle more than 1,000 animal units, (except for swine, for which 700 animal units will apply), the scaled site plan shall be prepared by a registered land surveyor, a civil engineer or other person having comparable experience or qualifications. The local unit of government may require any or all of the following elements, or require additional elements,

in its site plan review process when needed to determine the nature and scope of the animal feeding operation.

1. Proposed number of animal units.

2. Total acreage of the site of the facility.

3. Existing and proposed roads and access ways within and adjacent to the site of the facility.

4. Surrounding land uses and ownership, if the operation will have the capacity to handle more than 1,000 animal units, except for swine, for which 700 animal units will apply.

5. A copy of the permit application submitted by the applicant to the Department of Health.

3.2 OWNERSHIP CHANGE

An *operator* of a facility that includes an *animal feeding operation* having a permit granted by this ordinance shall notify the local unit of government of the sale, or the transfer of the ownership of that operation.

3.3 OPERATING CHANGE

An *operator* of a facility that includes an *animal feeding operation* having a permit granted by this ordinance shall notify the local unit of government of intent to include an alternate *livestock* type. The notice shall be given at least 120 days prior to the anticipated date of the change.

STATUTORY AUTHORITY FOR JOINT POWERS AGREEMENTS

Cooperative or Joint Administration by Counties and Townships of Authority to Regulate Concentrated Feeding Operations

N.D.C.C. § 54-40.3-01 allows counties, townships or other political subdivisions to enter into agreements with other political subdivisions for the cooperative or joint administration of any power or function authorized by law or assigned to one or more of them. Counties and townships may use this authority to pool resources, cut red tape, and make their services and functions more cost effective, timely, efficient and responsive.

The 1999 Legislature amended N.D.C.C. § 11-33-02 and N.D.C.C. § 58-03-11 to clarify the power and function of counties and townships to regulate animal feeding operations. Counties and townships may wish to explore the possibility of cooperative or joint regulation of concentrated feeding operations to avoid unnecessary duplication of these regulations and to satisfy the purpose and intent of N.D.C.C. § 11-33-02 and N.D.C.C. § 58-03-11.

1. Factors Relevant Under Amended Law.

The 1999 Legislature amended N.D.C.C. § 11-33-02 and N.D.C.C. § 58-03-11 to clarify that counties and townships may "regulate the nature and scope of concentrated [animal] feeding operations." These amendments are given under the "INTRODUCTORY COMMENTARY" of this document.

In implementation of the amended laws, counties and townships may find it easier to ensure there are places for the development of animal feeding operations within their jurisdictions and to ensure there are reasonable and consistent regulations governing the nature and scope of operations, if they adopt one regulation for both counties and townships. One way of doing this would be for townships to relinquish their zoning authority over concentrated feeding operations to counties. Another way would be to enter into an agreement for cooperative or joint administration.

2. Decision Choices for a Cooperative or Joint Administration Agreement.

Counties and townships can structure agreements for joint or cooperative regulation of animal feeding operations in several ways. The factors, which are relevant to determining whether a county or township should enter into a cooperative or joint administration agreement with other counties or townships, are listed in Appendix II. One factor is cost. Another is representation. A third is working out the details of such an agreement. There are almost endless ways of structuring such agreements. state agencies and county and township organizations may be willing to help if interest is shown.

CLOSING COMMENTARY

A summary of the prevailing work group discussion that governed the substance of the model zoning ordinance for animal feeding operations.

The work group acknowledges that many counties and townships within the state have constraints on the resources needed for effective administration of zoning and zoning ordinances. The work group also acknowledges that compliance with detailed requirements of zoning and zoning ordinances by many people who practice farming and ranching could be a significant burden. Thus, the work group endeavored to achieve a practical and functional model ordinance supported with a model land use policy (required by law).

A report titled "History of the Development of a Model Zoning Ordinance for Animal Feeding Operations" provides information about the work group and its meetings.

The work group recognizes that the model zoning ordinance likely does not accommodate all existing zoning preferences and provisions of local units of government across the state. Thus, the model ordinance may be amended by a local unit of government as deemed appropriate. A **summary** of the prevailing discussion governing the substance of the model ordinance is provided below.

ROLE OF THE ND DEPARTMENT OF HEALTH (DoH)

Local units of government, as well as the livestock producers, prefer that the Department of Health shoulder responsibility for protection of natural resources from pollution via its rules for animal feeding operations, including land application of manure, without additional detail in a local ordinance for animal feeding operations.

An ordinance for animal feeding operations should be consistent in choice and use of terms as applied or defined in state laws and rules.

PUBLIC WATER SYSTEM SOURCE WATER SETBACKS

New animal feeding operations should avoid locating in areas which have been delineated for the protection of waters of the state, including both surface water and ground water, which are used as drinking water. The federal Safe Drinking Water Act requires EPA-approved state plans for the delineation of those waters-of-the-state used as water resources for public water systems. While the state plan for North Dakota does not prohibit location of new animal feeding operations within delineated areas, the best interests of the owners/operators of animal feeding operations and the owners of the public water systems are not served by siting these operations within delineated source water protection areas.

Maps of delineated source water protection areas for public water systems are available on the World Wide Web.

The model ordinance does not propose setbacks from those portions of flood plains that are not within delineated source water protection areas of Public Water Systems. Local governments should include a provision concerning land uses in flood plain areas.

ODOR SETBACKS

The choices for separation distances (setbacks) for animal feeding operations were balanced with the state odor standard (1999 SB 2365, N.D.C.C. chapter 23-25). The state odor standard makes an odor concentration of seven or more odor concentration units a violation of the standard at distances greater than one-half mile. This standard applies to all animal feeding operations, regardless of the type of livestock or the number confined and fed by the operation.

Reported information indicates that amount of odors produced by confined swine feeding operations are greater than amounts of odors produced by other livestock types. After odors are released from animal-housing or manure-storage structures, the atmosphere governs the downwind transport and dispersion of the odors.

The strength of odors released into ambient air and transported from animal feeding operations depends upon the construction of the animal housing and manure storage units and the topography of the site, as well as the type and number of animals. There is no apparent threshold based solely on the numbers of animals at which the downwind odor possibly could become a troublesome issue.

General zoning provisions usually establish setbacks for buildings and structures from roadways; thus, no specific roadway setback for animal feeding operations is necessary.

A framework for odor easements should be developed by the local unit of government when deemed appropriate. state law indicates that odor easements can be obtained by the owners/operators of animal feeding operations from owners of other property located beyond one-half mile (subparagraph b of paragraph 2 of section 11 of N.D.C.C. chapter 23-25).

CONDITIONAL-USE SIZE THRESHOLD

The state laws which allow zoning indicate that a local unit of government ". . . can not prohibit through regulation, the reasonable diversification or expansion of a farming or ranching operation." The interpretation of the words "prohibit" and

"reasonable" intertwine with selection of the appropriate regulatory (in the model ordinance) size threshold for animal feeding operations.

The number of animal feeding operations that have been issued permits by the Department of Health is about 440. (The Department presently requires any livestock feeding operation with more than 200 animals units to obtain a permit, and it anticipates a rule change adjusting this threshold to 300 animal units so as to be consistent with federal regulation.) Currently, there are: about 80 operations with 300 or more animal units; nearly 60 operations with more than 500 animal units; and nearly 30 operations with more than 1,000 animal units. Based upon a recent survey, other livestock feeding operations may not have permits because the operators are unaware of the rule permit requirements. The total number of animal feeding operations is unknown.

While a local permit requirement for animal feeding operations with less than 1,000 animal units would involve some paperwork, public hearings, etc., on the part of owners/operators, matters of public safety, health, and general public welfare should not be overlooked.

Additional summary details of the work group's discussion of this issue are provided in Appendix I of the report titled "History of the Development of a Model Zoning Ordinance for Animal Feeding Operations."

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APPENDIX I

Legislative Revisions of Local Zoning Law

ROLE OF LOCAL GOVERNMENTS

Although the North Dakota's constitution (Article VII, section 6) and law (NDCC chapter 11-09.1) grant home rule authority to counties, the model language proposed herein assumes that local governments in the state have only those powers expressly granted, or reasonably implied in, the law.

The 1999 North Dakota Legislative Assembly increased protection of farming and ranching in the state by amending laws that allow a county and/or a township to divide, or zone, all or any parts of the county or township into districts. Section 11-33-02 of the North Dakota Century Code, which grants zoning authority to counties, now states:

1. For any or all of the purposes designated in section 11-33-01, the board of county commissioners may divide by resolution all or any parts of the county, subject to section 11-33-20, into districts of such number, shape, and area as may be determined necessary, and likewise may enact suitable regulations to carry out the purposes of this chapter. These regulations must be uniform in each district, but the regulations in one district may differ from those in other districts. A regulation or restriction may not prohibit or prevent the use of land or buildings for farming or ranching or any of the normal incidents of farming or ranching. For purposes of this section, "farming or ranching" means cultivating land for production of agricultural crops or livestock, or raising, feeding, or producing livestock, poultry, milk, or fruit. The term does not include producing timber or forest products, nor does the term include a contract whereby a processor or distributor of farm products or supplies provides grain, harvesting, or other farm services.

2. A board of county commissioners may regulate the nature and scope of concentrated feeding operations permissible in the county; however, if a regulation would impose a substantial economic burden on a concentrated feeding operation in existence before the effective date of the regulation, the board of county commissioners shall declare that the regulation is ineffective with respect to any concentrated feeding operation in existence before the effective date of the regulation.

3. A regulation may not preclude the development of a concentrated feeding operation in the county. A regulation addressing the development of a concentrated feeding operation in the county may set reasonable standards, based on the size of the operation, to govern its location.

4. For purposes of this section, "concentrated feeding operation" means any livestock feeding, handling, or holding operation, or feed yard, where animals are concentrated in an area that is not normally used for pasture or for growing crops and in which animal wastes may accumulate, or in an area where the space per animal unit is less than six hundred square feet [55.74 square meters]. The term does not include normal wintering operations for cattle. For purposes of this section, "livestock" includes beef cattle, dairy cattle, sheep, swine, poultry, horses, and fur animals raised for their pelts.

5. A board of county commissioners may not prohibit, through regulation, the reasonable diversification or expansion of a farming or ranching operation.

6. This chapter does not include any power relating to the establishment, repair, and maintenance of highways or roads.

COUNTY POWERS

First. state law allows, but does not require, boards of county commissioners to take action to promote safety, health and public welfare. Section 11-33-01 of the North Dakota Century Code states, in part:

> For the purpose of promoting health, safety, morals, public convenience, general prosperity, and public welfare, the board of county commissioners of any county may regulate and restrict within the county, subject to section 11-33-20 and chapter 54-21.3, the location and the use of buildings and structures and the use, condition of use, or occupancy of lands for residence, recreation, and other purposes.

However, section 11-33-02, as quoted under the "Role of Local Governments" above, defines the scope of zoning regulations that pertain to farming or ranching and concentrated feeding operations.

Second. Zoning divides land into districts so as to enable compatible and adjoining land uses to coexist in each district and to separate incompatible land uses from each other. Thus, a zoning ordinance consists of: (1) a map that divides the jurisdiction (county or township) into districts for classes of use, which typically are residential, recreational, commercial, industrial, agricultural and other; and (2) written conditions that establish criteria under which the land may be developed and used for the particular land use class. Section 11-33-02, as quoted earlier in this chapter, grants authority to county commissions to divide the county and to set reasonable standards, based upon size, to govern locations of concentrated feeding operations.

Third. A prerequisite for adopting a zoning ordinance is a comprehensive land use plan for the jurisdiction. Section 11-33-03 of the North Dakota Century Code states, in part:

> These regulations shall be made in accordance with a comprehensive plan and designed for any or all of the following purposes:
>
> 1. To protect and guide the development of non-urban areas.
> 2. To secure safety from fire, flood, and other dangers.
> 3. To conserve and develop natural resources.
>
> These regulations shall be made with a reasonable consideration, among other things, to the character of the district and its peculiar suitability for particular uses. The comprehensive plan shall be a statement in documented text setting forth explicit goals, objectives, policies and standards of the jurisdiction to guide public and private development within its control.

TOWNSHIP POWERS

Sections 58-03-11, 58-03-12 and 58-03-13 of the North Dakota Century Code contain similar requirements, as described above, for townships that choose to establish zoning districts and regulate development.

APPENDIX II

Elements of a Cooperative or Joint Administration Agreement

N.D.C.C. § 54-40.3-01 provides:

1. Any county, city, township, city park district, school district or other political subdivision of this state, upon approval of its respective governing body, may enter into an agreement with any other political subdivision of this state for the cooperative or joint administration of any power or function that is authorized by law or assigned to one or more of them. Any political subdivision of this state may enter into a joint powers agreement with a political subdivision of another state or political subdivision of a Canadian province if the power or function to be jointly administered is a power or function authorized by the laws of this state for a political subdivision of this state and is authorized by the laws of the other state or province. A joint powers agreement may provide for:

   a. The purpose of the agreement or the power or function to be exercised or carried out.

   b. The duration of the agreement and the permissible method to be employed in accomplishing the partial or complete termination of the agreement and for disposing of any property upon the partial or complete termination.

   c. The precise organization, composition, and nature of any separate administrative or legal entity, including an administrator or a joint board, committee, or joint service council or network, responsible for administering the cooperative or joint undertaking. Two or more political subdivisions which enter into a number of joint powers agreements may provide a master administrative structure for the joint administration of any number of those agreements, rather than creating separate administrative structures for each agreement. However, no essential legislative powers, taxing authority, or eminent domain power may be delegated by an agreement to a separate administrative or legal entity.

   d. The manner in which the parties to the agreement will finance the cooperative or joint undertaking and establish and maintain a budget for that undertaking. The parties to the agreement may expend funds pursuant to the agreement, use unexpended balances of their respective current funds, enter into a lease-option to buy and contract for deed agreements between themselves and with private parties, accumulate funds from year to year for the provision of services and facilities, and otherwise share or contribute property in accordance with the agreement in cooperatively or jointly exercising or carrying out the power or function. The agreement may include the provision of personnel, equipment, or property of one or more of the parties to the agreement that may be used instead of other financial support.

   e. The manner of acquiring, holding, or disposing of real and personal property used in the cooperative or joint undertaking.

   f. The acceptance of gifts, grants, or other assistance and the manner in which those gifts, grants, or assistance may be used for the purposes set forth in the agreement.

   g. The process to apply for federal or state aid, or funds from other public and private

sources, to the parties for furthering the purposes of the agreement.

h. The manner of responding for any liability that might be incurred through performance of the agreement and insuring against that liability.

i. Any other necessary and proper matters agreed upon by the parties to the agreement.

2. Any county, city, township, city park district, school district, or other political subdivision of this state may enter into an agreement in the manner provided in subsection 1 with any agency, board, or institution of the state for the undertaking of any power or function which any of the parties is permitted by law to undertake. Before an agreement entered into pursuant to this subsection is effective, the respective governing body or officer of the state agency, board, or institution must approve the agreement and the attorney general must determine that the agreement is legally sufficient.

3. An agreement made pursuant to this chapter does not relieve any political subdivision or the state of any obligation or responsibility imposed by law except to the extent of actual and timely performance by a separate administrative or legal entity created by the agreement. This actual and timely performance satisfies the obligation or responsibility of the political subdivision.

Thus, as defined by N.D.C.C. § 54-40.3-01, a cooperative or joint administration agreement relating to regulating concentrated animal feeding operations may contain the following elements:

1. The purpose of the agreement;

2. The duration of the agreement and procedure for termination;

3. The organization, composition and nature of its administering board;

4. Budget and financing;

5. Location and who will own or lease the property, if needed;

6. How to handle gifts, grants or other assistance, if needed or relevant;

7. The process to apply for federal or state aid, or other funds, if relevant;

8. Liability and insurance; and

9. Any other necessary and proper matters agreed upon by the parties to the agreement.

This ordinance was adopted by the Renville County Board of Commissioners on July 23, 2002.

Susan A. Ritter
Renville County Auditor

CHAPTER 33-16-03.1
CONTROL OF POLLUTION FROM ANIMAL FEEDING OPERATIONS

33-16-03.1-01. Authority. The North Dakota state department of health has been authorized to provide and administer this chapter relating to the control of pollution from animal feeding operations under the provisions of North Dakota Century Code section 61-28-04.

History: Effective December 1, 2004.
General Authority: NDCC 61-28-04
Law Implemented: NDCC 61-28-04

33-16-03.1-02. Scope and purpose. This chapter establishes procedures governing the application for, and the issuance, denial, modification, and revocation of, permits for animal feeding operations to maintain beneficial uses of and prevent degradation of quality of the waters of the state.

History: Effective December 1, 2004.
General Authority: NDCC 61-28-04
Law Implemented: NDCC 61-28-04

33-16-03.1-03. Definitions. As used in this chapter, unless the context otherwise indicates:

1. "Animal feeding operation" means a lot or facility, other than an aquatic animal production facility, where the following conditions are met:

   a. Animals, other than aquatic animals, have been, are, or will be stabled or confined and fed or maintained for a total of forty-five days or more in any twelve-month period; and

   b. Crops, vegetation, forage growth, or post-harvest residues are not sustained in the normal growing season over any portion of the lot or facility.

2. "Bedding material" means an absorbent substance applied to dirt or concrete flooring systems, including wood shavings, wood chips, sawdust, shredded paper, cardboard, hay, straw, hulls, sand, and other similar, locally available materials.

3. "Best management practices" means schedules of activities, prohibitions of practices, conservation practices, maintenance procedures, and other management strategies to prevent or reduce the pollution of waters of the state. Best management practices also include treatment requirements, operating procedures, and practices to control production area and land application area runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage.

4. "Concentrated animal feeding operation" means an animal feeding operation that is defined as a large concentrated animal feeding operation, as a medium concentrated animal feeding operation, or is a small or other type of animal feeding operation designated as a concentrated animal feeding operation in accordance with section 33-16-03.1-04. For purposes of determining animal numbers, two or more feeding operations under common ownership are considered to be a single animal feeding operation if they adjoin each other or if they use a common area or system for the disposal of wastes. All concentrated animal feeding operations are required to obtain a North Dakota pollutant discharge elimination system permit pursuant to chapter 33-16-01.

5. "Department" means the North Dakota state department of health.

6. "Discharge of a pollutant" and "discharge of pollutants" each means any addition of any pollutant to the waters of the state from any source, including the disposal of pollutants into wells.

7. "Earthen storage pond" or "pond" means a topographic depression either below or above ground level, manmade excavation, or diked area formed primarily of earthen materials, although it may be lined with manmade materials or other seepage control materials, and used to store manure or process wastewater and runoff from the production area of a livestock facility.

8. "Engineer" means a professional engineer registered to practice in the state of North Dakota.

9. "Facility or livestock facility" has the same meaning as animal feeding operation or concentrated animal feeding operation.

10. "General permit" means a general North Dakota pollutant discharge elimination system permit or a general state animal feeding operation permit. This is a permit issued to cover multiple facilities of the same

or similar type, without requiring each facility to be covered under an individual permit.

11. "Large concentrated animal feeding operation" means any animal feeding operation that stables or confines as many as or more than the numbers of animals specified in any of the following categories:

    a. Seven hundred mature dairy cows, whether milked or dry;

    b. One thousand veal calves;

    c. One thousand cattle other than mature dairy cows or veal calves. For purposes of this subdivision, "cattle" includes heifers, steers, bulls, and cow-calf pairs;

    d. Two thousand five hundred swine, each weighing fifty-five pounds [24.95 kilograms] or more;

    e. Ten thousand swine, each weighing less than fifty-five pounds [24.95 kilograms];

    f. Five hundred horses;

    g. Ten thousand sheep or lambs;

    h. Fifty-five thousand turkeys;

    i. Thirty thousand laying hens or broilers, if the animal feeding operation uses a liquid manure handling system;

    j. One hundred twenty-five thousand chickens, other than laying hens, if the animal feeding operation uses other than a liquid manure handling system;

    k. Eighty-two thousand laying hens, if the animal feeding operation uses other than a liquid manure handling system;

    l. Thirty thousand ducks, if the animal feeding operation uses other than a liquid manure handling system; or

    m. Five thousand ducks, if the animal feeding operation uses a liquid manure handling system.

12. "Litter" means a mixture of fecal material, urine, animal bedding material, and sometimes waste feed.

13. "Manure" or "livestock manure" means fecal material and urine, animal-housing wash water, bedding material, litter, compost, rainwater,

or snowmelt that comes in contact with fecal material and urine, and raw or other materials commingled with fecal material and urine or set aside for disposal.

14. "Manure handling system" means all of the water pollution control structures used at the production area of a livestock facility.

15. "Manure storage pond" means an earthen storage pond that stores liquid manure and process wastewater from indoor confined animal feeding operations.

16. "Manure storage structure" means any water pollution control structure used to contain or store manure or process wastewater. It includes earthen manure storage ponds; runoff ponds; concrete, metal, plastic, or other tanks; and stacking facilities.

17. "Medium animal feeding operation" means any animal feeding operation that stables or confines the numbers of animals specified within any of the following ranges:

    a. Two hundred to six hundred ninety-nine mature dairy cows, whether milked or dry;

    b. Three hundred to nine hundred ninety-nine veal calves;

    c. Three hundred to nine hundred ninety-nine cattle other than mature dairy cows or veal calves. For purposes of this subdivision, "cattle" includes heifers, steers, bulls, and cow-calf pairs;

    d. Seven hundred fifty to two thousand four hundred ninety-nine swine, each weighing fifty-five pounds [24.95 kilograms] or more;

    e. Three thousand to nine thousand nine hundred ninety-nine swine, each weighing less than fifty-five pounds [24.95 kilograms];

    f. One hundred fifty to four hundred ninety-nine horses;

    g. Three thousand to nine thousand nine hundred ninety-nine sheep or lambs;

    h. Sixteen thousand five hundred to fifty-four thousand nine hundred ninety-nine turkeys;

    i. Nine thousand to twenty-nine thousand nine hundred ninety-nine laying hens or broilers, if the animal feeding operation uses a liquid manure handling system;

    j. Thirty-seven thousand five hundred to one hundred twenty-four thousand nine hundred ninety-nine chickens, other than laying

hens, if the animal feeding operation uses other than a liquid manure handling system;

k. Twenty-five thousand to eighty-one thousand nine hundred ninety-nine laying hens, if the animal feeding operation uses other than a liquid manure handling system;

l. Ten thousand to twenty-nine thousand nine hundred ninety-nine ducks, if the animal feeding operation uses other than a liquid manure handling system; or

m. One thousand five hundred to four thousand nine hundred ninety-nine ducks, if the animal feeding operation uses a liquid manure handling system.

18. "Medium concentrated animal feeding operation" means a medium animal feeding operation that meets either one of the following conditions:

a. Pollutants are discharged into waters of the state through a manmade ditch, flushing system, or other similar manmade device; or

b. Pollutants are discharged directly into waters of the state which originate outside of and pass over, across, or through the facility or otherwise come into direct contact with the animals confined in the operation.

19. "North Dakota pollutant discharge elimination system permit" means the permit issued by the department pursuant to chapter 33-16-01 to a concentrated animal feeding operation that the department has determined will not cause, nor likely cause, pollution to waters of the state.

20. "Nutrient management plan" means a written description of the equipment, methods, and schedules by which:

a. Manure, litter, and process wastewater is beneficially reused in an environmentally safe manner such as being applied to land at appropriate agronomic rates as nutrients or fertilizers; and

b. Water pollution and air pollution, including odors, are controlled sufficiently to protect the environment and public health.

21. "Open lot" means livestock pens, feeding, or holding areas at the production area of an animal feeding operation which are outside and not under roof, and where rain can fall directly on the lot area.

22. "Open manure storage structure" means an earthen pond or storage tank for holding liquid manure which is not covered so rainfall can fall directly into the pond or tank.

23. "Operation and maintenance plan" means a written description of the equipment, methods, and schedules for:

a. Inspection, monitoring, operation, and maintenance of the animal feeding operation, including manure storage structures, water pollution control structures, and the production area; and

b. Controlling water pollution and air pollution, including odors, sufficient to protect the environment and public health.

It includes emergency response actions for spills, discharges, or failure of a collection, storage, treatment, or transfer component.

24. "Operator" means an individual or group of individuals, partnership, corporation, joint venture, or any other entity owning or controlling, in whole or in part, one or more animal feeding operations.

25. "Overflow" means the discharge of manure or process wastewater resulting from the filling of wastewater or manure storage structures beyond the point at which no more manure, process wastewater, or storm water can be contained by the structure.

26. "Pollutant" means wastes as defined in North Dakota Century Code section 61-28-02, including dredged spoil, solid waste, incinerator residue, garbage, sewage, sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt, and industrial, municipal, and agricultural waste discharged into water.

27. "Process wastewater" means water directly or indirectly used in the operation of the animal feeding operation for any or all of the following: spillage or overflow from animal or poultry watering systems; washing, cleaning, or flushing pens, barns, manure pits, or other animal feeding operation facilities; direct contact swimming, washing, or spray cooling of animals; or dust control. Process wastewater also includes any water which comes into contact with any raw materials, products, or byproducts, including manure, litter, feed, milk, eggs, or bedding material.

28. "Production area" means those areas of an animal feeding operation used for animal confinement, manure storage, raw materials storage, and waste containment. The animal confinement area includes open lots, housed lots, feedlots, confinement houses, stall barns, free stall barns, milking rooms, milking centers, cattle yards, barnyards, medication pens, walkers, animal walkways, and stables. The manure

storage area includes lagoons, runoff ponds, storage sheds, stockpiles, under-house or pit storages, liquid impoundments, static piles, and composting piles. The raw materials storage area includes feed silos, silage bunkers, and bedding materials. The waste containment area includes settling basins, areas within berms, and diversions which separate uncontaminated storm water. Also included in the definition of production area is any egg washing or egg processing facility and any area used in the storage, handling, treatment, or disposal of mortalities.

29. "Runoff" means rainwater or snowmelt that comes in contact with manure at an open lot or open manure storage area and, therefore, is defined as manure.

30. "Runoff pond" means an earthen storage pond that is used to collect and store runoff from an open lot or from a manure storage area.

31. "Seepage" means the volume of flow through a manure storage structure.

32. "Sensitive ground water area" means vulnerable hydrogeologic settings as determined by the department such as glacial outwash deposits or alluvial or aeolian sand deposits that are critical to protecting current or future underground sources of drinking water. Areas designated as sensitive ground water areas by the department include alluvial or aeolian sand deposits shown on Geologic Map of North Dakota (Clayton, 1980, North Dakota geological survey) and glacial drift aquifers listed in North Dakota Geographic Targeting System for Groundwater Monitoring (Radig, 1997, North Dakota state department of health), or most recent editions of these publications, with DRASTIC scores greater than or equal to 100 based on methodology described in DRASTIC: A Standardized System for Evaluating Groundwater Pollution Potential (Aller et al., 1987, United States environmental protection agency).

33. "Small animal feeding operation" means any animal feeding operation that stables or confines less than the numbers of animals specified for a medium animal feeding operation.

34. "Small concentrated animal feeding operation" means any animal feeding operation that stables or confines less than the numbers of animals specified for a medium animal feeding operation and is designated as a concentrated animal feeding operation in accordance with section 33-16-03.1-04.

35. "State animal feeding operation permit" means a permit issued by the department pursuant to this chapter to an animal feeding operation that the department has determined will not cause, nor likely cause, pollution to waters of the state.

36. "Surface water" means waters of the state that are located on the ground surface, including all streams, lakes, ponds, impounding reservoirs, marshes, watercourses, waterways, and all other bodies or accumulations of water on the surface of the earth, natural or artificial, public or private.

37. "Unconfined glacial drift aquifer" means a glacial drift aquifer that does not have an impervious soil layer which acts to prevent or minimize movement of water into, through, or out of the aquifer.

38. "Water pollution control structure" means a structure built or used for handling, holding, transferring, or treating manure or process wastewater, so as to prevent it from entering the waters of the state. The term also includes berms, ditches, or other structures used to prevent clean water from coming in contact with manure.

39. "Water quality standards" means the water quality standards contained in chapter 33-16-02.1.

40. "Waters of the state" means all waters within the jurisdiction of this state, including all streams, lakes, ponds, impounding reservoirs, marshes, watercourses, waterways, and all other bodies or accumulations of water on or under the surface of the earth, natural or artificial, public or private, situated wholly or partly within or bordering upon the state, except those private waters that do not combine or effect a junction with natural surface or underground waters just defined.

History: Effective December 1, 2004.
General Authority: NDCC 61-28-04
Law Implemented: NDCC 61-28-04

33-16-03.1-04. Designation of concentrated animal feeding operations.

1. The department may designate any animal feeding operation as a concentrated animal feeding operation upon determining that it is a significant contributor of pollutants to waters of the state. In making this designation, the department shall consider the following factors:

   a. The size of the animal feeding operation and the amount of wastes reaching waters of the state;

   b. The location of the animal feeding operation relative to waters of the state;

   c. The means of conveyance of animal wastes, manure, and process wastewater into waters of the state; and

d. The slope, vegetation, rainfall, and other factors affecting the likelihood or frequency of discharge of animal wastes, manure, and process wastewater into waters of the state.

2. No medium or small animal feeding operation shall be designated a concentrated animal feeding operation under this section unless the department has conducted an onsite inspection of the operation and determined that the operation should and could be regulated under chapter 33-16-01. In addition, no small animal feeding operation with numbers of animals below those established in subsection 17 of section 33-16-03.1-03 may be designated as a concentrated animal feeding operation unless:

   a. Pollutants are discharged into waters of the state through a manmade ditch, flushing system, or other similar manmade device; or

   b. Pollutants are discharged directly into waters of the state which originate outside the facility and pass over, across, or through the facility or otherwise come into direct contact with the animals confined in the operation.

History: Effective December 1, 2004.
General Authority: NDCC 61-28-04
Law Implemented: NDCC 61-28-04

33-16-03.1-05. Operations requiring a permit. The operator of an animal feeding operation shall apply for a permit as follows:

1. Any animal feeding operation that has been defined as a concentrated animal feeding operation in section 33-16-03.1-03 or designated a concentrated animal feeding operation under section 33-16-03.1-04 must obtain a North Dakota pollutant discharge elimination system permit pursuant to chapter 33-16-01.

2. Any medium animal feeding operation where manure or process wastewater from the operation causes or is likely to cause water pollution or those that are located within one-fourth mile [.40 kilometer] of a stream or surface water that contains water, except for infrequent periods of severe drought, must apply for a state animal feeding operation permit pursuant to this chapter or a "no potential to pollute" determination pursuant to section 33-16-03.1-06. Waters completely contained on an owner's property and which do not combine or effect a junction with natural surface or underground waters are not included.

3. A small animal feeding operation shall apply for a state animal feeding operation permit pursuant to this chapter when the department has determined that manure or process wastewater from the operation causes or is likely to cause water pollution.

4. An animal feeding operation which stables or confines animals, other than the types of animals specified in the definition of medium animal feeding operation, shall apply for a state animal feeding operation permit pursuant to this chapter when the department has determined that manure or process wastewater from the operation causes or is likely to cause water pollution.

History: Effective December 1, 2004.
General Authority: NDCC 61-28-04
Law Implemented: NDCC 61-28-04

33-16-03.1-06. No potential to pollute determination.

1. The department, upon request, may make a case-specific determination that a livestock facility that is not a concentrated animal feeding operation has no potential to discharge pollutants to waters of the state and does not require a state animal feeding operation permit. The department shall review the determination at least every five years.

2. The department retains the authority to subsequently require a state animal feeding operation permit if circumstances at the facility change, if new information becomes available, or if there are other reasons for the department to determine that the operation has a potential to discharge pollutants into waters of the state.

3. No potential to pollute means the facility is located where there is:

   a. No discharge of pollutants to ground water and no discharge of pollutants to surface water from a rainfall event that is less than or equal to a twenty-five-year, twenty-four-hour rainfall event; and

   b. The facility follows a nutrient management plan for the utilization of manure and process wastewater that is consistent with this chapter.

History: Effective December 1, 2004.
General Authority: NDCC 61-28-04
Law Implemented: NDCC 61-28-04

33-16-03.1-07. Permit application content and procedures.

1. Any new livestock facility or existing livestock facility that is proposing an increase in the number of livestock above the level allowed in the current permit or above the level at which a permit is required under section 33-16-03.1-05 shall apply for and obtain a state animal feeding operation permit or a North Dakota pollutant discharge elimination system permit prior to construction or expansion. Any livestock facility that is proposing to expand the production area, or update or change the manure handling system, and which requires a permit under section 33-16-03.1-05, shall apply for and obtain a state animal feeding

operation permit or a North Dakota pollutant discharge elimination system permit prior to construction.

2. An existing concentrated animal feeding operation shall submit a permit application pursuant to chapter 33-16-01 by February 12, 2006.

3. An existing medium animal feeding operation for which a permit is required as per section 33-16-03.1-05 shall submit a permit application pursuant to this chapter by July 1, 2008, or earlier if requested by the department when concerns of potential or actual pollution of waters of the state are documented.

4. Application forms for state animal feeding operation permits are available from the department. An operator shall furnish information requested by the department that is consistent with this chapter. The department will not process an application unless all of the necessary information is provided. The information within or attached to an application must include the following:

   a. The owner's and operator's name and mailing addresses.

   b. The facility's legal location and mailing address.

   c. A topographic map of the area where the facility is or proposes to be located and showing the specific production area.

   d. Specific information about the number, size, and type of animals proposed for the facility; the number of days per year animals will be handled; and the type of confinement (open or housed under roof).

   e. The type of containment and storage (anaerobic lagoon, roofed storage shed, ponds, under-floor pits, aboveground storage tanks, underground storage tanks, concrete pad, impervious soil pad, water spreading system, other) and total capacity for manure, litter, and process wastewater storage (tons or gallons), or other measures to meet department requirements to prevent discharge of pollutants to waters of the state.

   f. The total number of acres under control of the applicant and available for land application of manure, litter, or process wastewater.

   g. Estimated amounts of manure, litter, and process wastewater generated per year (tons or gallons).

   h. Estimated amounts of manure, litter, and process wastewater transferred to other persons per year (tons or gallons).

   i. Designs, including location, for all manure storage and water pollution control structures and site-specific background information as specified in the North Dakota Livestock Program Design Manual. Design plans developed by anyone other than the facility owner must be signed by the engineer who prepared or supervised the preparation of the plans under North Dakota Century Code chapter 43-19.1.

   j. Site-specific information on topography, surface water, ground water, and soil geology.

   k. A nutrient management plan or information related to a nutrient management plan as specified in subsections 4 and 5 of section 33-16-03.1-08.

   l. The signatures of individuals responsible for the animal feeding operation.

   m. A description of how dead animals will be handled and disposed of by the facility operator.

   In preparing an application, the operator shall follow the North Dakota Livestock Program Design Manual.

   The operator of an existing animal feeding operation may reference any information previously submitted to the department rather than resubmitting it. Existing information shall be updated if changes to the operation have been made since the prior application.

5. Permit conditions. The department may impose any conditions upon a state animal feeding operation permit to ensure proper operation of the facility to protect water and air quality, including:

   a. Sampling, testing, and monitoring at or adjacent to the facility of manure, process wastewater, ground water, or runoff.

   b. Steps to prevent the facility from causing exceedances of water quality standards or air quality standards and to minimize odors during land application of manure.

   c. Recordkeeping and reporting.

   d. Compliance schedules for upgrades at facilities to meet the requirements of this chapter.

6. If the department determines that the animal feeding operation will not cause nor likely cause pollution of waters of the state, either after upgrades are made or at its current status, and the department determines that it is not likely to exceed air quality standards, a

state animal feeding operation permit or a no potential to pollute determination will be issued.

7. If manure storage or water pollution control structures were required at the facility, the operator shall notify the department within thirty days of construction completion and provide certification from an engineer or the designer that construction of manure storage and water pollution control structures was completed according to designs provided with the application or to department-approved changes.

8. The permit shall be valid until its expiration date as long as the animal feeding operation is not materially changed or waters of the state are not impacted pursuant to chapter 33-16-02.1. If an operator plans to change the type or increase the number of animals or change the facility, including expanding barns or pens or changing manure storage or water pollution control structures, the operator shall inform the department in writing prior to implementation of these changes.

9. Expiration of permits. Every state animal feeding operation permit issued by the department shall have a fixed term not to exceed five years.

10. Renewal of permits. One hundred eighty days prior to the expiration of an existing permit, an application for permit renewal shall be submitted to the department for review. If an operator submits a complete application for a permit renewal at least one hundred eighty days prior to the expiration date, but the department, through no fault of the operator, fails to issue a new permit prior to the expiration of the previous permit, the department may extend the expired permit until the permit is reissued. All conditions and stipulations of permits extended under this subsection remain fully effective and enforceable.

11. Transfer of permits. The holder of a state animal feeding operation permit may transfer it by notifying the department in writing at least thirty days in advance of the proposed transfer date. The notice shall include a written agreement between the current and new owners or operators and contain a specific date for the permit transfer and the name and address of the individual responsible for compliance with the permit.

12. General permits. The department may issue a general state animal feeding operation permit covering similar facilities. Any general permit shall comply with all requirements of this chapter and shall identify criteria by which facilities may qualify for the general permit. Facilities that would qualify for a general permit shall apply to the department for coverage under the terms of the general permit. The department may grant a facility's request to construct and operate under a general permit or, at its discretion, issue an individual permit if circumstances warrant.

13. Confidentiality. If the department determines that certain information should be accorded confidential status for reason of being a trade secret, it shall disclose such information to the administrator upon the latter's request. The administrator shall maintain the disclosed information in confidence, unless the administrator determines that such information, if made public, would not divulge methods of processes entitled to protection as trade secrets.

History: Effective December 1, 2004; amended effective January 7, 2005.
General Authority: NDCC 61-28-04
Law Implemented: NDCC 61-28-04

33-16-03.1-08. Facility requirements.

1. A livestock facility requiring a permit under this chapter must be located, designed, built, maintained, and operated to limit or prevent pollution of or the discharge of pollutants into waters of the state consistent with the North Dakota Livestock Program Design Manual, best professional judgment, best management practices, and pursuant to the requirements of North Dakota Century Code chapter 61-28, this chapter, and the facility's state animal feeding operation permit.

2. All concentrated animal feeding operations must be located, designed, built, maintained, and operated to limit or prevent pollution of or the discharge of pollutants into waters of the state consistent with the North Dakota Livestock Program Design Manual, best professional judgment, best management practices, and pursuant to the requirements of North Dakota Century Code chapter 61-28, North Dakota Administrative Code chapter 33-16-01, this chapter, and the operation's North Dakota pollutant discharge elimination system permit.

3. Nutrient management plan. A nutrient management plan must be developed and a copy maintained onsite by the owner or operator of any livestock facility that land applies manure, litter, or process wastewater to cropland or grassland and is required to obtain a permit or a no potential to pollute determination pursuant to this chapter or chapter 33-16-01. These facilities must land apply manure litter or process wastewater in accordance with the current properly developed nutrient management plan. At a minimum the nutrient management plan must contain the following information:

   a. Description of the land to which an operator has access for applying manure or process wastewater, or both, and adequate information to demonstrate that manure or process wastewater, or both, will be applied at agronomic rates. The agronomic rate for nitrogen must not exceed the plant utilization rate for the cropping year. Phosphorous must not be applied at rates exceeding the recommendations based on either the North Dakota phosphorous index, the North Dakota state university extension

service soil tests, or other risk assessment methods approved by the department.

b. The proposed method and timing of land application of manure and process wastewater.

c. The precautions that will be taken to:

(1) Prevent manure and process wastewater from reaching waters of the state or areas where they have the potential to impact waters of the state; and

(2) Minimize odors to residences and public areas where people are present during transport and land application of manure.

d. Other information specified in the North Dakota Livestock Program Design Manual.

4. Of the facilities identified in subsection 3, the following facilities must submit a copy of their current nutrient management plans to the department along with their application or design, or both, plans:

a. Concentrated animal feeding operations;

b. Livestock facilities that plan to apply manure on frozen ground;

c. Livestock facilities with land that is designated for manure application and which also has soil phosphorous levels that meet or exceed the very high levels for crop production based on North Dakota state university extension service information;

d. Livestock facilities that daily haul and land apply manure; and

e. Livestock facilities that fail to comply with these rules or permit conditions.

5. Livestock facilities identified in subsection 3, which do not meet conditions in subsection 4, must submit to the department, along with their application or design, or both, plans, the following information:

a. An indication that the facility has a nutrient management plan that meets the department requirements;

b. The name of the individual who developed the nutrient management plan and the organization with which that individual is affiliated;

c. The amount of land available for land application of manure;

d. The type of crops or vegetation grown on this land;

e. The typical manure application rate for each crop or vegetation grown;

f. The method and timing of application;

g. The precautions used to prevent manure from reaching waters of the state; and

h. The precautions, if needed, used to minimize odors to residences and public areas where people are present during transport and land application of manure.

6. Manure storage structures. All livestock facilities requiring permits under chapter 33-16-01 and this chapter, which are constructed or expanded after the effective date of the respective rule, must meet the following requirements:

a. All facilities regulated under this chapter shall have manure storage structures designed and constructed to store runoff from a twenty-five-year, twenty-four-hour rainfall event, except swine, chicken, turkey, and veal calf facilities which shall be designed and constructed to store runoff from a one hundred-year, twenty-four-hour rainfall event. In addition, all facilities shall collect and store all manure, process wastewater, and runoff for a minimum of two hundred seventy days. Overflows from a properly operated manure storage structure due to a chronic or catastrophic rainfall event in excess of those specified or seepage from the storage structure that is within the standards as specified in the North Dakota Livestock Program Design Manual are not considered violations of this chapter.

b. A ground water site assessment is required for all manure storage structures.

c. All manure storage structures must be designed and maintained to withstand natural forces, to prevent impacts to waters of the state, and minimize seepage.

d. All earthen storage ponds shall have a properly designed and constructed liner to minimize seepage, unless the department has determined a liner is not necessary based on site conditions.

e. Other manure storage structure requirements specified in the North Dakota Livestock Program Design Manual must be met.

f. The department may specify additional design or monitoring requirements as needed to ensure facilities will satisfactorily prevent pollution to waters of the state.

7. Liquid storage facilities. All livestock facilities requiring permits under this chapter and all concentrated animal feeding operations requiring permits under chapter 33-16-01 which store liquid manure, process wastewater, or manure-contaminated runoff must meet the following requirements:

   a. New facilities, expanding facilities significantly increasing their number of livestock, or those facilities that have not housed livestock within five years must not be located over an unconfined glacial drift aquifer unless approved by the department.

   b. All livestock facilities requiring permits under chapter 33-16-01 or this chapter, which are constructed or expanded after the effective date of the respective rule, must be designed by the facility owner or designed by or under the direct supervision of an engineer. If designed by an engineer, all final drawings, specifications, plans, reports, or other engineering documents, when issued, shall be signed by the engineers or land surveyors who supervised the preparation of these documents under North Dakota Century Code chapter 43-19.1. After construction completion, an engineer or the designer shall certify that the construction was completed according to the design plan.

   c. Other requirements specified in the North Dakota Livestock Program Design Manual.

8. Odor management. An operator shall manage a facility to minimize the impact of odors on neighboring residents and public areas and comply with the odor requirements of North Dakota Century Code section 23-25-11, North Dakota Administrative Code chapter 33-15-16, and the North Dakota Livestock Program Design Manual.

9. Best management practices. An operator of a livestock facility requiring a permit under this chapter or a concentrated animal feeding operation requiring a permit under chapter 33-16-01 is responsible for applying best management practices to ensure compliance with the requirements of this chapter and the permit and to prevent pollution of waters of the state. The best management practices used must be included in the design plans or in the nutrient management plan.

10. Additional requirements which the department may require for livestock facilities requiring permits under this chapter and concentrated animal feeding operations requiring permits under chapter 33-16-01. The department may:

   a. Require the operator to install and collect routine samples from monitoring wells to ensure that potentially usable ground water resources are not adversely impacted.

   b. Require odor control for manure storage and livestock housing areas and require steps to minimize odors to residences or public areas during transport and land application of manure.

   c. Based on site-specific conditions, specify additional design or monitoring requirements as needed to ensure the facility will satisfactorily prevent pollution of waters of the state.

History: Effective December 1, 2004; amended effective January 7, 2005.
General Authority: NDCC 61-28-04
Law Implemented: NDCC 61-28-04

33-16-03.1-09. Recordkeeping and reporting requirements.

1. The operator of a livestock facility requiring a permit under this chapter shall record and maintain the following for a period of not less than three years:

   a. Any sampling, testing, and monitoring results as required by this chapter or by the department;

   b. Maintenance and inspection records for water pollution control structures;

   c. Reports and data required by this chapter, the North Dakota Livestock Program Design Manual, and the permit; and

   d. A copy of this permit.

   The department may request an extension of the record retention period if a facility has failed to comply with these rules or permit conditions or during the course of any unresolved litigation regarding the discharge of pollutants by the operation. The information shall be provided to department representatives upon request. A concentrated animal feeding operation must keep records as required under chapter 33-16-01.

2. Reports shall be submitted to the department in accordance with the schedule prescribed and on the appropriate forms supplied by the department or in a manner specified by the department if required as a condition of the state animal feeding operation permit or the North Dakota pollutant discharge elimination system permit for concentrated animal feeding operations or based on site-specific conditions. Information requested may include sampling, testing, and monitoring

results; maintenance and inspection records; records related to facility operation; or nutrient management plan information or records.

History: Effective December 1, 2004; amended effective January 7, 2005.
General Authority: NDCC 61-28-04
Law Implemented: NDCC 61-28-04

33-16-03.1-10. Enforcement and compliance.

1. The department shall evaluate all reports, notifications, and data submitted by an operator in compliance with this chapter and the state animal feeding operation permit. The department shall investigate all apparent violations for possible enforcement action pursuant to North Dakota Century Code section 61-28-08.

2. No person may knowingly make a false statement, representation, or certification in any application, record, report, plan, or other document filed or required under this chapter or the permit. No person may knowingly falsify, tamper with, or provide inaccurate information regarding a monitoring well or other device required under this chapter or the permit.

3. Operators of permitted facilities that are not operating properly shall update those facilities to achieve compliance with this chapter and the conditions of the permit within a timeframe approved by the department.

4. If the department finds that a facility, which has not been covered by a state animal feeding operation permit or a North Dakota pollution discharge elimination system permit within the last five years, is causing or is likely to cause pollution of waters of the state, or poses a significant threat to public health or safety, the operator will be notified that actions shall be taken to prevent the pollution.

5. Within one hundred twenty days following the notification described in subsection 4, the operator shall submit a compliance plan to prevent the facility from impacting waters of the state.

   a. The compliance plan shall be prepared in accordance with the minimum requirements of this chapter and the North Dakota Livestock Program Design Manual. The plan shall contain adequate information to enable the department to determine whether the proposed measures will abate or prevent pollution of waters of the state. The operator also shall present a proposed schedule for plan implementation and completion.

   b. If the compliance plan allows for operation of the facility in a manner that will not cause nor likely cause pollution of waters of the state, the department will issue a permit with a compliance schedule for construction. Approval of the permit shall be contingent upon any

changes which may be required by the department after its review of the proposed plan. The construction must be completed within the timeframe specified in the compliance schedule.

   c. If the approved compliance plan needs to be modified or amended during construction, the operator shall notify the department prior to making any modifications or amendments and they must be approved by the department.

6. If the department revokes a state animal feeding operation permit for cause, the operator can finish feeding the animals for up to one hundred twenty days from the date of revocation, provided public and environmental health are not threatened. The operator will not be allowed to bring any other animals into the facility until the requirements of the permit, this chapter, and the North Dakota Livestock Program Design Manual have been met as approved by the department.

History: Effective December 1, 2004.
General Authority: NDCC 61-28-04
Law Implemented: NDCC 61-28-04

33-16-03.1-11. Departmental inspection. Authorized representatives of the department may request access to a facility site under authority of North Dakota Century Code section 61-28-04. The owner or operator of a livestock facility may request to see the representatives' credentials. Authorized representatives of the department shall be allowed:

1. To enter the facility site or area in which any records required to be kept under terms and conditions of the permit are stored;

2. To have access to and copy any records required to be kept under terms and conditions of the permit;

3. To inspect any monitoring equipment or water pollution control structures at the facility; or

4. To sample any discharge of pollutants.

The department representatives will abide by all security measures implemented by the owner or operator to protect the health and safety of the workers and the animals at the facility.

History: Effective December 1, 2004.
General Authority: NDCC 61-28-04
Law Implemented: NDCC 61-28-04

33-16-03.1-12. Prohibited activities. It shall be unlawful for any person:

1. To feed any livestock on the ice cover of streams or lakes.

2. To create or maintain an immediate threat to human, public, or environmental health.

3. To dispose of an animal carcass along or in any stream, lake, river, or other surface water; to bury the carcass near any such surface water; to dispose of a carcass in an area that will discharge into waters of the state; to dispose of a carcass in any structure used to store or treat liquid manure, process wastewater, or storm water unless the department-approved system is designed for such a purpose; or to dispose of a carcass in a manner that is in violation of North Dakota Administrative Code article 33-20 or North Dakota Century Code chapter 36-14.

4. To cause pollution of waters of the state or to place or cause to be placed any wastes in a location where they are likely to cause pollution of waters of the state.

5. To discharge any pollutants into waters of the state thereby reducing the quality so as not to comply with the water quality standards established by the department, except facilities that are in compliance with subsection 6.

6. To discharge manure or process wastewater from a livestock facility except:

   a. The overflow of a properly operated manure storage structure due to a chronic or catastrophic rainfall greater than a twenty-five-year, twenty-four-hour event or greater than a one hundred-year, twenty-four-hour event for swine, chicken, turkey, or veal calf facilities; or

   b. Seepage from the manure storage structures that is within the standards as specified in the North Dakota Livestock Program Design Manual.

History: Effective December 1, 2004.
General Authority: NDCC 61-28-04
Law Implemented: NDCC 61-28-04

33-16-03.1-13. Public participation.

1. If the department determines a significant degree of public interest exists regarding new or expanding facilities, it shall issue a public notice requesting comment on applications for both individual permits and general state animal feeding operation permits.

2. The department shall provide a period of not less than thirty days during which time interested persons may submit comments. The period of comment may be extended at the discretion of the department.

3. The public notice must be placed in the official county newspaper or other daily or weekly newspaper circulated in the area of the proposed animal feeding operation. In the case of draft general permits, the public notice will be placed in applicable official county newspapers. The department may also use any other reasonable means to provide the public notice information to parties potentially affected.

4. The public notice must include at least the following:

   a. Name, address, and telephone number of the agency issuing the public notice.

   b. Name and address of the applicant and a brief description of the application information, including the proposed location of the facility. The exception would be draft general permits for which there is no specific applicant.

   c. The date, time, and location of any scheduled public meeting or hearing.

   d. An explanation of how to view or obtain materials (e.g., copy of design plans) related to the application and the department's review.

   e. An explanation of how to submit comments.

5. The department shall send copies of the public notice to the applicant and to local governmental entities which have jurisdiction over the area where the facility is located or is proposed to be located.

6. The department shall hold a public meeting or hearing as it deems appropriate to allow additional public input or to provide information to the public concerning the department's review of the facility.

7. In making its final decision on the application or draft permit, the department shall consider all comments submitted within a timeframe specified in the public notice and all comments received at any public hearing. Within twenty days of the close of the public comment period, the applicant, if any, may submit a written response to the public comments. The department shall consider the applicant's response in making its final decision.

8. Pursuant to the requirements of this chapter and within sixty days of the applicant's response to the public comments, the department shall make a final determination as to whether the permit should be approved, approved with conditions, or denied.

9. The department shall notify the applicant in writing of its final determination and provide to the applicant a copy of the final permit,

if issued. Upon request, other interested individuals may also obtain copies of the final permit.

10. Once finalized, information on general permits and their availability must be provided to potentially eligible or affected facilities.

History: Effective December 1, 2004; amended effective January 7, 2005.
General Authority: NDCC 61-28-04
Law Implemented: NDCC 61-28-04

HISTORY OF

THE DEVELOPMENT

OF A MODEL ZONING ORDINANCE

FOR ANIMAL FEEDING OPERATIONS

Final

March 2000

NORTH DAKOTA DEPARTMENT OF HEALTH
Murray Sagsveen, State Health Officer
Francis Schwindt, Environmental Health Section Chief
P.O. Box 5520
Bismarck, North Dakota 58506-5520

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FOREWORD

This report was prepared pursuant to Executive Order 1999-03, which indicates that "The Department of Health shall report to my office, [the] progress, status and successes of implementing Senate Bill 2355." It provides information on the history of the formation of a Work Group assembled to develop a model zoning ordinance for animal feeding operations. It describes the process by which the work group was assembled, the outcome of meetings of the work group and the outcome of a subcommittee of volunteers who prepared a draft handbook for the model zoning ordinance.

The department appreciates the contributions of members of the work group and its sub-committee; specifically, the sharing of concerns and constructive comments during meetings was instrumental in improving an understanding of the issues surrounding the livestock industries and land use administration by local government.

The work product of the work group is a report titled "A Model Zoning Ordinance for Animal Feeding Operations."

BACKGROUND

Since statehood, agriculture has been the primary industry in North Dakota and a primary part of the state's economic base. North Dakota's livestock industry has been an essential component of North Dakota's agricultural economy and important to the viability of many rural communities.

In recent years, domestic and export market forces and technological changes have caused substantial changes in the nation's animal production industries. These factors have prompted expansion of confined animal production and feeding operations because of their advantages in economics of scale and ability to adopt the new technologies. The growth of larger operations has resulted in larger quantities of manure and wastewater on some watersheds and the separation of animal production and feeding operations.

In the past, North Dakota's livestock industry has primarily involved cow-calf operations and other similar livestock production, rather than the large-scale feeding and finishing operations. Other states have been wrestling with the environmental and zoning issues of large operations for the past decade. Difficulties in locating two large-scale hog production facilities, one in the southwest corner of the state and the other in the northeast corner, raised in North Dakota the issue of how and where to locate such large animal feeding operations. Litigation involving the second, the EnviroPork facility, resulted in the introduction of legislation in the 1999 legislative session. After much negotiation and many drafts, the Legislative Assembly passed Senate Bills 2355 and 2365 to limit and guide political subdivisions and the Department of Health in regulating the larger animal feeding operations.

More specifically, SB 2355 amended NDCC chapters 11-33 and 58-03 with similar language pertaining to the zoning authority granted to counties and townships, respectively. The amendments concerning county zoning state, in part:

2. A board of county commissioners may regulate the nature and scope of concentrated feeding operations permissible in the county; however, if a regulation would impose a substantial economic burden on a concentrated feeding operation in existence before the effective date of the regulation, the board of county commissioners shall declare that the regulation is ineffective with respect to any concentrated feeding operation in existence before the effective date of the regulation.

3. A regulation may not preclude the development of a concentrated feeding operation in the county. A regulation addressing the development of a concentrated feeding operation in the county may set reasonable standards, based on the size of the operation, to govern its location.

4. For purposes of this section, "concentrated feeding operation" means any livestock feeding, handling, or holding operation, or feed yard, where animals are concentrated in an area that is not normally used for pasture or for growing crops and in which animal wastes may accumulate, or in an area where the space per animal unit is less than six hundred square feet [55.74 square meters]. The term does not include normal wintering operations for cattle. For purposes of this section, "livestock" includes beef cattle, dairy cattle, sheep, swine, poultry, horses, and fur animals raised for their pelts.

5. A board of county commissioners may not prohibit, through regulation, the reasonable diversion or expansion of a farming or ranching operation.

Within one week of signing SB 2355, Governor Edward T. Schafer issued Executive Order 1999-03. This order states, in part:

1. The Department of Health shall monitor implementation of Senate Bill 2355, and take steps reasonably necessary to protect the environment of the state of North Dakota, according to its responsibilities under law; and

2. The Department shall establish a working group with interested political subdivisions, or their associations to develop model zoning regulations for the subdivisions to implement as they deem appropriate; and

3. The Department of Health shall report to my office, progress, status and successes of implementing Senate Bill 2355.

The department's role was that of a facilitator in arranging for the work group and conducting its meetings.

THE AFO WORK GROUP

The department arranged for membership on the work group by contacting the North Dakota Association of Counties the North Dakota League of Cities, and the North Dakota Township

Officers' Association. Each of the three associations was invited to designate three representatives for the work group.

The North Dakota Association of Counties responded by designating three individuals; the North Dakota League of Cities named about five candidates, and the department contacted two for the work group; and the Township Officers Association named its secretary. The department, after making some inquires and having been informed by the Ward County Land Use Administrator that the county had recently updated its comprehensive land use plan, then contacted the chair of the county township officers association, who offered to serve on the work group.

Finally, two producer groups also joined the work group during its first meeting. The members of the work group are listed in the following table.

WORK GROUP MEMBERS	
NAME	**AFFILIATION**
Claus Lembke	Burleigh County Commissioner
Constance Triplett	Grand Forks County Commissioner
Roger Chinn	McKenzie County Commissioner
Jerry Lein	Wahpeton, Director of Public Works
Steve Frovarp *	Hazen, City Planner
Bryan Hoime *	President, ND Township Officers Assoc.
Donny Malcomb	Chair, Ward County Township Officers Assoc.
Wade Moser *	Executive VP, ND Stockmen's Assoc.
Doug Dukart	Milk Producers Association of ND

During the formation of the work group, several other people expressed interest in the project to develop a model zoning ordinance for animal feeding operations. These people were informed of the first meeting of the work group, and they are listed in the following table.

STAKEHOLDERS REQUESTING TO BE KEPT INFORMED OF THE WORK GROUP'S ACTIVITIES	
NAME	**AFFILIATION**
Carl Hokenstad *	City Planner, Bismarck-Burleigh

Carole McMahon	Zoning Administrator, Grand Forks County
Linda Kingery	Planner, Red River Regional Planning Council
Barbara Berge *	Planning & Zoning Director, Morton County
Audrey Boe Olsen *	Consulting Planning, Fortuna
Mark Johnson	Executive Director, ND Association of Counties
Connie Sprynczynatyk	Executive Director, League of ND Cities
Scott Birchall	Carrington Research Extension Center
Carl Altenberndt	Planner, Lake Agassiz Regional Council
Norma Duppler	Planning & Zoning Administrator, Barnes County
Don Siebert	Land Use Administrator, Ward County
Roger Scheibe *	Dairy Commissioner, ND Dept. of Agriculture
Charlotte Meier	Executive Director, ND Pork Producers
Dave Muehler	ND Turkey Federation
Brian Kramer	ND Farm Bureau
April Fairfield	Public Policy Analyst, ND Farmers Union
Brad Stevens	Energy & Environmental Research Center
Isis Stark or Mark Trechock *	Dakota Research Council

FIRST MEETING OF THE WORK GROUP

In preparation for the first meeting of the work group, the department assembled information into a three-ring binder for each member of the work group. This information pertained to the following topics: background for formation of the work group, local zoning laws, results of a survey of county auditors or land use administrators and results of a survey of livestock producers about manure management practices, a report by the National Association of Counties on the role of counties pertaining to animal feeding operations,[1] the North Dakota livestock rules (NDAC chapter 33-16-03), reports of two studies of the odors emitted from livestock feeding operations, and examples of ordinances pertaining to livestock feeding operations.

[1] Senate Bill 2355 (1999) used and defined the term "concentrated feeding operation." A substitute term, "animal feeding operation," is used throughout this document and the handbook for the model zoning ordinance. The definition used in these documents for "animal feeding operation' follows the definition given by the Environmental Protection Agency.

The first meeting of the work group on AFO Zoning was held on July 27, 1999. A notice and agenda for the meeting was distributed to everyone listed in the tables above. Several people were invited to present information on the topics of existing animal feeding operations across the state, a survey of operators of existing operations as to their awareness of regulatory requirements and their manure handling practices, the issues of encroachment that might be addressed by zoning, and the experiences of two ongoing zoning proposals.

The first meeting of the work group was a success in bringing together people who were interested in zoning of animal feeding operations, in identifying the guiding factors for developing a model zoning ordinance and in creating a follow-up action. The record of the first meeting was distributed to everyone who had attended the meeting and to others who had expressed an interest the work group's activities as noted above. A portion of this record follows.

HIGHLIGHTS OF COMMENTS AND DISCUSSION DURING THE WORK GROUP'S FIRST MEETING

- ✓ land uses are changing; for example, growth and sprawl of larger cities into rural areas is occurring, and it should be anticipated through planning and zoning
- ✓ the zoning concept was originally introduced into law to address nuisance problems between incompatible land uses
- ✓ as farms become fewer and as net returns decrease, family farms are becoming larger
- ✓ size of the animal operation does matter, as larger operations introduce environmental and health concerns due to increased scale of activity usually in confined areas
- ✓ animal feeding operations are changing with improved technologies; some technologies may reduce odor problems
- ✓ the DOH needs to demonstrate to EPA that its "feedlot" program satisfies environmental protection criteria to maintain program delegation; a strong state program tuned into local circumstances provides the DOH with the ability to make such demonstration
- ✓ duplication among state, county and township rules and ordinances should be avoided
- ✓ a significant portion of existing producers lack an awareness of rule requirements and another significant portion have not been permitted by the DOH, thus would not be in compliance with rules
- ✓ one out-of-state local jurisdiction provides information to developers of new property in rural areas which alerts these developers of rural activities which create dust, noise, traffic and odor; this approach could be considered in North Dakota
- ✓ 1,348 of about 1,800 townships within the state are organized; some townships in several counties have relinquished zoning authority to the county, but the number which have is unknown
- ✓ agricultural practices, population densities, climate as well as perceived need for zoning control of AFOs vary among local jurisdictions and regions of the state; however, uniformity of adopted ordinances is preferred where possible

- ✓ a joint powers agreement between local jurisdictions is permissible under law and could reduce the administrative and enforcement burdens of an AFO zoning ordinance while also standardizing the ordinance through out a county or broader region
- ✓ zoning emphasis should be on the larger animal feeding operations
- ✓ setbacks should consider the type of animal and the number of animal units
- ✓ a reverse setback issue occurs where residential dwellings are built near an established AFO
- ✓ the goal for completion of a model zoning ordinance is January 1st of next year

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SUMMARY OF SUBCOMMITTEE'S WORK

During the conclusion of the first meeting of the work group, a subcommittee of volunteers was formed to draft a model ordinance. The subcommittee included three members of the work group. As the meetings of the subcommittee were sequentially announced, three additional people by their choosing also joined the meetings of the sub-committee. The names of the persons who participated in the work of the subcommittee are flagged with an asterisk [*] in tables above.

First Meeting - 24 August 1999

Prior to the first meeting of the subcommittee, the department prepared a matrix of issues for consideration by the subcommittee as to merit for inclusion in a draft model ordinance. The matrix was based upon review of issues included in other model, draft or adopted zoning ordinances. Prior to the meeting, the matrix was distributed to the work group, other people who were interested in the actions of the work group, and the subcommittee. The matrix was complex, containing a two-tiered level of potential detail for the model ordinance that could apply to intermediate or larger, respectively, sizes of animal feeding operations.

During the subcommittee's first meeting, it chose to simplify the matrix by narrowing the scope of the issues for the model ordinance, as well as by reducing those issues which could be approached with the two-tiered level of detail. The subcommittee also discussed setbacks and reverse setbacks for odors, coordination of the zoning permitting process with the department's permitting process and merits of cooperative or joint powers agreements. In concluding its first meeting, two members of the subcommittee volunteered to assist the department with assembling an initial draft of the model ordinance.

A significant outcome of this meeting was an agreement on separation distances as setbacks or reverse setbacks between animal feeding operations and other (non-agricultural) land-use development for each of four sizes of animal feeding operations. The four sizes were 300, 1,000, 2,000 and 5,000 animal units. The foundation for the shortest distance, which is one-half mile, was the state odor standard, which had been re-established in the NDCC via 1999

SB 2365. The lower size of 300 then implied a threshold for an initial ordinance draft at which a zoning permit would become necessary.

The state odor standard makes an odor concentration of seven or more odor concentration units a violation of the standard at distances greater than one-half mile. This standard applies to all animal feeding operations, regardless of the type of livestock or the number confined and fed by the operation. Nevertheless, hog operations were assigned larger setbacks due to the nature of odors emitted from them.

An initial draft was assembled, and the department expanded the scope of the document for the model ordinance to include a preamble, zoning law, summary commentary and a bibliography. These additional sections were added in anticipation that this information would be needed by other people to understand the content of the model ordinance. Subsequently, these sections helped facilitate subcommittee discussion.

Second Meeting - 12 October 1999

The materials used by the subcommittee for its second meeting were assembled initial drafts of the sections and the model zoning-ordinance elements for a handbook.

The outcome of the second meeting:

- Resulted in several changes to the preamble and the introductory commentary, which describes zoning law, by adding emphasis on the expanded rights to practice farming and ranching from Senate Bill 2355.
- Resulted in several significant and minor changes to the model ordinance.
- Resulted in the subcommittee taking ownership of the draft document by virtue of the decisions that had occurred.

Third Meeting - 26 October 1999

The third meeting of the subcommittee was a marathon meeting that lasted more than four hours. The outcome of this meeting also resulted in further refining of the wording of the emerging handbook for a model zoning ordinance applicable to animal feeding operations.

A summary of consensus among participants attending the third meeting for aspects of the model ordinance handbook is listed in the following table. Consensus is based upon observation of no expressed and unresolved concerns.

HANDBOOK ELEMENT	CONSENSUS	REMAINING UNRESOLVED CONCERN of ONE or MORE SUBCOMMITTEE MEMBERS
Preamble	yes	
Intro Commentary	yes	
Model Land Use Policy	yes	
Model AFO Ordinance	----	
1. Definitions	yes	
2. Equiv. Animal Num.	yes	
3. Permit Procedures	no	permit process, hinges on AFO size threshold when permit required
4. Ownership Change	no	paperwork, hinges on item #3
5. Operating Change	no	paperwork, hinges on item #3
6. Environmental Protection	yes	
7. Water Resource Setbacks	yes	
8. Odor Setbacks	yes	but, hinges on item #3
-. Closure	omit	issue lacks definition
-. Abandonment	omit	issue lacks definition
9. Enforcement	yes	
10. Severability	yes	
Joint Powers Agreements		detailed narrative not discussed
Closing Commentary		detailed narrative not discussed

Ordinance Applicability.

The subcommittee's third meeting brought into focus those concerns regarding the applicability of the draft for a model ordinance for animal feeding operations. These concerns centered on the size threshold, expressed in animal units, at which operations would be regulated by the model zoning ordinance. Some aspects of the discussion on this issue are described in the "Introductory Commentary" and the "Closing Commentary" for the model ordinance. A summary of the details of the principal aspects of the applicability issue is presented in the Appendix for the benefit of local government officials who might proceed to evaluate, develop and adopt an ordinance.

SECOND MEETING OF THE WORK GROUP

The second meeting of the work group was held on November 30, 1999. A notice for the meeting was distributed to everyone listed in the two tables above. The notice included the subcommittee's draft for an AFO zoning handbook, which contained draft model land-use policies with objectives and a draft model zoning ordinance, as well as a draft of this report.

The ordinance applicability issue described above was reviewed for the meeting participants. A few substantive word changes were made in the model ordinance.

SALIENT COMMENTS DURING THE WORK GROUP'S SECOND MEETING

- ✓ persons planning non-agricultural development in agricultural land-use areas should be expected to know and become aware of livestock producers located nearby, and they should be expected to follow zoning process for obtaining a land-use variance in a delineated agricultural land-use area
- ✓ (existing) livestock producers in agriculturally zoned areas should be protected from encroachment of non-agricultural land-use development without the burden of obtaining zoning permits
- ✓ the typical range-cattle operation has about 75 cows
- ✓ the legislature clearly confined use of zoning ordinances as applied to farming and ranching to the non-normal incidents of farming and ranching
- ✓ most counties have not adopted comprehensive land use plans and, thus, have not delineated agricultural land-use areas; developers there do not need to seek a land-use variance
- ✓ existing livestock producers (AFOs) which are normal practices of farming or ranching should not be required to obtain a zoning permit, unless undertaking a major expansion
- ✓ the permitting process of zoning is needed to document the location and size of AFOs
- ✓ abandoned farm homes are now being repopulated by 'urban' families, who expect urban services
- ✓ one purpose for a the model ordinance is to foster consistent AFO zoning criteria among local governments; however, it can be amended as deemed appropriate for local circumstances; currently, fewer than 10 of the state's counties are considering ordinances for animal feeding operations
- ✓ inventories of existing AFOs by local governments might be a service to land-use developers, as well as necessary for the general land-use planning function of local government

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A conceptual solution to the applicability size threshold emerged during the second meeting of the work group. Parts 1 and 2 are preferred policy principles, while parts 3 and 4 inject the size thresholds of animal feeding operations, which would be non-normal incidents of farming and ranching and subject to conditional-use (aka special-use) zoning permits.

1st. Local governments should adopt comprehensive land use plans and delineate agricultural land-use areas. This process is necessary so as to create the foundation in land-use planning for protection of the practices of farming and ranching. Land-use should be in harmony with first-in-time uses, such as agriculture, consistent with the legal doctrine of coming to the nuisance.

2nd. People developing non-traditional, non-agricultural uses of land should need a zoning variance prior to developing land within an agriculturally zoned area. The process of obtaining such variance in the normal administration of zoning can inform all land-use stakeholders of potential land-use conflict.

3rd. The word "existing" as applied to animal feeding operations should be defined in the ordinance, and its meaning should be those animal feeding operations in place and operating when the ordinance of a local unit of government takes effect.

4th. Option a.

New AFOs. The zoning permit applicability size thresholds for new animal feeding operations should be 300 animal units for hogs and a larger number for other livestock types, which was not specified in deference to option b. Hog operations generally emit odors that can be obtrusive.

Existing AFOs. The zoning permit applicability size threshold for existing animal feeding operations, other than hogs, should be 1,000 animal units. The threshold for hogs should be a lower number, which was not specified in deference to option b, because hog operations generally emit odors that can be obtrusive.

4th. Option b.

New AFOs. The zoning permit applicability size threshold for new animal feeding operations, regardless of livestock type, should be 300 animal units. The stronger odor emitted by hog operations has already been considered in the odor separation (setback) distances.

Existing AFOs. An existing animal feeding operation, regardless of livestock type, should be required to have a permit whenever the operation increases capacity to handle more than 300 animal units, whether by a single expansion or cumulatively by several expansions. (The size baseline for an existing animal feeding operation would be the capacity of the operation on the date the ordinance takes effect.)

Permitted AFOs. [2] A permitted animal feeding operation, regardless of livestock type, should be required to have a **new** permit whenever the operation increases capacity to handle more than 300 animal units, whether by a single expansion or cumulatively by several expansions.

The work group favored 4-b over 4-a because it more equitably applies a zoning permit requirement to new and existing (as defined) animal feeding operations but does not require existing operations, regardless of size, to obtain a zoning permit unless expanding to handle more than 300 animal units. This choice signals an interpretation of non-normal incidents of farming and ranching or the reasonable diversification or expansion of farming and ranching (1999 SB 2355). That is, the model ordinance should require zoning permits whenever a new animal feeding operation is constructed to handle more than 300 animal units and whenever an existing or a permitted operation expands capacity to handle additional livestock of 301 or more animal units, whether by one or more increments of expansion.

SUMMARY OF COMMENTS PERTAINING TO A FOURTH DRAFT

On January 4, 2000, concurrence or comments were solicited by the department from the work group, its subcommittee and other stakeholder contacts pertaining to "A Model Zoning Ordinance for Animal Feeding Operations." The quoted document was the fourth draft prepared by the department on behalf of the work group from discussions during prior meetings of the work group or its subcommittee. This draft contained the latest round of revisions arising from a meeting of the work group held on November 30, 1999.

Comments were received from eight people. Some comments did not seek changes to the content of the model ordinance for animal feeding operations, while other comments did. For example, the following comments did not seek changes to the model ordinance, but rather were recommendations to:

a. Clarify the purpose of the conditional (or special) use permits in section 3.A.

b. Move the last paragraph of section 8 pertaining to odor setbacks forward as the first paragraph of that section.

c. Add a statement in the "Closing Commentary" that the water resource provisions of section 7 do not address siting of animal feeding operations in flood plains.

d. Change the tone of the document by including greater emphasis on developer awareness.

[2] The meeting's participants concluded that "each subsequent cumulative expansion exceeding 300 animal units requires a permit." Given the definition for "existing," a distinction was necessary between existing and permitted operations.

e. Include noise, truck traffic and chemical application, in addition to odor and dust, as aspects of farming or ranching activities under "Developer Awareness."

f. Add the web site for the Local Government Environmental Assistance Network, www.lgean.org, to the Reference Bibliography.

In addition to item a above, another comment observed that the setback provisions of the model ordinance as written are independent of the criteria, such as hazards and effects on environmental resources, which create the need for conditional use permits.

Those recommendations for changes in the model ordinance for animal feeding operations were:

g. Include a category for swine less than 55 pounds within the table of section 2.

h. Remove the requirement in section 3.C that "a registered land surveyor, civil engineer or other person ..." must prepare the site plan for those operations with fewer than 1,000 animal units.

i. Remove item 4 of section 4.C, which requires an application for a permit to include information about "surrounding land uses, zoning and ownership," because the local government should be responsible for this information.

j. Change the threshold at which operators would be required to apply for and obtain a permit from 300 animal units to 1,000 animal units.

Given the comment that setbacks in the model ordinance are independent of required conditional use permits, the ten sections of the model ordinance were rearranged into three sections with subsections as follows:

1. General Provisions
   - 1.1 Definitions
   - 1.2 Equivalent Animal Numbers
   - 1.3 Environmental Provisions
   - 1.4 Enforcement
   - 1.5 Severability
2. Setback Requirements
   - 2.1 Water Resource Setbacks
   - 2.2 Odor Setbacks
3. Conditional Uses
   - 3.1 Permit Procedures
   - 3.2 Ownership Change
   - 3.3 Operational Change

It is likely that most people participating in meetings of the work group did not disassociate the required setbacks from the required permits even though drafts had not linked the two. A clear disassociation of setbacks for animal feeding operations greater than 300 animal units would free up the threshold for conditional-use permits based upon a size threshold when size can infringe (for reasons other than odor) on the rights of nearby people. The disassociation has merit because the state odor standard (1999 SB 2365) applies to all animal feeding operations regardless of size or type of livestock.

Items b, c and f have been addressed with changes as recommended.

Item g has been addressed by using a value of 0.1 animal equivalent units for a nursery pig. (See section 1.2) South Dakota uses 0.1 animal equivalent units per nursery pig and Minnesota uses 0.05.

Items h and i have been addressed by inserting language that these items would be required for operations larger than 1,000 animal units. (See section 3.1)

Items d and e have been addressed within a rewritten "Introductory Commentary" chapter of the document. The prior narrative in this chapter was transferred into an appendix.

Items a and j are interdependent: a has been addressed in the rewritten "Introductory Commentary," and the zoning permit applicability section of the model ordinance has been rewritten. (See section 3.1, the size threshold remains at 300 animal units). An adjustment for item j was not developed from the record of the work group's November 30th meeting; for example, setting the threshold greater than 300 animal units.

In addition, one comment indicated that the document was too long: Appendix II, titled "History of the Development of a Model Zoning Ordinance for Animal Feeding Operations" has been removed for printing as a separate document.

THIRD MEETING OF THE WORK GROUP

The third and final meeting of the work group was held on February 29, 2000. A notice for the meeting was distributed to everyone listed in the two tables above. The notice included a fifth draft for an AFO zoning handbook, which contained draft model land-use policies with objectives and a draft model zoning ordinance, as well as an updated draft of this report.

The primary outcome of this meeting was adoption of revised size from 300 to 1,000 animal units for animal feeding operations that would be conditional (or special) use of land. The consensus for the change acknowledged that as a model ordinance local governments can select the size with which to meet local concerns and specific circumstances.

APPENDIX

Applicability of an Ordinance for Animal Feeding Operations

Aspects of Applicability.

Normal zoning procedures of local units of government often require permits prior to construction of buildings and structures. Conditional use (aka special use) permits are issued when proposed buildings or construction is inconsistent with the functional use of the zoned district. The permitting procedures have requirements that are necessary for public participation and for assessment of proposed new construction with established construction criteria.

Two primary purposes for the application of zoning to animal feeding operations have emerged from the sub-committee's deliberations.

One purpose is to foster compatible uses within agriculturally zoned land through separation distances (setbacks) where a new animal feeding operation must distance itself from certain other uses of the land, such as residences, school, churches, etc. The separation distances are intended to disengage the odor, as well as, fly, dust and noise aspects of animal feeding operations from the neighbors of these operations so as to protect the right to practice farming or ranching by fostering harmony (negating complaints).

Another purpose is to protect operators of existing animal feeding operations from encroachment through reverse setbacks (as rights to practice farming and ranching) where new development could not locate within those distances. Thus, this second purpose, in turn, affords subsequent encroachment protection to newly constructed animal feeding operations.

Both purposes follow the duty of local governments to promote public safety, health and welfare; the location of buildings and structures; the occupancy of lands; and the conservation and development of natural resources (NDCC chapters11-33 and 58-03).

One question arises as to whether the conditional-use permit is the tool needed to implement setbacks and reverse setbacks, regardless of the size of the animal feeding operation. In a simplistic concept, are the permits needed so as to place animal feeding operations "on the map" in a zoned district and so as to establish the "buffer" which is meant to protect the rights of farming by controlling encroachment. The apparent answer is yes.

Another question arises as to whether the conditional uses apply, by virtue of present zoning procedures, to atypical animal feeding operations. For example, in the context of "normal incidents of farming or ranching" (1999 SB 2355), non-normal or atypical incidents would be the larger animal feeding operations. The apparent answer is yes.

Two factors that were briefly discussed by the subcommittee and that relate to the interpretations of the phrase "normal incidents of farming or ranching" (1999 SB 2355) are described in more detail below.

First. The number of animal feeding operations that have been issued permits by the Department of Health is about 440. The department presently requires any livestock feeding operation with more than 200 animals units to obtain a permit. Based upon a recent survey of the livestock industry, some operators of livestock feeding operations larger than 200 animal units may not be aware of rule permit requirements.

Currently, there are:

about 80 operations with 300 or more animal units;
nearly 60 operations with more than 500 animal units;
nearly 35 operations with more than 700 animal units; and
nearly 30 operations with more than 1,000 animal units.

A bar diagram of these groupings of permitted animal feeding operations follows. The total number of animal feeding operations, which would include those having fewer than 200 animal units, is unknown. In 1997, there were 12,744 beef cow farms; 797 hog farms; 1,170 dairy farms; and 1,101 sheep farms.[3] The total number of farms in North Dakota was 31,000 in 1998.

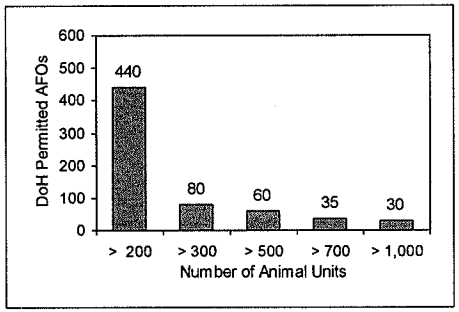

Figure 2. The number of animal feeding operations permitted by the Department of Health for thresholds of numbers of animal units.

Second. Another factor that ought to be considered, however, is the strength of odors emitted into the atmosphere from the combination of animal housing and manure storage structures of animal feeding operations. Odor strength conventionally is expressed as the number of odor

[3] Source: Farming in North Dakota, http:/www.ag.ndsu.edu/farming/farmingprimer.htm

units per second. It generally increases with the number of confined animals, but is also highly dependent upon the type of housing and the type of manure storage structures, including open surface area. The point scatter diagram which follows demonstrates relationships between the number of animal units and the emitted strength of odors from animal housing, which includes confounding factors such as the type of animal housing. The 16 data points on the diagram include one beef steer operation, two Holstein dairy operations, three poultry operations and 10 swine operations.[4] The emitted strength of odors does not include manure storage structures that are not within the animal housing.

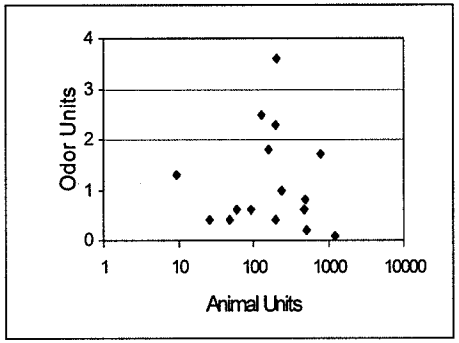

Figure 3. Scatter plot of source odor strength as a function of the number of animal units.

The Pearson correlation for the 16 data points is a -0.21, which indicates no functional dependance for odor source strength on the number of animal units for this data set. The poor correlation likely is influenced or confounded by the type of animal housing. An odor emission strength of two odor units per second is not synonymous with an ambient air concentration of two odor concentration units.

Odor concentrations downwind of animal feeding operations depend upon wind speed and other atmospheric characteristics governing odor dispersal. For example, higher wind speeds dilute odors. The potential frequency of excursions of odors at specific places downwind can be estimated, and this frequency varies by direction, because wind occurs more frequently from some directions than from others. Assessment of odor concentrations at specific places downwind of animal feeding operations requires application of atmospheric transport and

[4] Source: Jacobson, Larry D., et al. July 18-22, 1999. Odor and Gas Emissions from Animal Manure Storage Units and Buildings, ASAE Paper No. 994004, ASAE, St. Joseph MI.

dispersion calculations or computer models.[5] Field measurements of odors downwind of animal feeding operations can also be used (1999 SB 2365).

The data set shown in the figure above does not display an apparent best-fit line signature from which an applicability size threshold would be apparent. Since intended separation distances between farming and ranching and other developments originated from concern regarding odor complaints and concern regarding the right to farm or ranch, the source odor strength data favor setting the size threshold at a lower number of animal units. (The separation distances at which odors might cause a conflict with neighboring land uses selected by the first meeting of the sub-committee were not changed during the second or third meetings of the sub-committee.)

A minority view during the third meeting was that existing or new animal feeding operations with fewer than 1,000 animal units already are protected by virtue of being located in an area zoned for agriculture. This view asserted that the burden of knowing the locations of animal feeding operations should be on developers of alternate uses of land through the process of obtaining a variance to agricultural zoning, since the existing ranch or farm would be first in time. This view also indicated concern about subjecting operators to the application information and procedures, including public participation in hearings, as presented in the draft ordinance. The view assumes that the majority of local units of government have adopted comprehensive land-use plans that delineate agricultural-use districts. Another consequence of this view is that local governments might be expected somehow to have the information at hand so that setbacks and reverse setbacks could be applied.

A majority view during the last meeting was that setbacks can apply to new animal feeding operations with more than 300 animal units and can conform to SB 2355; thus, the threshold should be at 300 animal units so as to provide the intended benefit of setbacks and reverse setbacks. Furthermore, some of these subcommittee members also expressed the view that the protection of rights to farm and ranch via reverse setbacks cannot be given to existing animal feeding operations without application of common practices for issuing conditional-use permits, because zoning officials otherwise have no way of knowing where the existing operations are located.

It was noted that state rule thresholds currently apply at 200 and 1,000 animal units, but that the Department of Health hopes to change its 200 threshold to 300 animal units so as to be the same as EPA regulations. The size threshold of animal feeding operations that release odors of sufficient strength such that conflict might arise between those larger operations and neighboring land uses (at setback distances greater than one-half mile) is elusive, because the types of animal housing, as well as the types of manure storage, determine in odor strength. Thus, a threshold, whether at 300 or 1,000 animal units, follows the thresholds for permits required by federal or state rule as a substitute for a threshold derived from odor information.

[5] Source: Jacobson, Larry D., et al. Odor Rating System Demonstration Project, March - August 1997, Final Report. Department of Biosystems and Agricultural Engineering, University of Minnesota. St. Paul MN.

During the subcommittee's third meeting, the Department of Health proposed an option that would change the threshold from 300 to 1,000 animal units and that an operator of an existing animal feeding operation with fewer than 1,000 animal units be given zoning protection if the operator "registers" (meaning written notice including certain information) that operation with the local unit of government. This proposal was unanimously rejected.

Summary of the Applicability Issue.

The purpose of the separation distances of the model ordinance is to disengage the odor, as well as fly, dust and noise aspects, of animal feeding operations from the neighbors of these operations so as to protect the right to practice farming or ranching by fostering harmony (negating complaints). Separation distances would be imposed as setbacks on new animal feeding operations and as reverse setbacks on encroaching development. Local units of government cannot achieve this purpose without knowing where new animal feeding operations are proposed to be located or where existing operations are located.

The designated land-use districts (zones or zoning) of land-use plans and the conditional-use permits, granted in accordance with adopted plans and designated districts for the jurisdictional areas of local governments, provide the mechanisms for recognition and promotion of separation distances.

The notable features for each of the two applicability size thresholds for the permitting function of zoning, namely 300 and 1,000 animal units, are listed below.

Threshold of 300 animal units relative to a threshold of 1,000 animal units

① A threshold of 300 animal units is consistent with the threshold at which the federal rules for animal feeding operations apply. The department plans to amend the state feedlot rules upward from 200 animal units to 300 animal units so that the state rule threshold becomes the same as federal regulation.

② If the operator of an existing animal feeding operation implements a "major" expansion so as to exceed 300 animal units, this operator would have to apply for a conditional-use permit and would then be protected from subsequent encroachment via the reverse setbacks.

③ New animal feeding operations with more than 300 animal units would need a conditional use permit and would be subject to the odor and source-water setbacks. These animal feeding operations then would be protected from encroachment through reverse setbacks.

④ The lower threshold increases the likelihood that reverse setbacks to control encroachment will diminish neighbor complaints about odor, as well as flies, dust and noise.

⑤ The lower threshold increases by about 50 the number of existing animal feeding operations that could become regulated by the model zoning ordinance, IF each operator of these operations decides to implement a "major" expansion.

Threshold of 1,000 animal units relative to a threshold of 300 animal units

❶ A threshold of 1,000 animal units is consistent with the threshold at which the federal EPA NPDES regulations apply.

❷ If the operator of an existing animal feeding operation implements a "major" expansion so as to exceed 1,000 animal units, this operator would have to apply for a conditional use permit and would then be protected from subsequent encroachment via the reverse setbacks.

❸ New animal feeding operations with more than 1,000 animal units would need a zoning conditional use permit and would be subject to the odor and source water setbacks. These animal feeding operations then would be protected from encroachment through reverse setbacks.

❹ The higher threshold decreases the likelihood that reverse setbacks to control encroachment will diminish neighbor complaints about odor, as well as flies, dust and noise.

❺ The higher threshold decreases by about 50 the number of existing animal feeding operations which could become regulated by the model zoning ordinance, IF each operator of these operations decides to implement a "major" expansion.

The following matrix summarizes the concepts for application of zoning as presented by the work group's subcommittee.

CONDITIONAL USE (aka SPECIAL USE) PERMIT REQUIREMENTS		
	Size of Animal Feeding Operation (animal units, a.u.)	
AFO	< 301 a.u.	more than 300 a.u.
Existing	no	yes, but only if operator plans a "major" expansion as administered by the local unit of government
New	no	yes

Animal feeding operations that exist at the time a local unit of government adopts the provisions of the model ordinance, regardless of size, do not have to apply for zoning conditional-use permits. Thus, the existing animal feeding operations are not protected from encroachment until the operator receives a conditional-use permit, which would be required only when the operator implements a "major" expansion. Local units of government would decide whether an expansion was "major" based upon factors, - including but not limited to, location conditions, environmental conditions, or public safety, health or welfare - that could reasonably be affected.

EPA United States Environmental Protection Agency

Agriculture: Laws and Regulations that Apply to Your Agricultural Operation by Farm Activity

Related Information

- Laws and Regulations by Statute
- Upcoming and Recent Compliance Dates
- Programs, Practices, and Topics of Interest

- Join the Ag Center's News Service

This is a general description of EPA's requirements, and should only be used as a guide. Since rules and regulations may change, use this information as a starting place to determine which regulations apply to your agricultural operation.

About these lists:

- Programs applicable to the general public, common to multiple sectors, manufacturers of food products, and retailers may not be included.
- Some requirements only apply after a threshold is reached [e.g., size, geographical location].
- Many States have similar requirements to EPA's but may be more stringent or broader in scope.

Check with your State and/or EPA Regional Office for more information.

- Aquaculture
- Livestock and Poultry including beef, dairy, swine, poultry
- Crop production including nurseries, greenhouses, forestry
- Provision of Drinking Water
- Farm Facilities, Fuel and Equipment
- Buildings/Construction/Renovation
- Chemical Handling
- Air Emissions/Releases
- Wastes

Livestock, Poultry and Aquaculture (including beef, dairy, swine, poultry, aquaculture)

Topic	Type of Farm or Ranch Activity	Link to Program Area Information	Requirements of Farm
Aquaculture	Criteria to determine which aquaculture discharges require an NPDES permit.	National Pollutant Discharge Elimination System (NPDES) Concentrated Aquatic Animal Production (CAAP) facilities	Permit required if meet specific conditions
Livestock and Poultry Production	Concentrated Animal Feeding Operations that discharge to a water of the U.S.	National Pollutant Discharge Elimination System (NPDES) Concentrated Animal Feeding Operation Rule	NPDES Permit required if CAFO discharges to a water of the U.S.
Livestock and Poultry Production	All Large Concentrated Animal Feeding Operations that land apply manure.	National Pollutant Discharge Elimination System (NPDES) Concentrated Animal Feeding Operation Rule	Large CAFOs that land apply manure must meet nutrient planning requirements. Permit required if CAFO discharges to a water of the U.S.

Topic	Type of Farm or Ranch Activity	Link to Program Area Information	Requirements of Farm
	Livestock facilities with manure management systems for livestock manure that emit equal to or greater than 25,000 metric tons CO2e per year. EPA's analysis of this emission source estimates 100- 110 of the largest livestock facilities would be required to report. A manure management system stabilizes or stores livestock manure in one or more of the following system components: • Uncovered anaerobic lagoons • Liquid/slurry systems (with and without crust covers, and including but not limited to ponds and tanks) • Storage pits • Digesters, including covered anaerobic lagoons • Solid manure storage • Drylots, including feedlots • High-rise houses for poultry production (poultry production without litter) • Poultry production with litter • Deep bedding systems for cattle and swine • Manure composting • Aerobic treatment	Greenhouse Gas Reporting	Very large livestock facilities with emissions over the threshold would be required to report emission estimates.

Topic	Type of Farm or Ranch Activity	Link to Program Area Information	Requirements of Farm
	If aggregate of non-fugitive emissions of any regulated pollutant exceeds 100 tpy. Also, generally, sources that are major under Section 112, Section 302, or Part D of title I are also considered major under title V and required to obtain a title V permit.	Title V Permit	Apply for permit
	The source must apply for a permit if aggregate of non-fugitive emissions of any regulated pollutant exceeds a certain threshold amount depending on the attainment/non-attainment status of the area and on the pollutant. This requirement applies to new sources as well as to major modifications of sources.	New Source Review / Prevention of Significant Deterioration permit	Apply for permit

Crop Production (including nurseries, greenhouses, forestry)

Topic	Type of Farm or Ranch Activity:	Link to Program Area Information	Requirements of Farm
Pesticide use by workers or handlers:	Mixing, loading and application of pesticides and any other farm labor that involves exposure to pesticides.	Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) Pesticide Label Worker Protection Standard	Label restrictions typically require protective clothing and engineering controls (e.g., tractors with enclosed cabs and air recirculation systems).
Restricted Pesticide Use:	Pest control with the use of 'restricted use' pesticides.	Certification and training regulations	Required training for farmers and/or their pesticide applicators that use 'restricted use' pesticides.
Pesticide Use:	Storage and disposal of pesticides and pesticide containers.	Pesticide Containers Pesticide Storage Pesticide Disposal	Follow label instructions for storing and disposing of pesticides and containers.

Pesticide Use and Water:	Applications of (1) biological pesticides and (2) chemical pesticides that leave a residue, in which applications are made directly to waters of the United States, or where a portion of the pesticide will unavoidably be deposited to waters of the United States.	National Pollutant Discharge Elimination System (NPDES) Water Related Pesticides Rule	Applications required to be covered under a National Pollutant Discharge Elimination System (NPDES) permit.
Pesticide use and endangered species:	Pest control on farmland or forests that have endangered species habitat.	EPA Office of Pesticide Programs Endangered Species Protection Program Bulletins Live	Farmer must follow label requirements and county bulletin requirements (if available) to ensure protection of endangered species.
Pesticide Use:	Crop and livestock production practices that involve pest control.	Pesticide Label	Follow label instructions to apply pesticide legally.

Pesticide Use:	Farms that dispose of pesticide residues and rinsates off-site	Waste pesticides Pesticide Disposal	Proper disposal of pesticide hazardous wastes Waste pesticides disposed of on a farmer's own property in compliance with specified waste management requirements, including the disposal instructions on the pesticide label, are not subject to the TSD facility standards. Even wastes that exhibit one or more of the characteristics of a hazardous waste are exempt from regulation when the farmer triple rinses each emptied pesticide container and disposes of the rinsate on his own farm in compliance with the disposal instructions on the label. However, • if the rinsate is characterized as "acute hazardous waste," some regulations may apply. • if the pesticides have been recalled, some RCRA regulations may apply. • disposal of hazardous waste could subject farmers to hazardous waste generator requirements. Irrigation return flows are not solid wastes. Farmers can dispose of non-hazardous waste (e.g. agricultural wastes including manure, crop residues returned to the soil as fertilizers or soil conditioners; solid or dissolved materials in irrigation return flows) on their own property unless prohibited by other State or local laws.

Land Application:	Farms that land apply biosolids or which own land on which biosolids are land applied.	National Pollutant Discharge Elimination System (NPDES) - Biosolids	Federal permit generally not required, but farms must directly meet regulatory requirements for pollutant limits, management practices, operational standards, reporting and other requirements.
Forestry:	Rock crushing, gravel washing, log sorting, and log storage facilities	National Pollutant Discharge Elimination System (NPDES) Silviculture	Permit required for specific forestry activities

Provision of Drinking Water

Topic	Type of Farm or Ranch Activity:	Link to Program Area Information	Requirements of Farm
Drinking water:	Farms providing for human consumption (e.g., drinking, showering) from its own source to 25 people or through 15 service connections for more than 59 days/year	Small Drinking Water Systems	Total coliform, nitrate testing most likely. Surface water source would invoke other Non Drinking Water regulations.

Farm Facilities, Fuel and Equipment

Topic	Type of Farm or Ranch Activity:	Link to Program Area Information	Requirements of Farm

Reciprocating internal combustion engines:	The engine must comply with this regulation if it is located at a facility whose emissions are at least 10tpy of one HAP or 25tpy of total HAP and if the engine itself is at least 500 HP.	Stationary Engines or Reciprocating Internal Combustion Engines (RICE) (National Emission Standard for Hazardous Air Pollutants (HAP) – 40 CFR Part 63, subpart ZZZZ)/Standards of Performance for Stationary Spark Ignition Internal Combustion Engines (New Source Performance Standards – 40 CFR Part 60, subpart JJJJ)/Standards of Performance for Stationary Compression Ignition Internal Combustion Engines (New Source Performance Standards – 40 CFR Part 60, Subpart IIII)	Comply with regulatory requirements
On and Off-Road equipment:	Farm vehicles, engines, equipment and fuels.	Mobile Source Program	Producers are subject to various mobile source requirements, similar to other similar users/operators of highway and off-road vehicles, engines, equipment, and fuel.

Oil Storage:	Farm that stores, transfers, uses, or consumes oil or oil products, such as diesel fuel, gasoline, lube oil, hydraulic oil, adjuvant oil, crop oil, vegetable oil, or animal fat; and stores more than 2,500 U.S. gallons in aboveground containers; and could reasonably be expected to discharge oil to waters of the United States or adjoining shorelines, such as interstate waters, intrastate lakes, rivers, and streams. OR An aggregate aboveground storage capacity greater than 2,500 gallons and less than 6,000* gallons; and no reportable discharge history*. *see link for more information	Spill Prevention Control and Countermeasures (SPCC)	Prepare and implement an SPCC Plan (plan may need to be certified by a professional engineer or farmer may be able to self-certify, see link for more information)
Oil Storage:	Any farm/facility storing more than 1,000,000 gallons of oil in above ground storage or 42,000 gallons where transfers occur over water.	Facility Response Plan (FRP)	Prepare a Facility Response Plan and submit to EPA

Underground storage tanks (UST):	Farms with underground storage tanks with a capacity of more than 1,100 gallons of motor fuel. Farm and residential USTs and their associated underground piping holding less than 1,100 gallons of motor fuel for non-commercial purposes, tanks holding less than 110 gallons, tanks holding heating oil used on the premises, septic tanks, and other listed tanks are excluded from regulations.	Underground storage tanks (UST)	Underground storage tanks that are not excluded must meet regulations related to design, construction, installation, notification, monitoring, operating, release detection, reporting to State or Federal regulatory agencies, owner record keeping, corrective action, closure and financial responsibility.
Used Oil	Farms storing more than 25 gallons in underground or above-ground tanks. Farmers who generate an average of 25 gallons or less per month of used oil from vehicles or machinery used on the farm in a calendar year are exempt from used oil regulations.	Resource Conservation and Recovery Act (RCRA) Training Module on Used Oil	Farmers exceeding 25 gallons are required to store the used oil in tanks meeting underground or above ground technical requirements and use transporters with EPA authorization numbers for removal from the farm.
Oil spill:	Any farm that has a discharge of oil that may reach navigable waters or adjoining shoreline	Oil Pollution Prevention	Report spills of oil that reach waterways to the National Response Center

Buildings/Construction/Renovation

Topic	Type of Farm or Ranch Activity:	Link to Program Area Information	Requirements of Farm

Building/Construction	Stormwater discharges from construction activities (such as clearing, grading, excavating, and stockpiling) that disturb one or more acres, or smaller sites that are part of a larger common plan of development or sale, are regulated under the National Pollutant Discharge Elimination System (NPDES) stormwater program.	National Pollutant Discharge Elimination System (NPDES) Stormwater	Obtain a permit or obtain coverage under a general permit prior to discharging stormwater.
Building renovation/demolition:	Renovations of buildings which contain a certain threshold amount of friable asbestos, and during demolitions of all structures, installations, and facilities (except apartment buildings that have no more than four dwelling units).	Air program/Asbestos	The Asbestos National Emissions Standards for Hazardous Air Pollutants (NESHAP) is intended to minimize the release of asbestos fibers during activities involving the handling of asbestos. Accordingly, it specifies work practices to be followed during renovations of buildings.
Dredge and Fill:	Discharges of dredged or fill material into waters of the U.S.; The U.S. Army Corps of Engineers (COE) makes permit decisions and jurisdictional determinations, with EPA oversight.	Clean Water Rule What the Clean Water Rule Does Not Do Wetlands/404 Program	Permit for non-exempt activities

Wastes

Topic	Type of Farm or Ranch Activity:	Link to Program Area Information	Requirements of Farm
Underground injection:	Farms operating injection well(s)	Underground Injection Control	Submit injection well inventory information; must not endanger underground sources of drinking water

Hazardous waste:	Farms that generate, transport, treat, store or dispose of hazardous waste	Subtitle C hazardous waste	Proper handling of listed and characteristic hazardous

Air Emissions/Releases

Topic	Type of Farm or Ranch Activity:	Link to Program Area Information	Requirements of Farm
	Farms located in air "non-attainment" areas	Clean Air Act Click here to determine if you are in a non-attainment area.	Particulate Matter (PM) National Ambient Air Quality Standards (NAAQS): Some agricultural sources in PM10 nonattainment areas are impacted by PM10 standards to satisfy reasonably available control measures and control technologies requirements. PM2.5 SIPs will be due no later than April 2008. In those SIPs, states will evaluate, on an area by area basis, whether there is a need to regulate PM 2.5 or PM 2.5 precursors from ag related sources. Ozone NAAQS: Some agricultural areas are impacted by these standards which primarily deal with nitrogen oxides (NOX) and Volatile Organic Compound (VOC) emissions. These have the potential to impact some animal production practices and have potential to impact pesticide application practices. NOX emissions from stationary engines could be impacted by these standards and the corollary implementation rules.

Air emissions:	If aggregate of non-fugitive emissions of any regulated pollutant exceeds 100 tpy. Also, generally, sources that are major under Section 112, Section 302, or Part D of title I are also considered major under title V and required to obtain a title V permit.	Title V Permit	Apply for permit
Air emissions:	The source must apply for a permit if aggregate of non-fugitive emissions of any regulated pollutant exceeds a certain threshold amount depending on the attainment/non-attainment status of the area and on the pollutant. This requirement applies to new sources as well as to major modifications of sources.	New Source Review / Prevention of Significant Deterioration permit	Apply for permit
Hazardous substance release:	Any farm handling Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) hazardous substances that has had or currently has a threat of a release that is determined to be an imminent and substantial danger to public health or welfare.	Emergency response	Allow access to federal responders; hire contractor(s) for response/cleanup actions

Hazardous substance release:	Any farm that has a release of a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) hazardous substance above a reportable quantity (RQ). Release could be to the atmosphere, soil, surface water or groundwater.	Release reporting--episodic or continuous	Report releases of hazardous substances to the National Response Center.
Hazardous substance releases:	Any farm that releases more than a reportable quantity or more of an extremely hazardous substance or a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) hazardous substance. Hazardous chemicals used in routine agricultural operations or a fertilizer held for resale by a retailer are excluded.	Emergency release reporting	Report releases of extremely hazardous substances or CERCLA hazardous substances to state and local emergency planning entities

Chemical Handling

Topic	Type of Farm or Ranch Activity:	Link to Program Area Information	Requirements of Farm
Hazardous substances:	Farms that handle hazardous substances. Agricultural nutrients when held by a farmer are excluded (e.g. ammonia)	General duty for chemical accident prevention	The owners and operators of stationary sources (facility) that handle any extremely hazardous substance in any quantity have a general duty to identify hazards, design and operate a safe facility and to prevent and/or mitigate accidental releases

Hazardous substances:	Any farm handling more than a threshold quantity of extremely hazardous substances or substances requiring an Occupational Safety and Health Administration (OSHA) material safety data sheet (MSDS)	Emergency Planning & Community Right to Know Act (EPCRA)	Report inventory of certain extremely hazardous substances to State and local planning entities
Toxic and/or flammable substances:	Facilities that handle more than a threshold quantity of certain toxic and/or flammable substances Listed agricultural nutrients when held by a farmer are excluded (e.g. ammonia); and flammables used as a fuel	Risk Management Program and Plan (RMP)	Must implement a chemical accident program and prepare and submit a Risk Management Plan (RMP) to EPA

Last updated on February 2, 2016

Manure Odour Control Field Day for Media and Regulators

W.T.(Bill) Henley P. Eng.
Agricultural Operations Section
Saskatchewan Agriculture and Food

Background

The hog industry in the prairie region of Western Canada has a competitive advantage over other Provinces and areas of the world, with respect to cost, animal density, high herd health status and management expertise. This has lead to rapid expansion of the industry with an increase in the size of farms. Typical new farm size is either 600 sow farrow to finish sites which are planned to expand to 1200 sows or 2400 sow SEW operations with 2400 sow space farrowing sites, 8800 pig space nursery sites and 8000 pig space feeder sites. Saskatchewan has traditionally had a very small hog industry, which for many years has produced approximately 1 million feeder hog per year. These hogs were produced on more than 4000 farms 10 years ago and today are being produced on 2200 farms. Less than 100 of today's 2200 producers produce more than 80% of these pigs. Projections indicate that 3 million hogs will be produced in Saskatchewan in 5 years time. This small concentrated industry is not well understood by the rest of society in Saskatchewan or even by the rest of the agricultural industry in this Province. The hog industry has been negatively affected by headline grabbing "horror" stories from other jurisdictions and the odour control work that has been developed here is not well known outside the industry. Consequently the need to make people aware of these developments.

Tour Design

Through funding provided by the Agri-Food Innovation Fund (AFIF) a demonstration tour was set for July 29/97. The purpose of the tour was to actively demonstrate cost effective methods of odour control in the storage, agitation and application of manure that can be used on commercial hog farms today. The organizers of the tour were the Prairie Agricultural Machinery Institute (PAMI), Saskatchewan Agriculture and Food (SAF) and the Prairie Swine Centre Inc (PSCI). This tour is part of a larger project, which has as its objectives the development of written information on odour control, the production of videos on odour control as well as the demonstration tour. It was decided that the tour would be targeted at media, municipal politicians and provincial employees. The media was targeted because of their impact on public opinion. Municipal politicians were chosen because of their involvement in site selection at the local level. Provincial regulatory employees were included because of their involvement in the approval process for the establishment of new facilities. All three of these groups can have a major impact on the growth of the industry. Personal invitations were sent to all participants and follow up was done with each invitation to ensure attendance at the event. Everyone was asked to be part of the group who traveled from site to site on the tour bus. This helped to

alleviate the concern of bio security as well as encouraged discussion with resource staff and comparison among the group as the bus traveled between sites. All participants except the television media were able to comply with this request. A meal was planned for the end of the event to illustrate how well odour can be controlled. The event itself was promoted with media releases prior to and on the day of the tour.

The Tour Itself

The day started with everyone meeting at a mall in Saskatoon to board the bus. An information package was distributed to everyone in attendance. It consisted of a brochure on the AFIF project, information from PSCI on their inflated balloon cover, information from PAMI on various aspects of manure management and odour control, as well as articles of general interest on manure and odour most of which were taken from hog trade magazines. A video produced by PSCI on bio security was shown on the bus trip to the first stop of the tour

The first stop was PSCI where an inflated, balloon type cover on a 60' diameter, 12' deep circular concrete tank was demonstrated. The design and operation of the inflated cover was explained by Dr. Stephan Lemay, Engineering Research Scientist. PSCI also has an identical concrete tank that is not covered so that, participants could notice the significant difference in odour levels between the two storage vessels.

The second stop was an 8800, pig space nursery site where the manure is stored in a 200' by 400' clay lined earthen manure storage. No odour control measures were used at this site. The purpose of the stop here was for participants to determine the offensive of the site based on their own experiences, rather than relying on other people's opinions.

The third stop was a 600, sow farrow to finish site where the manure is stored in an earthen manure storage. This particular barn uses a pit additive in the barn to reduce odour and to improve the solids handling of the manure at pump out. The PAMI developed Pit Sweep was also demonstrated at this site in comparison to conventional earthen manure storage agitation methods. The Pit Sweep consists of a horizontal hydraulically driven rotating auger and shield attached at the open impeller end of a conventional lagoon pump. It can stir up solids and drag them to the impeller with very little disturbance of the liquids at the surface, thus reducing odour and fuel consumption compared with continuous conventional agitation..

The fourth stop was in a field where the PAMI developed liquid manure injection system was demonstrated. This system consists of a modified cultivator with a distribution head and shanks on 12 " row spacing so that manure can be evenly applied below the soil surface. The system has been designed to handle slurry trash such as hair, straw and other foreign materials without plugging. It also operates in fields with very heavy surface residues and long stubble.

The final stop was at a earthen manure storage where the liquid surface had been covered with barley straw approximately 30 days previously. Some of the straw surface had blackened and sunk by the time of the

demonstration but participants could notice the significant reduction in odour levels caused by the straw cover. Additional straw was added to the liquid surface using a machine manufactured by Highline Manufacturing called the "TopGun". This machine consists of a large round bale processor with a centrifugal fan and nozzle attached. After new straw was added the odour level at the storage was considered to be zero.

The day was completed with a catered full course hot meal being served beside the straw covered earthen storage. This was done to drive home the point there are steps that producers can take to significantly reduce the odour level in the storage, handling and spreading of liquid hog manure. The meal was delicious, everyone ate (even those who declared at the start of the tour that they wouldn't be able to eat seated beside a manure storage site) and many people had second helpings.

Media Activity and Follow up

One of the main objectives of the day was to have the media file stories of what they saw and smelled. Prior to the actual event and on the day of the event two media releases were put out explaining the event, and giving the name of a contact person. On the day of the event a reporter with CBC radio did a "live" broadcast on the noon hour show as the tour was in progress. In the afternoon the same reporter did another story for the 4 to 6 pm show. As well for the two following days stories were either ran again during a different part of the day or a follow up story was provided by the CBC. Two television crews covered the event. They both filed evening stories on the day of the event as well as follow up stories later in the same week. Print media ran stories in the following publications: The Western Producer which is read in all 3 prairie provinces; Ag World which is distributed free to all farmers in Saskatchewan; and in the Humboldt Journal which is the newspaper covering the area where most of the tour was held. As well SAF issued it's own press release on the event where the media in attendance at the event were quoted on their impressions regarding how well the odour reduction methods worked.

The release went as follows:

Week of August 25, 1997

HOG INDUSTRY'S NEW ODOR-CONTROL TECHNOLOGY IMPRESSES MEDIA

As with any good journalist, CBC Saskatoon radio reporter Amy Jo Ehman approaches every news story with an open mind. Her response to the invitation to attend the Agri-Food Innovation Fund Manure Odour Control Field Day in late July, however, was slightly different.

"I expected hog manure to stink," she confesses.

And it did -- but not near as badly as she expected.

"I attended the field day because the issue of odor control in hog operations has raised a lot of public controversy, and I wanted a first-hand look,"

Ehman explains. "We weren't in the barns, but we were given a demonstration of a new machine that injected the swine manure directly into the ground. This produced no smell at all.

"One of the most interesting events was our lunch beside a manure pit. The pit was covered with straw, and we could eat there with no problem at all. That was a big surprise," says Ehman.

The latter included a straw-blowing demonstration with a TopGun machine by Highline Manufacturing Inc., says Denise Phipps, a summer employee of Pork Central, Saskatchewan Agriculture and Food in Saskatoon.

Phipps organized the late-July Manure Odour Control Field Day to allow members of the media and representatives from various companies and agencies, such as SaskWater and Canadian Imperial Bank of Canada, to experience the olfactory effects of various odor-control techniques emerging on Saskatchewan farms. Participants visited two commercial pork production facilities near Humboldt -- Big Sky Pork and Possberg Pork Farm 1 -- and Paul and Judy Ulrich's hog farm near Spalding.

"In addition to the TopGun demonstration we showed the effect of a pit additive product that controls odor by reducing the ammonia loss," says Phipps.

"The Prairie Agricultural Machinery Institute (PAMI) demonstrated its Pit Sweep, which will likely revolutionize the future of pit agitation in large swine operations. PAMI also demonstrated its cultivator-based, high-volume manure injection system. The main advantage of this system over the traditional broadcast methods is odor reduction, but it also retains more of the valuable crop nutrients."

Ed White, a Saskatoon reporter from *The Western Producer*, admits he was skeptical about the alleged benefits of these new odor-control technologies.

"I know hog manure can be horrific," White says. "But I was particularly struck by how well the straw cover over the lagoon worked. That's where we had the barbecue and there was no smell at all. I was also impressed with the comparison of the old and new lagoon agitation methods."

Marilyn Maki, a reporter with CBC Television in Saskatoon, attended the demonstrations of the Pit Sweep and PAMI's field injection system only. The odor reduction of both systems impressed her.

"It's nice to see the hog industry is addressing the odor problem with technology that seems to be effective," she concludes.

The entire field tour was attended by Murray Lyons, a Saskatoon *Star Phoenix* reporter who has had previous experiences on the traditional hog farm. He was most impressed by PAMI's direct-injection system.

"If this system was widely used, I don't think there would be any great

objection to the distribution of hog manure," says Lyons.

"But I was kind of apprehensive about the prospect of eating lunch beside the outdoor storage pit. I was generally impressed by the straw-blowing demonstration. We were quite comfortable eating there.

"So I left this field tour with the impression that the odor from swine operations is a manageable problem. And it seems the industry is working hard to deal with it," says Lyons.

For more information, contact: (name and address of Bill Henley)

Evaluation and Further Development

Participants in the tour were asked to formally evaluate the event. Almost all ratings were in the very good to excellent range, especially in the areas of usefulness of information and quality and content of demonstrations. Interesting comments to note were:

1. The need to do this type of field day in other parts of the province, and
2. The desire by people outside the pig industry to see, hear and touch a real pig.

Printed material as well as a video on odour reduction are in the process of being developed over the winter months in 1997/98. A tour is also tentatively being planned for the southern part of Saskatchewan for the spring of 1998. Other technology developments that will hopefully be demonstrated include the use of a pipeline direct injection system and the use of liquid manure pumping equipment that effectively handles the straw from a straw cover.

BACK INDEX NEXT

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CONFINEMENTS

Confinements

All confinements (totally roofed operations), including small animal feeding operations, are required to follow state regulations when building or operating a facility, including retaining all manure until it is land applied. For existing confinement feeding operations, most requirements concern manure management and land application. See Current Requirements below for more information.

Proposed new, and existing confinement feeding operations that plan to expand or modify the operation, may also have to:

- apply for a construction permit prior to building, modifying or expanding,
- follow construction standards when building,
- develop and submit a manure management plan prior to building.

The exact pre-construction requirements will depend upon the size and type of operation being proposed. Producers who are planning a change in an existing confinement feeding operation or building a new operation should allow time for permit applications to be approved. Look for the specific requirements under Construction Requirements on the tab below.

For new construction, choosing a good site may be one of the most important decisions a producer can make. The DNR's AFO Siting Atlas may help producers choose the optimum site for a proposed facility.

Small Animal Truck Wash Facilities

Owners of small livestock truck washing businesses no longer need a permit for land application. However, wastewater must not cause runoff or water quality violations during land application. All equipment washed at the facility must be owned by the same person and the monthly average of wash water must average 2,000 gallons per day or

less. Livestock truck washes that do not qualify as small, should contact Paul Petitti at the Spencer field office for permitting requirements. Facilities washing other types of trucks, in addition to livestock, must obtain a wastewater operation permit to land apply. Find instructions in the *Land Application Manual*.

Current Requirements | Construction Requirements | Manure Management

For already existing confinement feeding operations, most requirements concern manure management and land application. Even small animal feeding operations (500 or less animal unit capacity) must at a minimum:

- retain all manure on site between periods of land application,
- observe land application separation distances,
- report any manure releases and
- correctly dispose of dead animals factsheet .

Larger confinement feeding operations (more than 500 animal unit capacity) must also have an approved manure management plan and use a certified manure applicator to apply manure.

For more information about required manure management and other requirements, see the manure management tab.

Producers interested in stockpiling dry manure should see either of the following fact sheets:

- Dry-bedded Manure Stockpiling Regulations for Cattle and Swine Confinements fact sheet
- Confinement Dry Manure Stockpiling Regulations fact sheet .

Additional requirements may apply to confinement feeding operations as a condition of a construction permit, including land application restrictions required as part of the Master Matrix operational conditions.

For confinement feeding operations that plan to modify or expand an existing site, or build a new site, see the Construction Requirements tab to determine the specific regulations that apply.

natural resources in cooperation with individuals and organizations to improve the quality of life for Iowans and ensure a legacy for future generations.

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FREQUENTLY ASKED QUESTIONS

DEAD ANIMAL DISPOSAL

ENVIRONMENTAL SERVICES DIVISION | WWW.IOWADNR.GOV

Q **How long do I have to dispose of dead livestock?**

A The Iowa Department of Agriculture and Land Stewardship requires that you must dispose of all dead livestock as soon as reasonably possible after the death of the animal.

Q **Can I burn dead livestock?**

A You may incinerate dead livestock in an engineered incinerator. Homemade incinerators may not be used. Open burning is not permitted.

Q **Can I bury dead livestock?**

A Yes. Burial must be no greater than 6 feet deep with a minimum of 30 inches of soil cover. Burial must be in well drained soils and be at least 2 feet above the highest groundwater elevation. Burial must be at least 100 feet from a private well, 200 feet from a public well, 50 feet from an adjacent property line, 500 feet from a residence and more than 100 feet from a stream, lake or pond. Burial cannot be in a wetland, floodplain or shoreline area.

Q **How many animals can I bury?**

A You may bury up to 44 butcher or breeding hogs, 7 slaughter or feeding cattle, 73 sheep or lambs, 400 poultry carcasses on any given acre per year.

Q **What if my rendering service is late or cannot make it within a few days?**

A You are ultimately responsible for the proper disposal of your livestock. Consider an alternative such as burial or taking the animals to a landfill.

Q **I have several animals that die daily. Do I have to cover and dig a new hole every day?**

A No. You must cover all animals as soon as reasonably possible with six inches of soil, and then cover with 30 inches of soil when the burial pit is at its maximum allowable capacity.

If I cannot bury or render my dead livestock, what else can I do?

Contact you local sanitary landfill. Landfills will generally accept dead livestock.

Q **Can I bury dead livestock on my neighbor's farm ground that I rent?**

A No. Dead livestock can only be buried on the premises where they originated.

Q **What happens if I have a disaster and a mass die-off?**

A Contact a rendering service, landfill or the local DNR Environmental Protection Division office for further assistance.

Q **Can I compost dead livestock?**

A Yes. Contact the DNR or your local Iowa State University Extension office for information on proper livestock composting.

- Composting Dead Animals: A new solution to an old problem
- Composting Swine Mortalities in Iowa
- Requirements for composting can be found in Chapter 105.3 (general requirements) and Chapter 105.6 (specific requirements) of the Iowa Administrative Code under Environmental Protection Commission.

Q **Am I required to have a "dead box"?**

A No. A "dead box" or some similar container to store dead livestock will reduce the chances of disease transmission and improve the aesthetics of your operation. However, it is not a requirement.

IOWA DEPARTMENT OF NATURAL RESOURCES

AFO FACTSHEETS

AFO Factsheets

Animal Feeding Operations Reports	
2010 Manure on Frozen and Snow-Covered Ground Report to the Governor and General Assembly	
2011 Manure on Frozen and Snow-Covered Ground Report to the Governor and General Assembly	
2012 Manure on Frozen and Snow-Covered Ground Report to the Governor and General Assembly	

Fact Sheets and Information for Animal Feeding Operations

The following fact sheets provide information on regulations, designed primarily for livestock and poultry producers: NPDES Permits for Combined Operations, Manure Management Plans for Confinements, Manure Application, Construction, Construction for Confinement Feeding Operations, Open Feedlots.

NPDES Permits for Combined Operations, Confinements and Open Feedlots	
NPDES Permits -- Determining if a Combination Open Feedlot and Animal Confinement Must Apply for an NPDES Permit in 2008, posted 10/08	
DAIRIES — ACT NOW! NPDES Permits Needed for Combined Cow Yard – Confinement Operations, posted 10/08	
What to Expect when DNR Inspects	
Alluvial and Karst Determinations	
DNR Guide to Alluvial and Karst Determinations for Animal Feeding Operations	
Manure Management Plans for Confinements	
The Iowa Phosphorus Index and Manure Management Plans for Confinements, posted 1/06	

MMP Fact Sheet	
Manure Management Plan Administrative Review Checklist, revised 2/05	
Instructions and Introduction, 542-4000 revised 2/04	
Appendix A - Reference Tables, 542-4000 revised 10/11 with updated yield data and rules	
Preliminary Checklist for Manure Management Plan Preparation	
Manure Application, Manure Applicator Certification	
Commercial Manure Applicator Certification Factsheet, revised 11/12	
Confinement Site Manure Applicator Certification Factsheet, revised 11/12	
Manure Application, Land Application	
Separation Distances for Land Application of Manure, revised 10/08	
High Quality Water Resources, revised 3/03	
Construction - Other Permits Required	
Storm Water Permit (If more than one acre is disturbed by construction) How to File a Complete Notice of Intent, 1/03	
NPDES General Permit No.2	
Construction for Confinement Feeding Operations	
Concrete Standards	
Distance Requirements for Construction, Effective 3/1/03, Updated 2/15	
Designated Wetlands, effective on Aug. 23, 2006	
Using the Master Matrix for Construction Permits	
Example Aerial Photo and Map Showing Separation Distances, 10/06	
Stockpiles for Confinements	
Dry-Bedded Manure Stockpiling Regulations - For Cattle and Swine Confinements	
Confinement Dry Manure Stockpiling Regulations	
Open Feedlots	
Design Criteria for Livestock Waste Control Systems at Open Feedlot Medium CAFOs 2/11	
Open Feedlot Construction Permit Manual, 11/06 (6.6MB)	
Testing the Waters: A Beef and Dairy Producers' Guide to Check Water Quality below Open Lots	
Stockpiles for Open Lots	
Open Feedlot Manure Stockpiling Regulations	
Major Water Sources	
Table 1: Major Water Sources - Rivers and Streams, 3/06 (Map available on AFO Siting Atlas)	
Table 2: Major Water Sources - Lakes, 3/06 (Map available on AFO Siting Atlas)	
Technical Assistance	
Field Offices -- Providing Assistance for Animal Feeding Operations, 10/05	

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To conserve and enhance our natural resources in cooperation with individuals and organizations
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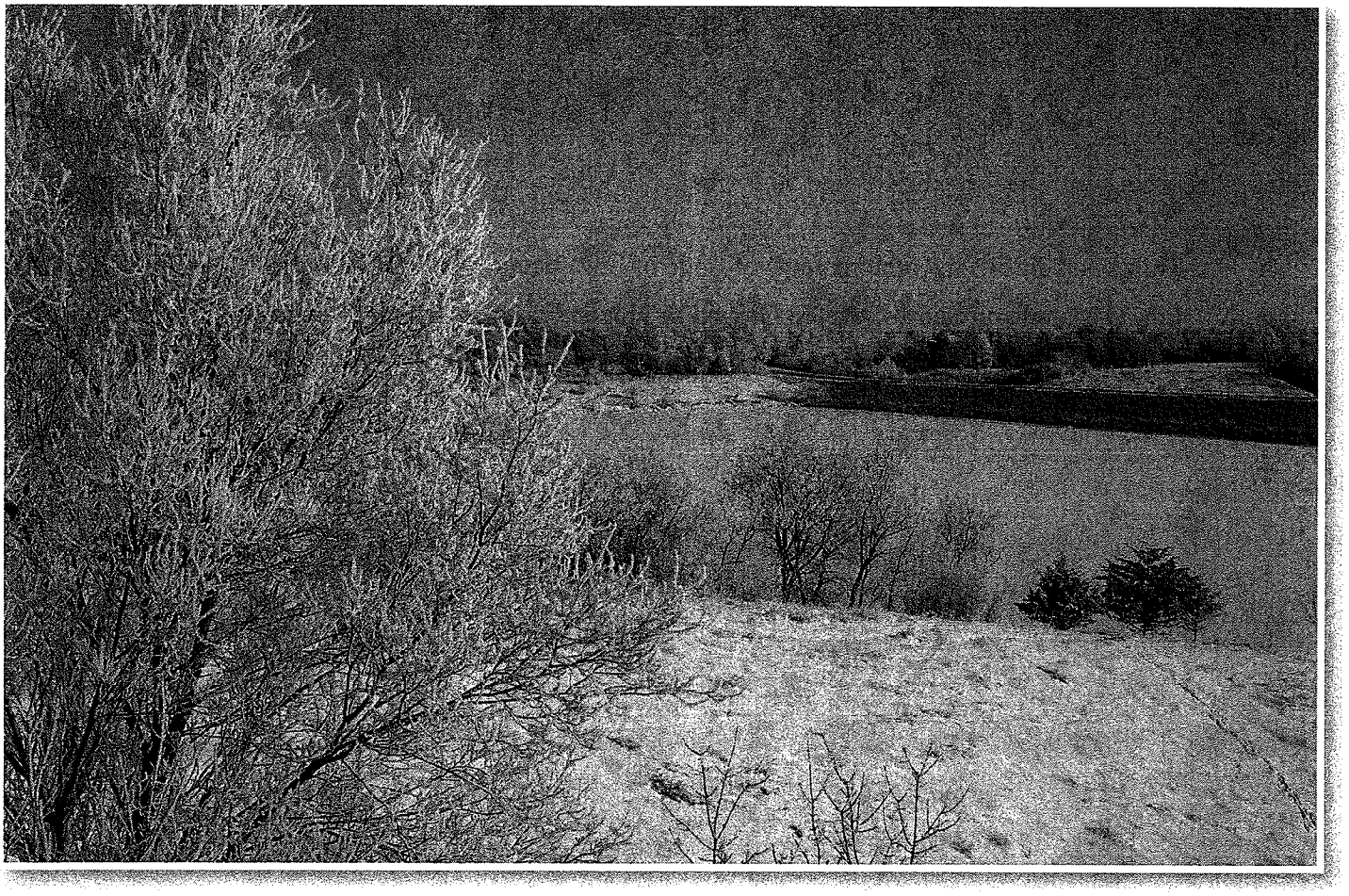
MANURE ON FROZEN & SNOW-COVERED GROUND

A REPORT TO THE GOVERNOR AND GENERAL ASSEMBLY | FEBRUARY 15, 2012



SUBMITTED BY ROGER L. LANDE, DIRECTOR
IOWA DEPARTMENT OF NATURAL RESOURCES

This report fulfills the requirements of Code of Iowa Sections 459.313B Application of Liquid Manure on Snow-Covered Ground or Frozen Ground – Annual Report

Background

In 2009, the General Assembly passed legislation that limits the surface application of liquid manure from confinement feeding operations during the winter. This legislation was designed to address the surface runoff and water pollution problems that may occur when manure is surface applied on frozen or snow-covered ground.

Those water quality problems are most prevalent during late winter application. For that reason, the legislation purposely restricted surface manure application except in emergency situations. Specifically, those confinements large enough to require a manure management plan (more than 500 animal units) are prohibited from surface applying if the manure cannot be injected or incorporated, from:

Dec. 21 to April 1 on snow-covered ground, and
Feb. 1 to April 1 if the ground is frozen.

The legislation leaves a window of opportunity for producers to surface apply manure early in the winter, or at any time the ground is not snow-covered or frozen. The limits on late winter application also encourage producers to plan for manure management, resulting in more nutrient uptake and better water quality.

The General Assembly defined what constitutes an emergency and explicitly stated that the failure to properly account for the volume to be stored is not an emergency. The law gave several examples of emergencies indicating they would be limited to infrequent events that could generally not be avoided such as a natural disaster, unusual weather conditions, or equipment or structural failure.

In 2010, producers who were concerned about having inadequate manure storage, and consequently having to apply manure during the winter, asked the Environmental Protection Commission for more time to improve their storage capacity. In the final adoption of rules, commissioners approved giving confinement producers with inadequate storage an extension to do emergency application through the 2014-2015 winter. This gave producers additional time to make decisions and make appropriate changes to their operations.

Producers who anticipate needing emergency land application are required to identify suitable fields in their manure management plans (MMPs). The law places additional restrictions on land application such as defining the types of fields where application would be allowed and protecting tile intakes. Starting Dec. 21, 2009, producers began notifying the appropriate DNR regional field office prior to application.

Requests for Emergency Application

Most of the state had nearly ideal weather conditions for manure application following harvest in the fall of 2011 and well into 2012. Dry weather and no snow meant most producers had many weeks to empty manure storage structures and land apply manure, making requests for emergency application after Dec. 21 unlikely. That proved true, and

by Feb. 15, 2012, the DNR had received zero requests for emergency surface application from producers affected by the law. This compares with nine requests from producers who lacked sufficient storage during the winter of 2010-2011. And it compares with 43 in the winter of 2009-2010 when a wet fall and early snowfalls limited after-harvest manure application.

An additional four producers contacted field offices with concerns about winter manure application in 2012. None of these was required to report emergency application on snow-covered or frozen ground. Most were open feedlots or had dry manure, so they are not required to abstain from or report emergency manure application on frozen or snow-covered ground. Field staff assisted these producers in identifying safe areas for land application.

Table 1: Number of Requests for Emergency Application by DNR Field Office Area

Region of State	Number of Requests		
	Winter 2009-2010	Winter 2010-2011	Winter 2011-2012
Northeast	7	5	0
North central	5	2	0
Northwest	11	1	0
Southwest	8	0	0
South central	9	1	0
Southeast	3	0	0
Total	43	9	0

As inquiries come into field offices, DNR staff and producers work together to decide on options for land application, the requirements for fields eligible for emergency surface application and the risks of surface runoff and water pollution when applying during late winter to frozen or snow-covered ground. Together, staff and producers sort through and identify the best possible sites to surface apply manure.

Complaints

It's clear that confinements needing an MMP are not the only type of facility that poses a potential risk to surface water quality as snow melt and thawing occur. Other types of livestock and poultry facilities can also cause runoff or pollution issues. Complaints concerning manure application on snow-covered or frozen ground are included in the four non-emergency applications reported to the DNR and mentioned above.

In past years almost 78 percent of the complaints reported to the DNR about manure application on snow-covered or frozen ground concern producers not regulated under this law. In 2009-2010, nearly half (45 percent) of complaints about winter manure application were about small animal feeding operations (confinements that are not regulated under this law). During the 2010-2011 winter, less than 22 percent of complaints concerned regulated confinements spreading liquid manure.

The four reports received this winter were about solid manure or manure originating from open feedlots. From the producer and complainants' viewpoints, problems occur at all types of facilities, not just larger confinement feeding operations.

Follow-up and Implications

There are currently 5,666 confinement feeding operations in the state with an animal unit capacity of 500 or more. Confinements of this size are required to notify the DNR and have approval before building, modifying or expanding. They are also required to have manure management plans and use a certified manure applicator. Each facility is required to keep records of manure application and plan changes, submit annual plan updates to the DNR, and take soil fertility tests at least once every four years. If they handle liquid manure, the same facilities are required to limit liquid manure application on frozen or snow-covered ground.

Obviously weather plays a large role in how well confinement facilities can comply with state law on winter manure application – the warmer and drier the weather, and the later it freezes or snows, the easier it is to complete manure application in the fall or early winter. However, producers also have a responsibility to have adequate manure storage or to consider alternative ways to store or transport manure if there is an early freeze or snow fall. Several confinements added manure storage structures recently – seven in 2010 and five in 2011 – indicating producers want to ensure they have adequate manure storage.

Good weather, good management and additional storage have successfully prevented manure spills this winter.

Trends in construction of animal confinements indicate many new facilities are planned for construction or expansion in the coming year. (See Table 2 below.)

Table 2: New Construction Applications Received 2006 to 2011

New Construction 2011	2011 Totals	2010 Totals	2009 Totals	2008 Totals	2007 Totals	2006 Totals
Permitted Hogs (new)	9	2	5	98	125	172
Permitted Hogs (expansions)	66	16	20	96	117	99
Permitted Poultry	2	3	5	9	2	3
Permitted Open Cattle lots	11	5	7	13	7	33
Permitted Confined Beef Cattle	14	3	2	5	9	5
Permitted Confined Dairy Cattle	4	2	8	9	5	4
Permitted Combined Operation	8	14	11	NA	NA	NA
Totals	**114**	**45**	**58**	**230**	**265**	**316**

The increase in construction permit applications for permitted facilities were up again in 2011, and the number of applications coming in 2012 has already exceeded the number

received at this same time in 2011. The DNR has reallocated field time to assist with review of the construction permits.

Iowa's animal producers are taking the requirements for winter application seriously. The combination of good management and a mild winter has kept the nutrient value of the manure on the field where it can be used for this year's crop. In addition, producers are continuing to increase their storage capacities to reduce the likelihood of having to apply manure during the winter season.

IOWA DEPARTMENT OF NATURAL RESOURCES

WHAT TO EXPECT WHEN DNR INSPECTS

WHAT CAN PRODUCERS EXPECT as the Iowa DNR reviews about 8,600 large and medium-sized livestock facilities in the next five years?

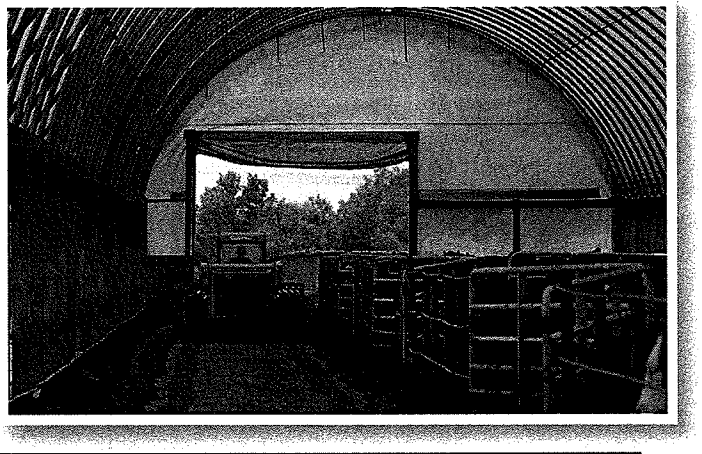
1. Not all operations will have an on-site inspection. Larger facilities, ones near a water of the U.S. (stream, lake, etc.) and ones with past runoff events are most likely to be inspected.

2. If your operation is inspected, DNR staff will call you before they come. Expect one to three days notice.

3. DNR staff will follow your bio-security protocols. If you don't have any, the DNR staff will follow DNR standard protocols.

4. DNR inspectors will let you know which records they will want to review: the complete, up-to-date nutrient or manure management plan; inventory records; and application records for the last five years.

5. Inspectors will look at your operation for signs of runoff. They will want to walk around your buildings to see if there are past signs of runoff. They will be looking at berms, freeboard and potential for erosion. They will also look for:
   - Number of pens, manure control and storage structures
   - Application equipment
   - Areas downhill of operation, looking for signs of runoff to the ground, wells, sinkholes or waters of the United States
   - Manure handling and control, including settleable solids removal, pen scraping, stockpiles and dewatering schedule
   - Chemical storage areas (this applies only to facilities with NPDES permits)
   - Feed storage and mortality handling areas



6. All inspectors will use a standard procedure during the inspection. It's designed to keep the inspections consistent, regardless of who is inspecting.

7. All inspectors will use standard forms to aid in uniformity.

8. If you've had an enforcement action due to runoff in the last five years, DNR staff will review their findings and discuss any needed improvements.

9. Before they leave, DNR inspectors will let you know what they found and what needs improvement.

10. You will find DNR environmental specialists, who conduct the inspections, to be courteous, fair professionals who share your concern for a healthy environment.

DNR 117: March 2014

The inspections are part of a work plan agreement with the U.S. Environmental Protection Agency. It's designed to strengthen how Iowa implements the federal National Pollutant Discharge Elimination System (NPDES) program.

You can find the work plan agreement, the procedures and the work plan obligations at **www.iowadnr.gov/afo** and search **EPADNRWorkplanMaterials.**

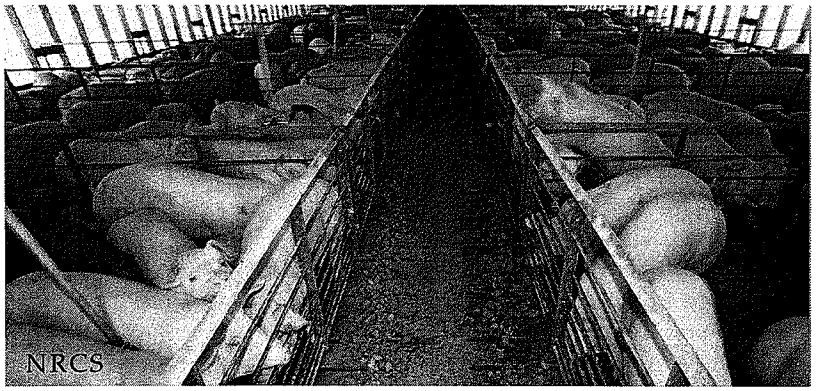
During the 2013 Iowa General Assembly session,

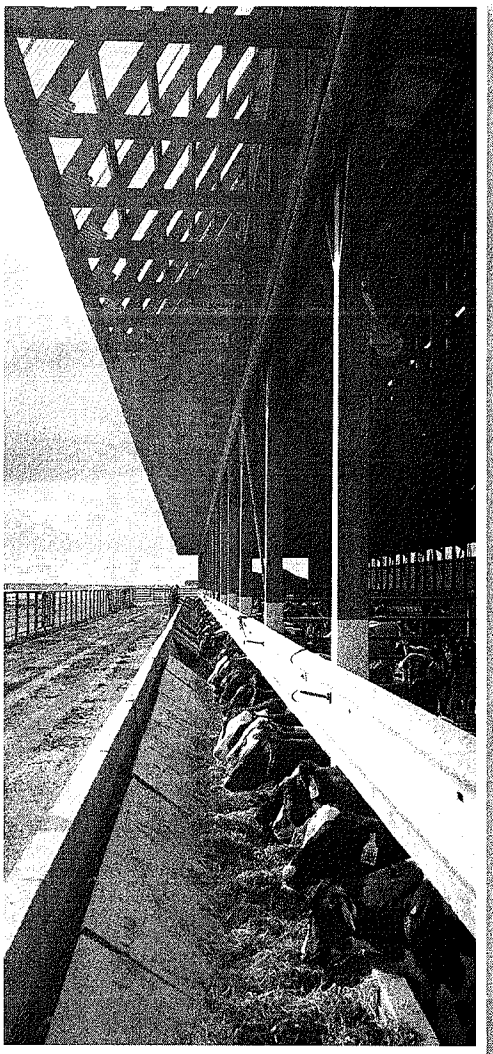
$700,000

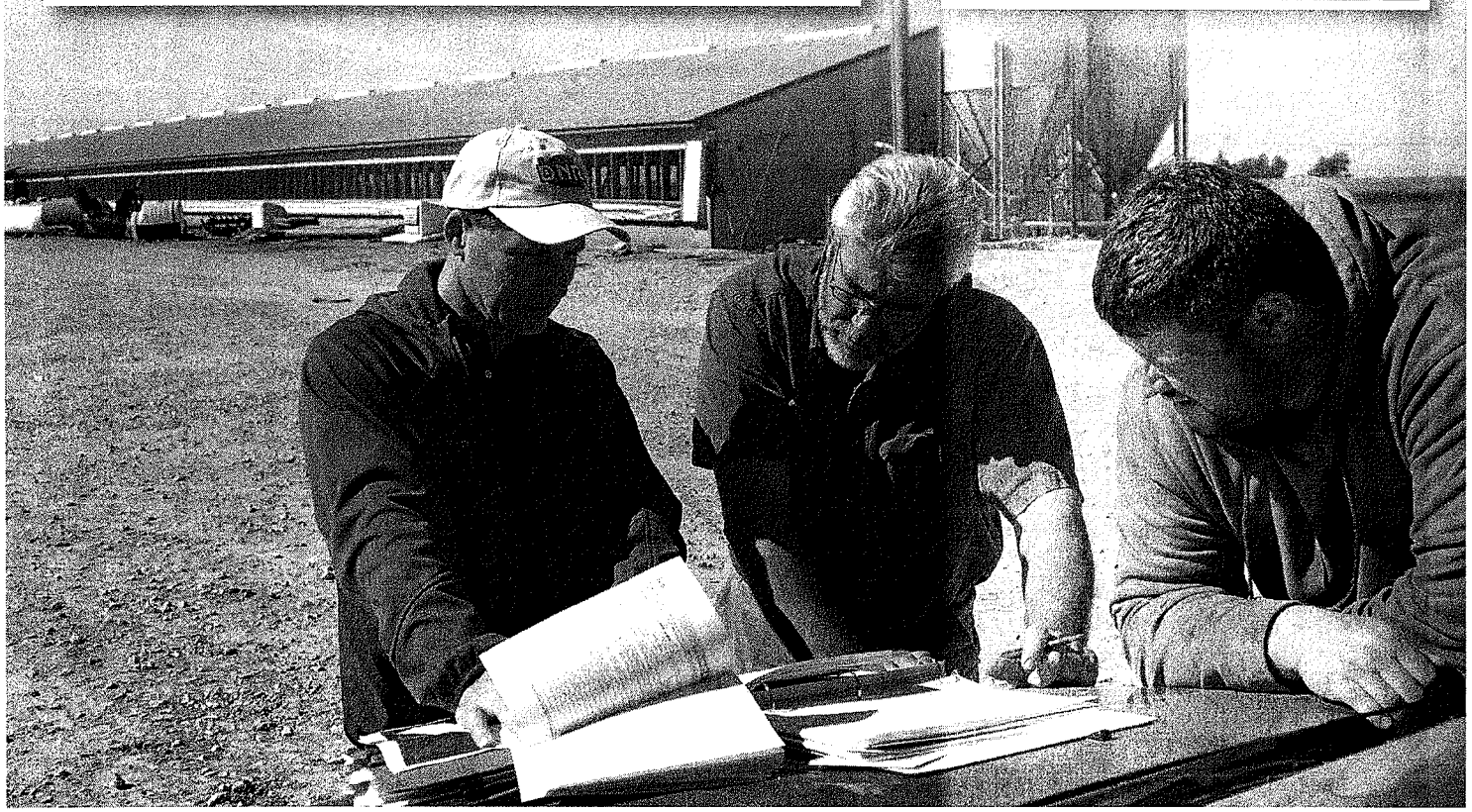
was appropriated to hire seven additional field staff for animal feeding operation reviews.

The hiring process on those positions has been completed. By April 1, 2014, DNR staff will have taken part in approximately 800 hours of training to ensure fair, complete and consistent inspections.

WWW.IOWADNR.GOV/AFO







DNR Guide to

Alluvial and Karst Determinations for Animal Feeding Operations

Environmental Services Division | www.iowadnr.gov

The Iowa Department of Natural Resources (DNR) can no longer offer geological reviews of karst and alluvial determinations for Animal Feeding Operations (AFO).

The following guidelines will help you successfully meet the DNR's standards for proposed construction of confinement (totally roofed) animal feeding operations, dry-bedded manure stockpiles in alluvial soils and karst terrain, and dry manure stockpiles in karst terrain. Unformed manure or egg washwater storage structures for confinement operations are prohibited in karst terrain.

Step 1. Find Out if Proposed Site is in Karst Terrain or Alluvial Soils

Check the DNR Siting Atlas Map

For newly proposed AFO sites or sites that are expanding, the AFO Siting Atlas can help you determine if the proposed confinement construction, dry-bedded manure stockpile or dry manure stockpile location is in mapped alluvial soils, karst or potential karst.

Check for Existing alluvial or karst determinations

A karst or alluvial determination may have already been completed for expansion of existing sites or even new sites that were proposed in the past, but never constructed. Check the records of the facility or search for the facility in the AFO database and look for a record of the determination under the GeoReview tab.

Determinations are valid for the specific location outlined in the original determination regardless of the name or ownership of the facility. DNR staff members have completed more than 3,000 determinations. However, recent determinations may not be in the database. The AFO database will be updated with past determinations as time allows.

Sites located in mapped alluvial soils (shaded blue) or potential karst (shaded pink) according to the AFO Siting Atlas are assumed to be in alluvial soils or karst terrain.

NRCS

A qualified professional, USDA Natural Resources Conservation Service (NRCS)-qualified staff or a soils professional can submit documentation refuting the alluvial or karst classification.

To Refute Alluvial Soils or Karst Terrain

Alluvial Soils: Documentation to refute alluvial soils must include:

- Name and qualification of soils professional.
- Color NRCS soils map with soils description including parent material and flood frequency.
- Copy of topographic map indicating creek elevation and proposed site elevation.
- Copy of Federal Emergency Management Agency (FEMA) Flood Hazard or Flood Insurance Rate Map (FIRM) if available.
- Copy of AFO Siting Atlas showing locations of proposed structures.

Karst Terrain: A well record or boring may be sufficient to remove the karst designation unless the site drains directly to a known sinkhole. The well record or boring must meet the following three criteria:

- taken by a certified well driller, NRCS-qualified staff or soils professional,

- taken from within 200 feet of the site, and
- shows more than 25 feet of unconsolidated material (low permeability soil) between the bottom of the proposed structure and the bedrock surface.

Submit all documentation to the appropriate DNR field office if the proposed project is less than 1,000 animal units (AU) and uses formed storage. If the proposed project is 1,000 AU or greater or uses earthen (unformed) storage, then submit all documentation with the construction permit application.

Step 2. Meeting State Requirements for Confinement Structures

ALLUVIAL SOILS: If the AFO Siting Atlas shows the proposed confinement structure is in alluvial soils and no documentation can be found to refute the mapping, then the applicant must contact the DNR's Flood Plain Program for a flood plain determination.

Proposed confinements located in alluvial soils with less than 1,000 animal units must petition the Flood Plain Program for a declaratory order stating the location is not a prohibited site. For convenience and to speed the review process, use DNR form 542-8157. Flood Plain staff members have 30 days to respond from the date they receive the complete petition. They will send the declatory order and any documentation to the applicant and appropriate DNR field office.

Confinements in alluvial soils that require a construction permit (1,000 animal units or more, or earthen storage) must request a Flood Plain determination and send it in with the construction permit application (DNR form 542-1428).

For more information about the Flood Plain review process and to submit petitions or determination requests, please visit the Flood Plain website or call the toll free help line at 866-849-0321.

IN KARST TERRAIN: If the proposed confinement structure is located in karst according to the AFO Siting Atlas and no documentation can be found to refute the mapping, then the applicant must conduct a soils investigation to meet the upgraded standards for proposed formed confinement structures located in karst terrain. The upgraded concrete standards require a soils investigation to verify vertical separation between the karst bedrock and the bottom of the structure. See the Iowa Administrative Code 567 — Chapter 65.15(14)"c."

An existing well record or boring may be sufficient to meet the upgraded standards. The soils investigation must include the following:

- a clear indication of the locations of the borings relative to the proposed structure,
- a description of the subsurface materials,
- clear documentation that a separation distance to bedrock will be met, including information about the depth of the proposed storage structure relative to the ground surface, and
- the name of the qualified individual who completed the investigation.

Send all soil boring data to the appropriate DNR field office if the facility is less than 1,000 AU. Send all soil boring data in with the construction permit application if the facility is 1,000 AU or more.

DRY MANURE STOCKPILES: Specific requirements for soils investigations and required separation from karst bedrock to dry manure stockpiles are listed in IAC — 567 Chapter 65.2(10). More information is also available in the Dry Manure Stockpiling Regulations fact sheet.

DRY-BEDDED CONFINEMENTS AND STOCKPILES: Dry-bedded confinements and stockpiled manure from dry-bedded confinements located directly above alluvial aquifers have additional requirements. Alluvial aquifers are generally areas underlain by sand and gravel adjacent to rivers. Alluvial aquifers are a subset of the alluvial soils mapped on the AFO Siting Atlas. The DNR will be updating the AFO Siting Atlas to include an improved map of potential alluvial aquifer areas in the future.

Specific requirements for soils investigations and required separation from karst bedrock and alluvial aquifers for dry-bedded confinements and dry-bedded manure stockpiles are listed in IAC — 567 Chapter 65.15 (8) and 65.2(11). More information is also available in the Dry-Bedded Manure Stockpiling Regulations fact sheet.

For questions about how to interpret these rules or which rules apply, please contact Gene Tinker at 563-927-2640 or your local field office.

Information Resources

DNR Field Offices

Northeast • Manchester • 563-927-2640

North central • Mason City • 641-424-4073

Northwest • Spencer • 712-262-4177

Southwest • Atlantic • 712-243-1934

South central • Des Moines • 515-725-0268

Southest • Washington • 319-653-2135

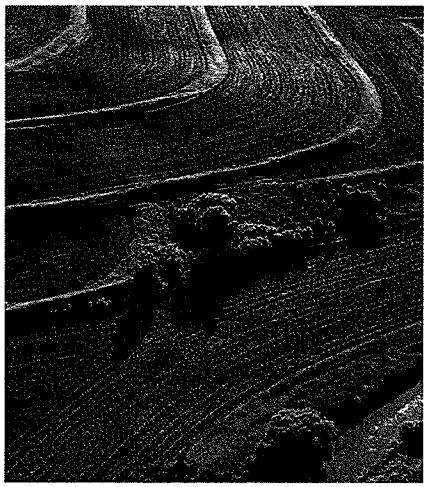
DNR AFO Website • www.iowadnr.gov/afo

DNR Flood Plain Website

floodplain.iowadnr.gov • 866-849-0321

The Iowa Phosphorus Index

and Manure Management Plans for Confinements



NRCS

Producers who plan ahead can influence their P index results by controlling erosion.

Incorporating the P index into your MMP

If you have a confinement and are required to have a manure management plan (MMP), you will soon be required to use the Iowa Phosphorus Index (P index) to determine application rates when developing the MMP. Some people are already using the P index. The remainder must use the P index starting in the fall of 2006 or 2008.

The P index comes from the field office technical guide published by the U.S.D.A.'s Natural Resources Conservation Service (NRCS).

Producers who plan ahead and run the P index before it's required in their manure management plan are more likely to make this transition successfully. The Department of Natural Resources (DNR) has the following recommendations that will help:

- First, find out when the P index is required for your operation. *See Table 1.*
- Determine levels of soil P by taking soil samples as soon as possible.
- Run RUSLE2, the NRCS soil loss calculator, and the P index for each field in your plan.
- Decide how the P index results will affect your operation and what you can do about it.

Since the P index is based on several factors including the erodibility of the soil, the soil test results and the distance from a stream, many producers will find that they will be able to use nitrogen-based application rates. Others may be able to adjust their land management practices, such as increasing residue cover, and still use a nitrogen-based application rate.

What is the implementation schedule for P index-based MMPs?

The P index will be phased in as indicated below. An original MMP is the first time an MMP is submitted.

Table 1. Date P index must be used based on date original MMP was submitted

Original MMP submitted	P index-based MMP update needed
prior to April 1, 2002	first updated plan after Aug. 25, 2008
April 1, 2002 - Oct. 24, 2004	first updated plan after Aug. 25, 2006
on and after Oct. 25, 2004	upon submittal

How does the P index work?

The NRCS P index estimates the potential for P movement from a field based on landscape features, soil P, soil conservation and nutrient management practices. The result of the P index is a site vulnerability rating, which describes the risk of P movement from the field as very low, low, medium, high or very high.

Are there soil sampling requirements?

There are specific sampling requirements for soil samples used in the MMP. Soil samples must be taken at least once every four years and one sample must be taken for every 10 acres of a field. See the MMP rule for the complete soil sampling requirements. See ISU Extension publication Pm-287 "Take a Good Sample to Help Make Good Decisions," for more information on taking soil samples.

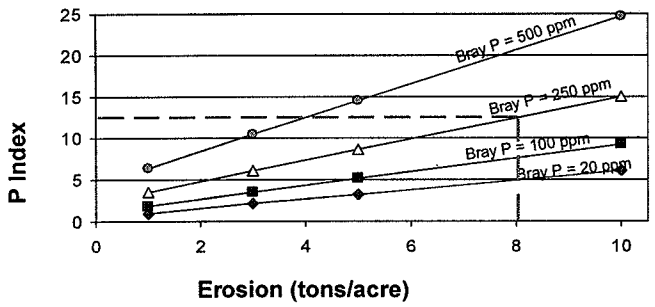
What's needed to run the P index?

- Estimate of gross erosion (sheet and rill, ephemeral gully and classic gully).
- Distance from center of field to nearest perennial or intermittent stream.
- Recent soil P test results.
- Soil type.
- Rate and method of P application.
- Management system (tillage, crop rotation, conservation practices).

Managing erosion is the key way to reduce the P index on highly erodible fields. For example, using

Chart 1 below, if current erosion is eight tons per acre and soil tests show a Bray P of 250 ppm, the P index can be found to the left of the intersection of the dotted lines. In this example field, the P index will be 12.5.

Chart 1. Impact of erosion and soil P on P Index



By reducing erosion to 5 tons per acre, a producer can reduce the P Index to 8, using the same soil test results of Bray P equal to 250 ppm.

How will the P index influence manure application rates in MMPs?

Manure application rates are based on the NRCS P index (site vulnerability rating) of each field. *See Table 2 below.*

Table 2. Application Requirements based on P index

P Index	Application Requirements
(0-2)	N-based manure management.
(>2-5)	N-based manure management but P application rate cannot exceed two times the P removal rate of the crop schedule.
(>5-10)	Until December 31, 2008, P-based manure management while adopting practices to reduce P index to 5 or below.
(>10)	No manure application until practices are adopted to reduce P index to 5 or below.

The DNR rule provides considerable flexibility for determining application rates unless a field greatly impacts water quality. *See Table 3 for example fields.* Producers will likely have the option of continuing to use nitrogen (N)-based manure application on many fields. However, even when planning manure applications based on N, producers should consider the effect that application rates will have on soil P concentrations. Over time, higher soil P concentrations may result in a higher P index, which could lead to application rate restrictions.

What is a phosphorus-based application rate?

A P-based manure application rate replaces the P removed from the soil by a crop. A common misconception of P-based rates is that they drastically reduce application rates. This would be true if manure applications were limited to applying P only for the crop receiving the application. However, P can be applied for multiple crop years in a single application. This feature makes a P-based system easier to implement than producers may have anticipated.

Table 3 shows the effect of soil P concentrations and erosion on the P index in four hypothetical fields. Field A, with an optimum soil test and low erosion, has a low P index risk rating while field D, with a very high soil test and high erosion, has a high P index risk rating.

Table 3. P index components on four hypothetical fields

Location: Audubon County, center of field is 500 feet from a stream, C-slope of 5 to 9%, no buffer

Factors	Field A	Field B	Field C	Field D
Gross Erosion (Tons/A)	3	3	8	8
Bray 1-P (ppm)	20	200	20	200
Sediment Trap/ SDR[1]	0.58	0.58	0.58	0.58
Buffer Factor	1.0	1.0	1.0	1.0
Enrichment	1.1	1.1	1.1	1.1
STP[2] Erosion	0.78	1.54	0.78	1.54
Erosion	**1.51**	**2.97**	**4.03**	**7.91**
Precipitation	7.4	7.4	7.4	7.4
Runoff	0.21	0.21	0.21	0.21
STP Runoff	0.15	1.05	0.15	1.05
Run-off	**0.23**	**1.61**	**0.23**	**1.61**
Flow	0.1	0.1	0.1	0.1
Precipitation	7.4	7.4	7.4	7.4
STP Drainage	0.07	0.2	0.1	0.2
Subsurface[3]	**0.07**	**0.15**	**0.07**	**0.15**
P index	**1.81**	**4.73**	**4.33**	**9.67**
P index Risk Rating	**Low**	**Medium**	**Medium**	**High**

Where can I find more information on the P index?

The Iowa P index calculator (an Excel spreadsheet), the RUSLE2 soil loss calculator, a list of technical service providers who can run the P index for producers and information about the Iowa P index are available on the Iowa Natural Resources Conservation Service's Web site, www.ia.nrcs.usda.gov. A copy of the MMP rule is available in Appendix A of the MMP form, www.iowadnr.com/afo/forms.html, DNR form number 542-4000.

1. SDR is the sediment delivery ratio
2. STP is the soil test P
3. Subsurface drainage includes tile and soil drainage

ENVIRONMENTAL PROTECTION COMMISSION[567]

Adopted and Filed

Pursuant to the authority of Iowa Code section 459.103, the Environmental Protection Commission hereby amends Chapter 65, "Animal Feeding Operations," Iowa Administrative Code.

The amendments modify the construction design standards for formed manure storage structures as prescribed by 2002 Iowa Acts, chapter 1137. The standards include upgraded requirements for formed manure storage structures in karst areas and separate construction design standards for formed manure storage structures that store manure exclusively in a dry form.

Notice of Intended Action was published in the Iowa Administrative Bulletin on August 20, 2003, as **ARC 2716B**.

Written comments were received by the Department. In addition, oral comments were received by the Department at a public hearing held on September 11, 2003.

As a result of the written and oral comments, the following changes have been made to the Notice of Intended Action:

1. The introductory paragraph of subrule 65.15(14) has been modified to address the Iowa Engineering Society's concerns. As a result, a definition has been added for a professional engineer licensed in the state of Iowa (PE) and for an engineer working for the USDA Natural Resources Conservation Service (NRCS engineer).

2. Adopted subrule 65.15(14) now provides alternative design methods, other than the DNR minimum standards initially proposed in the Notice. These alternative design methods include a design prepared and sealed by a PE or an NRCS engineer. When a PE or an NRCS engineer is not involved, the design shall be in accordance with MidWest Plan Service (MWPS) or in accordance with DNR minimum standards. This will allow for a more flexible, site-specific design and industry-based standards. If the design is prepared and sealed by a PE or an NRCS engineer, it shall be in conformance with the American Concrete Institute (ACI) Building Code ACI 318, ACI 360, or ACI 350; or MWPS-36 or MWPS TR-9; or Portland Cement Association (PCA) publication EB075, EB001, or IS072; or a combination. These technical documents meet or exceed the proposed minimum concrete standards set forth in the Notice.

3. Furthermore, subrule 65.15(14) requires that additional minimum concrete standards be met if the design of a formed manure storage structure is not prepared and sealed by a PE or an NRCS engineer.

4. For the subgrade preparation required in 65.15(14)"a"(2), numbered paragraph "1," a definition of the term "uniform" has been added for clarification purposes. Adopted subrule 65.15(14) requires that if the subgrade is nonuniform, it shall be made uniform. This specification, however, is only for a formed manure storage structure that is not designed and sealed by a PE or an NRCS engineer, due to the reasons explained in "2" above.

5. In 65.15(14)"a"(2), numbered paragraph "2," the requirement to install a drain tile at 2 feet below the footing elevation required has been modified. Several comments indicated this requirement might compromise the structural stability due to the need to place fill material underneath the footings. Comments recommended that the drain tile be installed right at the footing elevation, instead of at 2 feet below the footing, as initially proposed. A new Figure D-1 has been added at the end of Chapter 65 to illustrate the ideal location of the drain tile. In addition, the option to install fabric around the drain tile or a combination of fabric and granular material has been added. This specification, however, is only for a formed manure storage structure with a design not sealed by a PE or an NRCS engineer, due to the reasons explained in "2" above.

6. The requirements for concrete have been expanded in 65.15(14)"a"(2), numbered paragraph "4," to include blended cements. This specification, however, is only for a formed manure storage structure with a design not sealed by a PE or an NRCS engineer, due to the reasons explained in "2" above.

7. The minimum floor design requirements have been modified as follows in 65.15(14)"a"(1), numbered paragraphs "1" and "2," 65.15(14)"a"(2), numbered paragraph "8," and 65.15(14)"b"(2) and (3). The requirement that the floor be a minimum of 5 inches thick is for a nondry manure storage structure regardless of who designs the structure and for a dry manure storage structure that is not designed and sealed by a PE or an NRCS engineer. Wire mesh is not accepted as primary reinforcement for a formed manure storage structure with a depth of 4 feet or more regardless of who designs the structure. However, wire mesh can be used as shrinkage reinforcement in floor slabs of a formed manure storage structure with a depth of less than 4 feet. Fiber is not accepted as reinforcement, except for a dry manure storage structure designed and sealed by a PE or an NRCS engineer. In addition, clarification on the placement of the steel reinforcement has been added. Furthermore, in response to comments, the adopted subrule allows for floor thickness tolerances in accordance with industry standards. Finally, if a formed manure storage structure is not designed and sealed by a PE or an NRCS engineer, floor thickness verification will be limited to nondestructive methods.

8. The minimum dimensions required for footings have been modified slightly in 65.15(14)"a"(2), numbered paragraph "9," and 65.15(14)"b"(3). This specification, however, is only for a formed manure storage structure with a design not sealed by a PE or an NRCS engineer, due to the reasons explained in "2" above.

9. The minimum wall design has also been modified. Several comments indicated the initially proposed standards were "one size fits all" and did not allow for site-specific design considerations and that they restricted the design prepared and sealed by a PE or an NRCS engineer. Therefore, the standards in 65.15(14)"a"(1) and 65.15(14)"b"(1) accept a wall design prepared and sealed by a PE or an NRCS engineer, due to the reasons explained in "2" above. For cases in which a PE or an NRCS engineer is not involved, 65.15(14)"a"(2) and 65.15(14)"b"(3) refer to tables with varying minimum wall thickness and steel reinforcement requirements according to depth of the formed structure, vehicle traffic and type of backfill material used. Comments from the Iowa Farm Bureau Federation and Iowa Pork Producers Association suggested that DNR work with MidWest Plan Service (MWPS) to develop design specifications and tables based on depth of the formed manure storage structure and other factors. These new tables are in a new Appendix D at the end of the chapter.

10. In 65.15(14)"a"(1), numbered paragraph "4," 65.15(14)"a"(2), numbered paragraph "10," and 65.15(14)"b"(2) and (3), the requirements for vertical steel

or dowels have been modified to provide an alternative to the 90° bent dowel requirement and to provide an alternative for interior walls.

11. The term "load bearing wall" used in the Notice at 65.15(14)"a"(10) and 65.15(14)"b"(10) has been deleted.

12. The concrete curing requirements have been modified in 65.15(14)"a"(2), numbered paragraph "12," to provide a description of alternative methods for concrete curing. This specification, however, is only for a formed manure storage structure with a design not sealed by a PE or an NRCS engineer, due to the reasons explained in "2" above.

13. The waterstop and keyway requirements have been modified as follows. The keyway requirement has been eliminated. The waterstop requirements in 65.15(14)"a"(1), numbered paragraph "3," and 65.15(14)"a"(2), numbered paragraph "13," have been expanded to allow rolled bentonite and to include a reference to Appendix D, Figures D-1 and D-2, at the end of Chapter 65 to better illustrate installation.

14. The requirement that contraction joints be not more than 100 feet apart, proposed in the Notice at 65.15(14)"a"(15) and 65.15(14)"b"(14), has been removed because it is not an industry standard.

15. The concrete standards required for a structure storing manure exclusively in a dry form have also been modified. Several comments recommended that these standards be tailored to the characteristics of dry manure and current industry practices (mainly poultry), thereby eliminating unnecessary expenses without causing environmental damage. In addition, several comments suggested that the standards allow for alternative designs that are submitted by a PE or an NRCS engineer. In response to this suggestion and because of the explanation in "2" above, the adopted subrule allows for a design prepared and sealed by a PE or an NRCS engineer for a dry manure storage structure in lieu of the DNR minimum concrete standards. Most facilities store dry manure in formed structures aboveground. If a formed manure storage structure is not designed and sealed by a PE or an NRCS engineer and is above the ground, the adopted subrule requires that only certain concrete standards for nondry manure be met, but if a formed manure storage structure for the storage of manure exclusively in a dry form is to be constructed below or partially below the ground and is not designed and sealed by a PE or an NRCS engineer, all of the concrete standards for nondry manure must be met.

16. The upgraded concrete standards for karst areas in 65.15(14)"c" have been modified. The phrase "sinkholes within one-half mile" has been eliminated because several comments received mentioned that it was not compatible with the language provided in the statute. Adopted paragraph "c" maintains the language prescribed in Iowa Code section 459.307 and requires upgraded concrete standards in "an area that exhibits karst terrain or an area that drains into a known sinkhole." DNR will provide contact information by which the location of these karst areas and known sinkholes can be identified.

17. The language in 65.15(14)"c"(1) has been modified as a result of further technical review. The adopted subparagraph requires a vertical separation of at least 5 feet between the bottom of a formed structure and limestone, dolomite or other soluble rock unless the structure is designed by a PE or an NRCS engineer.

18. Subparagraph 65.15(14)"c"(2) has been modified to require a compacted liner below the floor of the formed structure if the vertical separation between the bottom of the formed structure and the limestone, dolomite or other soluble rock is less than 5 feet. Also, as a result of public comments, the Department is recommending that in those cases an
aboveground structure should be constructed (instead of a belowground structure).

19. Subparagraph 65.15(14)"c"(3) has also been modified to require that the soil borings or test pits for a soil investigation be performed by a PE, an NRCS engineer or a qualified organization. In addition, in response to several comments, a requirement that these soil borings or test pits be properly plugged, using similar language contained in other sections of the chapter, has been added.

20. New subparagraphs 65.15(14)"c"(4) and (5) have been added for structures constructed in areas that exhibit karst terrain or that drain into known sinkholes. Groundwater monitoring must be performed as specified by DNR, and backfill requirements are provided.

21. Comments received from the regulated community, through Iowa Farm Bureau Federation and Iowa Pork Producers Association, suggested that the Department work with MidWest Plan Service (MWPS) to develop design specification tables. Accordingly, a new Appendix D has been added to the end of Chapter 65. This new appendix includes five tables with design specifications for formed manure storage structures and two figures to illustrate requirements pertaining to waterstops and footing drain tile. Appendix D applies to a formed manure storage structure that is not required to be designed and sealed by a PE or an NRCS engineer.

These amendments are intended to implement Iowa Code section 459.307.

These amendments will become effective on March 24, 2004.

The following amendments are adopted.

ITEM 1. Rescind subrule 65.15(14) and adopt in lieu thereof the following **new** subrule:

65.15(14) Concrete standards. A formed manure storage structure which is constructed of concrete on or after March 24, 2004, that is part of a confinement feeding operation other than a small animal feeding operation shall meet the following minimum standards. For the purpose of this subrule, a "PE" is a professional engineer licensed in the state of Iowa and an "NRCS engineer" is an engineer working for the USDA Natural Resources Conservation Service (NRCS). (CAVEAT: These standards are not intended to address other site-related engineering and construction considerations beyond the department's jurisdiction.)

a. Nondry manure storage. The following minimum concrete standards are required for a formed manure storage structure other than that used for the storage of manure exclusively in a dry form. A formed manure storage structure must be designed in accordance with one of the following design methods:

(1) Engineering report, plans and specifications prepared and sealed by a PE or an NRCS engineer. Design considerations shall be in conformance with the American Concrete Institute (ACI) Building Code ACI 318, ACI 360 or ACI 350; or Portland Cement Association (PCA) publication EB075, EB001 or IS072; or MidWest Plan Service (MWPS) publication MWPS-36 or MWPS TR-9, and shall include all of the following:

1. The floors shall be a minimum of 5 inches thick. Non-destructive methods to verify the floor slab thickness may be required by the department. The results shall indicate that at least 95 percent of the floor slab area meets the

minimum required thickness. In no case shall the floor slab thickness be less than 4½ inches.

2. Wire mesh shall not be used as primary reinforcement for a formed manure storage structure with a depth of 4 feet or more. Fiber shall not be used as reinforcement.

3. Waterstops shall be installed in all areas where fresh concrete meets hardened concrete. Waterstops shall be made of plastic, rolled bentonite or similar materials approved by the department.

4. The vertical steel of all walls shall be extended into the footing and be bent at 90° or a separate dowel shall be installed. As an alternate to the 90° bend, the dowel may be extended at least 12 inches into the footing, with a minimum concrete cover of 3 inches at the bottom. In lieu of dowels, mechanical means or alternate methods may be used as anchorage of interior walls to footings.

(2) If a formed manure storage structure is not designed and sealed by a PE or an NRCS engineer, the design and specifications shall be in conformance with MWPS-36 (for a belowground rectangular tank) or MWPS TR-9 (for a circular tank); or in accordance with Appendix D at the end of this chapter (for a belowground, laterally braced rectangular tank). In addition, all of the following concrete standards shall apply:

1. The finished subgrade of a formed manure storage structure shall be graded and compacted to provide a uniform and level base and shall be free of vegetation, manure and debris. For the purpose of this subrule, "uniform" means a finished subgrade with similar soils.

2. When the groundwater table, as determined in 65.15(7)"c," is above the bottom of the formed structure, a drain tile shall be installed along the footings to artificially lower the groundwater table pursuant to 65.15(7)"b." The drain tile shall be placed within 3 feet of the footings as indicated in Appendix D, Figure D-1, at the end of this chapter and shall be covered with a minimum of 2 inches of gravel, granular material, fabric or a combination of these materials to prevent plugging the drain tile.

3. All concrete shall have the following minimum as-placed compressive strengths and shall meet American Society for Testing and Materials (ASTM) standard ASTM C 94:

- 4,000 pounds per square inch (psi) for walls, floors, beams, columns and pumpouts;
- 3,000 psi for the footings.

The average concrete strength by testing shall not be below design strength. No single test result shall be more than 500 psi less than the minimum compressive strength.

4. Cementitious materials shall consist of portland cement conforming to ASTM C 150. Aggregates shall conform to ASTM C 33. Blended cements in conformance with ASTM C 595 are allowed only for concrete placed between March 15 and October 15. Portland-pozzolan cement or portland blast furnace slag blended cements shall contain at least 75 percent, by mass, of portland cement.

5. All concrete placed for walls shall be consolidated or vibrated, by manual or mechanical means, or a combination, in a manner which meets ACI 309.

6. All rebar used shall be a minimum of grade 40 steel. All rebar, with the exception of rebar dowels connecting the walls to the floor or footings, shall be secured and tied in place prior to the placing of concrete.

7. All wall reinforcement shall be placed so as to have a rebar cover of 2 inches from the inside face of the wall for a belowground manure storage structure. Vertical wall reinforcement should be placed closest to the inside face. Rebar placement shall not exceed tolerances specified in ACI 318.

8. The floor slab shall be a minimum of 5 inches thick. The floor slab of any formed manure storage structure with a depth of 4 feet or more shall have primary reinforcement consisting of a minimum of #4 rebar placed a maximum of 18 inches on center in each direction placed in a single mat. The floor slab of any formed manure storage structure with a depth less than 4 feet shall have shrinkage reinforcement consisting of a minimum of 6 × 6-W1.4 × W1.4 welded wire fabric. Floor slab reinforcement shall be located in the middle of the thickness of the floor slab. Nondestructive methods to verify the floor slab thickness may be required by the department. The results shall indicate that at least 95 percent of the floor slab area meets the minimum required thickness. In no case shall the floor slab thickness be less than 4½ inches.

9. The footing or the area where the floor comes in contact with the walls and columns shall have a thickness equal to the wall thickness, but in no case be less than 8 inches, and the width shall be at least twice the thickness of the footing. All exterior walls shall have footings below the frostline. Tolerances shall not exceed -½ inch of the minimum footing dimensions.

10. The vertical steel of all walls shall be extended into the footing, and be bent at 90° or a separate dowel shall be installed as a #4 rebar that is bent at 90° with at least 20 inches of rebar in the wall and extended into the footing within 3 inches of the bottom of the footing and extended at least 3 inches horizontally, as indicated in Appendix D, Figure D-1, at the end of this chapter. As an alternative to the 90° bend, the dowel may be extended at least 12 inches into the footing, with a minimum concrete cover of 3 inches at the bottom. Dowel spacing (bend or extended) shall be the same as the spacing for the vertical rebar. In lieu of dowels, mechanical means or alternate methods may be used as anchorage of interior walls to footings.

11. All walls shall be formed with rigid forming systems and shall not be earth-formed.

12. All concrete shall be cured for at least seven days after placing, in a manner which meets ACI 308, by maintaining adequate moisture or preventing evaporation. Proper curing shall be done by ponding, spraying or fogging water; or by using a curing compound that meets ASTM C 309; or by using wet burlap, plastic sheets or similar materials.

13. All construction joints in exterior walls shall be constructed to prevent discontinuity of steel and have properly spliced rebar placed through the joint. Waterstops shall be installed in all areas where fresh concrete will meet hardened concrete as indicated in Appendix D, Figures D-1 and D-2, at the end of this chapter. The waterstops shall be made of plastic, rolled bentonite or similar materials approved by the department.

14. Backfilling of the walls shall not start until the floor slats or permanent bracing have been installed. Backfilling shall be performed with material free of vegetation, large rocks or debris.

15. A formed manure storage structure with a depth greater than 12 feet shall be designed by a PE or an NRCS engineer.

b. Dry manure storage. A formed structure for the storage of manure exclusively in a dry form shall be designed and constructed in accordance with one of the following:

(1) Engineering report, plans and specifications prepared and sealed by a PE or an NRCS engineer. Design considerations shall be in conformance with the American Con-

crete Institute (ACI) Building Code ACI 318 or ACI 360; or Portland Cement Association (PCA) publication EB075, EB001 or IS072; or MidWest Plan Service (MWPS) publication MWPS-36.

(2) If a formed manure storage structure that stores manure exclusively in a dry form is to be constructed aboveground and the design is not prepared and sealed by a PE or an NRCS engineer, the requirements set forth in 65.15(14)"a"(2), numbered paragraphs "1," "3," "4," "5," "6," "8" and "12," shall apply. Consideration shall be given to internal and external loads including, but not limited to, wind loads, building load, manure pile and equipment vehicle loads.

(3) If the formed structure that stores manure exclusively in a dry form is to be constructed below or partially below the ground and the design is not prepared and sealed by a PE or an NRCS engineer, the requirements set forth in 65.15(14)"a"(2), numbered paragraphs "1" through "15," shall apply. Wall design shall be in accordance with Appendix D at the end of this chapter or in accordance with MWPS-36. Consideration shall be given to internal and external loads including, but not limited to, lateral earth pressures, hydrostatic pressures, wind loads, manure pile and equipment vehicle loads.

c. Karst terrain—upgraded standards. If the site of the proposed formed manure storage structure is located in an area that exhibits karst terrain or an area that drains into a known sinkhole, the minimum concrete standards set forth in 65.15(14)"a" or "b" shall apply. In addition, the following requirements apply to all formed manure storage structures that store nondry or dry manure:

(1) A minimum 5-foot vertical separation distance between the bottom of a formed manure storage structure and limestone, dolomite, or other soluble rock is required if the formed manure storage structure is not designed by a PE or an NRCS engineer.

(2) If the vertical separation distance between the bottom of the proposed formed manure storage structure and limestone, dolomite, or other soluble rock is less than 5 feet, the structure shall be designed and sealed by a PE or an NRCS engineer who certifies the structural integrity of the structure. A 2-foot-thick layer of compacted clay liner material shall be constructed underneath the floor of the formed manure storage structure. However, it is recommended that any formed manure storage structure be constructed aboveground if the vertical separation distance between the bottom of the structure and the limestone, dolomite, or other soluble rock is less than 5 feet.

(3) In addition, in an area that exhibits karst terrain or an area that drains into a known sinkhole, a PE, an NRCS engineer or a qualified organization shall submit a soil exploration study based on the results from soil borings or test pits to determine the vertical separation between the bottom of the formed structure and limestone, dolomite, or other soluble rock. A minimum of two soil borings or two test pits, equally spaced within each formed structure, are required. After soil exploration is completed, each soil boring and pit shall be properly plugged with concrete grout, bentonite, or similar materials.

(4) Groundwater monitoring shall be performed as specified by the department.

(5) Backfilling shall not start until the floor slats have been placed or permanent bracing has been installed, and shall be performed with material free of vegetation, large rocks, or debris.

ITEM 2. Amend 567—Chapter 65 by adopting the following **new** appendix:

APPENDIX D
DESIGN SPECIFICATIONS—FORMED MANURE STORAGE STRUCTURES

The following design specifications apply to a formed manure storage structure that is constructed belowground, is laterally braced and is not designed using MWPS-36 or by a PE or an NRCS engineer:

(1) The walls of a rectangular formed structure with a depth up to 12 feet shall be designed in accordance with the tables provided in this appendix.

(2) Consideration shall be given to internal and external loads including, but not limited to, lateral earth pressures, hydrostatic pressures, wind loads, and floor or cover, building and equipment loads.

(3) Each wall shall be braced laterally at the top of the wall.

(4) The walls shall be constructed above the groundwater table, or a drain tile shall be installed to artificially lower the groundwater table.

(5) Each wall that includes a pumpout port shall be constructed under the design consideration that vehicles will be operating within 5 feet of the wall as provided in Tables D-2 and D-4.

(6) Minimum wall thickness and minimum vertical steel reinforcement shall be in accordance with one of the following:

(a) Table D-1, if **all** of the following conditions are met:

1. There will be NO VEHICLES operating within 5 feet of the wall.
2. Backfilling is performed with gravel, sand, silt, and clay mixtures (less than 50 percent fines), with coarse sand with silt or clay (less than 50 percent fines), or cleaner granular material (see NRCS Conservation Practice Standard, "Waste Storage Facility," Code 313, Table 2, for description and unified classification or ASTM D 2488 and D 653).

APPENDIX D, TABLE D-1
Minimum Wall Thickness and Vertical Steel Reinforcement

Wall height (feet)	Wall thickness (inches)	Steel Grade			
		Grade 40		Grade 60	
		Bar	Space o.c. (inches)	Bar	Space o.c. (inches)
4 or less	6	#4	16.5	#4	18.0
		#5	18.0	#5	18.0

4 or less	8	#4	12.0	#4	13.5
		#5	18.0	#5	18.0
6	6	#4	14.5	#4	18.0
		#5	18.0	#5	18.0
6	8	#4	12.0	#4	13.5
		#5	18.0	#5	18.0
8	8	#4	9.5	#4	13.5
		#5	14.5	#5	18.0
8	10	#4	9.5	#4	11.0
		#5	15.0	#5	17.0
10	8	#4	6.5	#4	9.5
		#5	10.0	#5	13.5
10	10	#4	6.5	#4	9.5
		#5	10.0	#5	15.0
12	10	#4	5.0	#4	7.5
		#5	7.5	#5	11.5

(b) Table D-2, if **all** of the following conditions are met:
1. There will be VEHICLES operating within 5 feet of the wall.
2. Backfilling is performed with gravel, sand, silt, and clay mixtures (less than 50 percent fines), with coarse sand with silt or clay (less than 50 percent fines), or cleaner granular material (see NRCS Conservation Practice Standard, "Waste Storage Facility," Code 313, Table 2, for description and unified classification or ASTM D 2488 and D 653).

APPENDIX D, TABLE D-2
Minimum Wall Thickness and Vertical Steel Reinforcement

Wall height (feet)	Wall thickness (inches)	Steel Grade			
		Grade 40		Grade 60	
		Bar	Space o.c. (inches)	Bar	Space o.c. (inches)
4 or less	6	#4	16.5	#4	18.0
		#5	18.0	#5	18.0
4 or less	8	#4	12.0	#4	13.5
		#5	18.0	#5	18.0
6	6	#4	10.5	#4	15.5
		#5	16.5	#5	18.0
6	8	#4	12.0	#4	13.5
		#5	18.0	#5	18.0
8	8	#4	6.5	#4	10.0
		#5	10.5	#5	16.0
8	10	#4	8.5	#4	11.0
		#5	13.5	#5	17.0
10	8	#4	4.5	#4	6.5
		#5	7.0	#5	10.5
10	10	#4	5.0	#4	7.5
		#5	8.0	#5	12.0
12	10	#4	3.5	#4	5.5
		#5	5.5	#5	8.5

(c) Table D-3, if **all** of the following conditions are met:
1. There will be NO VEHICLES operating within 5 feet of the wall.
2. Backfilling is performed with low plasticity silts and clays with some sand or gravel (50 percent or more fines); or fine sands with silt or clay (less than 50 percent fines); or low to medium plasticity silts and clays with little sand or gravel (50 percent or more fines); or high plasticity silts and clays (see NRCS Conservation Practice Standard, "Waste Storage Facility," Code 313, Table 2, for description and unified classification or ASTM D 2488 and D 653).

APPENDIX D, TABLE D-3
Minimum Wall Thickness and Vertical Steel Reinforcement

Wall height (feet)	Wall thickness (inches)	Steel Grade			
		Grade 40		Grade 60	
		Bar	Space o.c. (inches)	Bar	Space o.c. (inches)
4 or less	6	#4	16.5	#4	18.0
		#5	18.0	#5	18.0
4 or less	8	#4	12.0	#4	13.5
		#5	18.0	#5	18.0
6	6	#4	10.5	#4	15.5
		#5	16.5	#5	18.0
6	8	#4	12.0	#4	13.5
		#5	18.0	#5	18.0
8	8	#4	6.5	#4	10.0
		#5	10.5	#5	16.0
8	10	#4	9.0	#4	11.0
		#5	14.0	#5	17.0
10	8	#4	4.5	#4	6.5
		#5	7.0	#5	10.0
10	10	#4	5.0	#4	7.5
		#5	8.0	#5	12.0
12	10	#4	3.5	#4	5.0
		#5	5.5	#5	8.0

(d) Table D-4, if **all** of the following conditions are met:
1. There will be VEHICLES operating within 5 feet of the wall.
2. Backfilling is performed with low plasticity silts and clays with some sand or gravel (50 percent or more fines); or fine sands with silt or clay (less than 50 percent fines); or low to medium plasticity silts and clays with little sand or gravel (50 percent or more fines); or high plasticity silts and clays (see NRCS Conservation Practice Standard, "Waste Storage Facility," Code 313, Table 2, for description and unified classification or ASTM D 2488 and D 653).

APPENDIX D, TABLE D-4
Minimum Wall Thickness and Vertical Steel Reinforcement

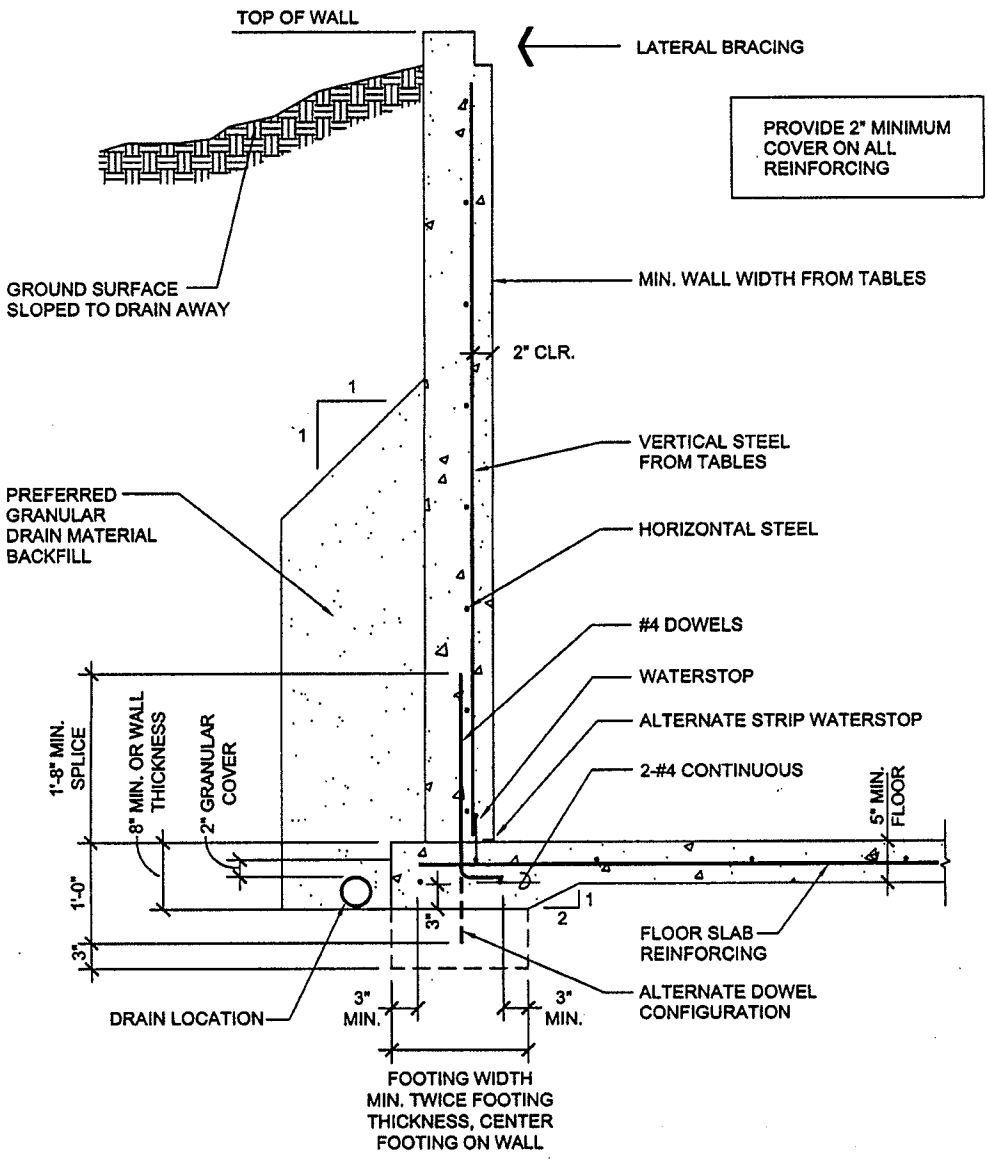
Wall height (feet)	Wall thickness (inches)	Steel Grade			
		Grade 40		Grade 60	
		Bar	Space o.c. (inches)	Bar	Space o.c. (inches)
4 or less	6	#4	16.5	#4	18.0
		#5	18.0	#5	18.0
4 or less	8	#4	12.0	#4	13.5
		#5	18.0	#5	18.0
6	6	#4	8.0	#4	12.0
		#5	12.5	#5	16.5
6	8	#4	9.5	#4	13.5
		#5	15.0	#5	18.0
8	8	#4	6.0	#4	9.0
		#5	9.0	#5	11.5
8	10	#4	6.0	#4	9.0
		#5	9.5	#5	14.0
10	8	#4	3.0	#4	4.5
		#5	4.5	#5	7.0
10	10	#4	4.5	#4	6.5
		#5	6.5	#5	10.0
12	10	#4	2.5	#4	4.0
		#5	4.0	#5	6.0

(7) Minimum horizontal steel for a rectangular tank shall be selected and placed according to Table D-5, regardless of wall height, and shall be tied to the soil side of vertical steel:

APPENDIX D, TABLE D-5
Minimum Wall Horizontal Steel Reinforcement

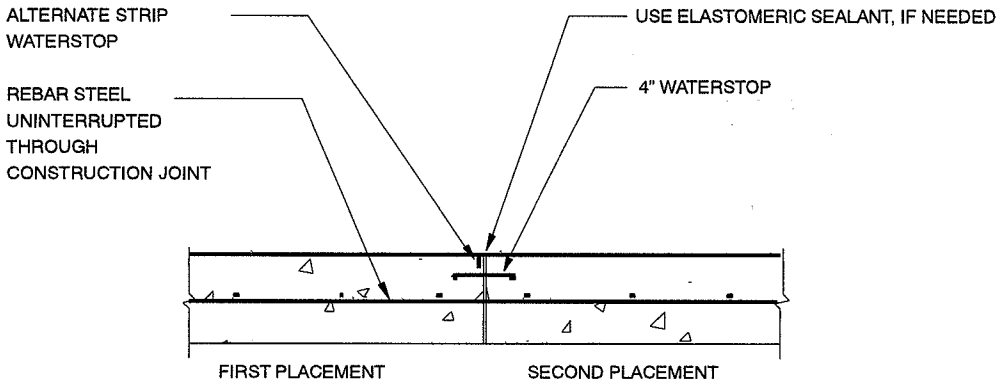
Wall thickness (inches)	Steel Grade			
	Grade 40		Grade 60	
	Bar	Space o.c. (inches)	Bar	Space o.c. (inches)
6	#4	16.5	#4	18.0
	#5	18.0	#5	18.0
8	#4	12.0	#4	13.5
	#5	18.0	#5	18.0
10	#4	9.5	#4	11.0
	#5	15.0	#5	17.0

APPENDIX D, FIGURE D-1
MONOLITHIC FOOTING FLOOR DETAIL*



*For a more detailed version of this figure, contact the department, animal feeding operations.

APPENDIX D, FIGURE D-2
WALL AND FLOOR CONSTRUCTION JOINT*



*For a more detailed version of this figure, contact the department, animal feeding operations.

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[Published 2/18/04]

EDITOR'S NOTE: For replacement pages for IAC, see IAC Supplement 2/18/04.

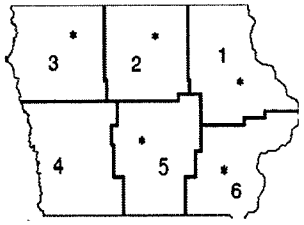
Minimum Separation Distances for Construction or Expansion of Confinement Feeding Operation Structures (All Animal Feeding Operations, including SAFO[1])

Instructions:

1. **Determine if you own or manage another confinement operation** that is located within 2,500 feet; or that utilize a common system for manure storage regardless of how far they are apart. If the answer is "yes", you must first contact the Animal Feeding Operations Program at (712) 262-4177 or your nearest DNR Field Office, before proceeding with separation distance determination.
2. **Complete Worksheet No. 1** (page 2) to determine the Animal Unit Capacity (AUC).
3. **Complete Worksheet No. 2** (page 2), to determine the Animal Weight Capacity (AWC), however, this only applies to an operation that was constructed prior to March 1, 2003.
4. **Determine the year when the operation was constructed.** This is the date when any of the following occurred:
   - Excavation of a structure or excavation of the footings of a structure.
   - Installation of forms for concrete of a structure.
   - Installation of piping to transport manure between confinement feeding operation structures.
5. **Select the Table that applies**, based on the year when the operation was constructed and the animal species, according to the following:

a) **Table 6**: New operation or expansion of an operation that was or will be constructed on or after March 1, 2003, for all animal species.	Page 3
b) **Table 6-A**: Expansion or modification of an operation that was constructed on or after January 1, 1999 but prior to March 1, 2003, for animals other than bovine (swine, sheep, horses, poultry).	Page 4
c) **Table 6-B**: Expansion or modification of an operation that was constructed on or after January 1, 1999 but prior to March 1, 2003, for bovine (beef, dairy).	Page 5
d) **Table 6-C**: Expansion or modification of an operation that was constructed prior to January 1, 1999, for animals other than bovine (swine, sheep, horses, poultry).	Page 6
e) **Table 6-D**: Expansion or modification of an operation that was constructed prior to January 1, 1999, for bovine (beef, dairy).	Page 7

6. **Distances to a residence, business, church, school or public use area**: In the appropriate table, select the type of structure being constructed, expanded or modified. Use the AUC or AWC [whichever applies], to select the appropriate range for AUC or AWC, and the minimum required separation distances.
7. **Distances to water wells**: In the middle portion of the appropriate table, select the type of structure being constructed, expanded or modified. To determine if a well is deep or shallow, use the well log record. A 'deep well' is defined in 567 IAC 65.1(455B). Distances to wells are required to all animal feeding operations (SAFOᵢs included).
8. **Distance to major water sources, sinkholes, water sources, designated wetlands, environmentally sensitive areas and public thoroughfares**: In the bottom part of the appropriate table, find these distance requirements that apply to all animal feeding operations (SAFOᵢs included, unless specifically exempted). Major water sources are listed in 567 IAC 65, Tables 1 and 2.



For more information, contact one of these DNR offices or visit: www.iowadnr.gov

AFO Construction Permits
1900 N Grand Ave
Spencer, IA 51301
(712) 262-4177

Field Office 1
909 W Main, Suite 4
Manchester, IA 52057
(563) 927-2640

Field Office 2
2300 15th St SW
Mason City, IA 50401
(641) 424-4073

Field Office 3
1900 N Grand Ave
Spencer, IA 51301
(712) 262-4177

Field Office 4
1401 Sunnyside Lane
Atlantic, IA 50022
(712) 243-1934

Field Office 5
7900 Hickman Rd Ste 200
Windsor Heights IA 50324
(515) 725-0268

Field Office 6
1004 W Madison
Washington, IA 52353
(319) 653-2135

CAUTION: This document is only a summary of Iowa Code chapter 459 (2003) and the DNR's amended administrative rules. It is a guidance document and should not be used as replacement for the statutory provisions and administrative rules (collectively, the law). While every effort has been made to assure the accuracy of this information, the law will prevail in the event of a conflict between this document and the law.

[1] SAFO = A Small animal feeding operation, which as an animal unit capacity of 500 animal units (AU) or less.

Name of Operation: _____ Facility ID No.: _____

Worksheet 1. Animal Unit Capacity (AUC)

The animal unit capacity (AUC) is the maximum number of animal units (AU) maintained at the operation at any one time. To calculate the AUC, multiply the maximum number of animals confined at any one time by the appropriate AU factor and then add all animal units together. If you own or manage another confinement operation that utilizes a common system for manure storage, or that is located within 2,500 feet, you must first contact the DNR (see page 1):

Animal Species	Current			Proposed Expansion (No. of animals to be added)			Total		
	(No. Head)	x (Factor)	= AUC	(No. Head)	x (Factor)	= AUC	(No. Head)	x (Factor)	= AUC
Slaughter or feeder cattle		1.0			1.0			1.0	
Immature dairy cattle		1.0			1.0			1.0	
Mature dairy cattle		1.4			1.4			1.4	
Gestating sows		0.4			0.4			0.4	
Farrowing sows & litter		0.4			0.4			0.4	
Boars		0.4			0.4			0.4	
Gilts		0.4			0.4			0.4	
Finished (Market) hogs		0.4			0.4			0.4	
Nursery pigs 15 lbs to 55 lbs		0.1			0.1			0.1	
Sheep and lambs		0.1			0.1			0.1	
Horses		2.0			2.0			2.0	
Turkeys 7lbs or more		0.018			0.018			0.018	
Turkeys less than 7 lbs		0.0085			0.0085			0.0085	
Broiler/Layer chickens 3 lbs or more		0.01			0.01			0.01	
Broiler/Layer chickens less than 3 lbs		0.0025			0.0025			0.0025	
Fish		0.001			0.001			0.001	
TOTALS:		**Current:**			**Proposed Expansion:**			**Total:**	

Worksheet 2. Animal Weight Capacity (AWC)

Only applies to operations that were first constructed prior to March 1, 2003. The animal weight capacity (AWC) is the product of multiplying the maximum number of animals confined at any one time by their average weight during the production cycle. Use the AWC definition and its examples set forth in rule 567 IAC 65.1(455B). Then add the AWC if more than one animal species is present.

Animal Species	Existing AWC (Before Permit)			Proposed Expansion (No. of animals to be added)			Total		
	(No. head) x	avg weight	= AWC	(No. head) x	avg weight	= AWC	(No. head) x	avg weight	= AWC
Slaughter or feeder cattle									
Immature dairy cattle									
Mature dairy cattle									
Gestating sows									
Farrowing sows & litter									
Boars									
Gilts									
Finished (Market) hogs									
Nursery pigs 15 lbs to 55 lbs									
Sheep and lambs									
Horses									
Turkeys 7lbs or more									
Turkeys less than 7 lbs									
Broiler/Layer chickens 3 lbs or more									
Broiler/Layer chickens less than 3 lbs									
Fish									
TOTALS:		**Current:**			**Proposed Expansion:**			**Total:**	

567 IAC 65.11(455B), Table 6

Minimum separation distances for a new confinement feeding operation or expansion of an operation constructed on or after March 1, 2003

Type of Structure (liquid, semi-liquid and dry manure storage)	Total Animal Unit Capacity (AUC) (AU)	Residences, Businesses, Churches, Schools		Public use areas
		Unincorporated Areas	Incorporated Areas	
Anaerobic lagoons and uncovered earthen manure storage basins	500 AU or less	1,875 feet	1,875 feet	1,875 feet
	501 AU to < 1,000 AU	1,875 feet	1,875 feet	1,875 feet
	1,000 AU to < 3,000 AU	2,500 feet	2,500 feet	2,500 feet
	3,000 AU or more	3,000 feet	3,000 feet	3,000 feet
Covered earthen manure storage basins	500 AU or less	1,250 feet	1,875 feet	1,875 feet
	501 AU to < 1,000 AU	1,250 feet	1,875 feet	1,875 feet
	1,000 AU to < 3,000 AU	1,875 feet	2,500 feet	2,500 feet
	3,000 AU or more	2,375 feet	3,000 feet	3,000 feet
Uncovered formed manure storage structures	500 AU or less	None	None	None
	501 AU to < 1,000 AU	1,500 feet	1,875 feet	1,875 feet
	1,000 AU to < 3,000 AU	2,000 feet	2,500 feet	2,500 feet
	3,000 AU or more	2,500 feet	3,000 feet	3,000 feet
Confinement buildings and covered formed manure storage structures	500 AU or less	None	None	None
	501 AU to < 1,000 AU	1,250 feet	1,875 feet	1,875 feet
	1,000 AU to < 3,000 AU	1,875 feet	2,500 feet	2,500 feet
	3,000 AU or more	2,375 feet	3,000 feet	3,000 feet
Egg washwater storage structures	500 AU or less	None	None	None
	501 AU to < 1,000 AU	1,000 feet	1,875 feet	1,875 feet
	1,000 AU to < 3,000 AU	1,500 feet	2,500 feet	2,500 feet
	3,000 AU or more	2,000 feet	3,000 feet	3,000 feet

Distances to Wells

Type of Structure	Public well		Private well	
	Shallow	Deep	Shallow	Deep
Aerobic structure, anaerobic lagoon, earthen manure storage basin, egg washwater storage structure.	1,000 feet	400 feet	400 feet	400 feet
Formed manure storage structure, confinement building	200 feet	100 feet	200 feet	100 feet

Other Distances

Applies to all Confinement Feeding Operations, regardless of animal unit capacity	
Surface intakes of an agricultural drainage well or water source other than major (Excluding farm ponds, privately owned lakes or when a secondary containment barrier is provided)	500 feet*
Wellhead or cistern of an agricultural drainage well or known sinkhole or major water source (Excluding farm ponds, privately owned lakes or when a secondary containment barrier is provided)	1,000 feet
Designated wetlands pursuant to subrule 65.11(4) and Iowa Code section 459.310	2,500 feet
Right-of-way of a thoroughfare maintained by the state or a political subdivision (Exemptions provided in subrule 65.12(2))	100 feet

*200 feet from a water source required for a dry bedded confinement feeding operation structure.

TABLE 6-A (Swine, Sheep, Horses and Poultry)
Minimum separation distances for expansion of confinement feeding operations constructed on or after January 1, 1999 but prior to March 1, 2003

Type of Structure (liquid, semi-liquid and dry manure storage)	Size of operation AUC (AU) and AWC (lbs)	Residences, Businesses, Churches, Schools		Public use areas
		Unincorporated Areas	Incorporated Areas	
Anaerobic lagoons and uncovered earthen manure storage basins	500 AU or less	1,250 feet	1,250 feet	1,250 feet
	501 AU to <625,000 lbs	1,250 feet	1,250 feet	1,250 feet
	625,000 lbs to <1,250,000 lbs	1,875 feet	1,875 feet	1,875 feet
	1,250,000 lbs or more	2,500 feet	2,500 feet	2,500 feet
Covered earthen manure storage basins	500 AU or less	1,000 feet	1,250 feet	1,250 feet
	501 AU to <625,000 lbs	1,000 feet	1,250 feet	1,250 feet
	625,000 lbs to <1,250,000 lbs	1,250 feet	1,875 feet	1,875 feet
	1,250,000 lbs or more	1,875 feet	2,500 feet	2,500 feet
Uncovered formed manure storage structures	500 AU or less	None	None	None
	501 AU to <625,000 lbs	1,250 feet	1,250 feet	1,250 feet
	625,000 lbs to <1,250,000 lbs	1,500 feet	1,875 feet	1,875 feet
	1,250,000 lbs or more	2,000 feet	2,500 feet	2,500 feet
Confinement buildings and covered formed manure storage structures	500 AU or less	None	None	None
	501 AU to <625,000 lbs	1,000 feet	1,250 feet	1,250 feet
	625,000 lbs to <1,250,000 lbs	1,250 feet	1,875 feet	1,875 feet
	1,250,000 lbs or more	1,875 feet	2,500 feet	2,500 feet
Egg washwater storage structures	500 AU or less	None	None	None
	501 AU to <625,000 lbs	750 feet	1,250 feet	1,250 feet
	625,000 lbs to <1,250,000 lbs	1,000 feet	1,875 feet	1,875 feet
	1,250,000 lbs or more	1,500 feet	2,500 feet	2,500 feet

Distances to Wells

Type of Structure	Public well		Private well	
	Shallow	Deep	Shallow	Deep
Aerobic structure, anaerobic lagoon, earthen manure storage basin, egg washwater storage structure.	1,000 feet	400 feet	400 feet	400 feet
Formed manure storage structure, confinement building	200 feet	100 feet	200 feet	100 feet

Other Distances

Applies to all Confinement Feeding Operations, regardless of animal unit capacity	
Surface intakes of an agricultural drainage well or water source other than major (Excluding farm ponds, privately owned lakes or when a secondary containment barrier is provided)	500 feet*
Wellhead or cistern of an agricultural drainage well or known sinkhole or major water source (Excluding farm ponds, privately owned lakes or when a secondary containment barrier is provided)	1,000 feet
Designated wetlands pursuant to subrule 65.11(4) and Iowa Code section 459.310	2,500 feet
Right-of-way of a thoroughfare maintained by the state or a political subdivision (Exemptions provided in subrule 65.12(2))	100 feet

*200 feet from a water source required for a dry bedded confinement feeding operation structure.

TABLE 6-B (Beef and Dairy Cattle)

Minimum separation distances for expansion of a confinement feeding operation constructed on or after January 1, 1999 but prior to March 1, 2003

Type of Structure (liquid, semi-liquid and dry manure storage)	Size of operation AUC (AU) and AWC (lbs)	Residences, Businesses, Churches, Schools		Public use areas
		Unincorporated Areas	Incorporated Areas	
Anaerobic lagoons and uncovered earthen manure storage basins	500 AU or less	1,250 feet	1,250 feet	1,250 feet
	501 AU to <1,600,000 lbs	1,250 feet	1,250 feet	1,250 feet
	1,600,000 lbs to <4,000,000 lbs	1,875 feet	1,875 feet	1,875 feet
	4,000,000 lbs or more	2,500 feet	2,500 feet	2,500 feet
Covered earthen manure storage basins	500 AU or less	1,000 feet	1,250 feet	1,250 feet
	501 AU to <1,600,000 lbs	1,000 feet	1,250 feet	1,250 feet
	1,600,000 lbs to <4,000,000 lbs	1,250 feet	1,875 feet	1,875 feet
	4,000,000 lbs or more	1,875 feet	2,500 feet	2,500 feet
Uncovered formed manure storage structures	500 AU or less	None	None	None
	501 AU to <1,600,000 lbs	1,250 feet	1,250 feet	1,250 feet
	1,600,000 lbs to <4,000,000 lbs	1,500 feet	1,875 feet	1,875 feet
	4,000,000 lbs or more	2,000 feet	2,500 feet	2,500 feet
Confinement buildings and covered formed manure storage structures	500 AU or less	None	None	None
	501 AU to <1,600,000 lbs	1,000 feet	1,250 feet	1,250 feet
	1,600,000 lbs to <4,000,000 lbs	1,250 feet	1,875 feet	1,875 feet
	4,000,000 lbs or more	1,875 feet	2,500 feet	2,500 feet

Distances to Wells

Type of Structure	Public well		Private well	
	Shallow	Deep	Shallow	Deep
Aerobic structure, anaerobic lagoon, earthen manure storage basin, egg washwater storage structure.	1,000 feet	400 feet	400 feet	400 feet
Formed manure storage structure, confinement building	200 feet	100 feet	200 feet	100 feet

Other Distances

Applies to all Confinement Feeding Operations, regardless of animal unit capacity	
Surface intakes of an agricultural drainage well or water source other than major (Excluding farm ponds, privately owned lakes or when a secondary containment barrier is provided)	500 feet*
Wellhead or cistern of an agricultural drainage well or known sinkhole or major water source (Excluding farm ponds, privately owned lakes or when a secondary containment barrier is provided)	1,000 feet
Designated wetlands pursuant to subrule 65.11(4) and Iowa Code section 459.310	2,500 feet
Right-of-way of a thoroughfare maintained by the state or a political subdivision (Exemptions provided in subrule 65.12(2))	100 feet

*200 feet from a water source required for a dry bedded confinement feeding operation structure.

TABLE 6-C (Swine, Sheep, Horses and Poultry)
Minimum separation distances for expansion of a confinement feeding operation constructed prior to January 1, 1999

Type of Structure (liquid, semi-liquid and dry manure storage)	Size of operation AUC (AU) and AWC (lbs)	Residences, Businesses, Churches, Schools		Public use areas
		Unincorporated Areas	Incorporated Areas	
Anaerobic lagoons and uncovered earthen manure storage basins	500 AU or less	1,250 feet	1,250 feet	1,250 feet
	501 AU to <625,000 lbs	1,250 feet	1,250 feet	1,250 feet
	625,000 lbs to <1,250,000 lbs	1,875 feet	1,875 feet	1,875 feet
	1,250,000 lbs or more	2,500 feet	2,500 feet	2,500 feet
Covered earthen manure storage basins	500 AU or less	750 feet	1,250 feet	1,250 feet
	501 AU to <625,000 lbs	750 feet	1,250 feet	1,250 feet
	625,000 lbs to <1,250,000 lbs	1,000 feet	1,875 feet	1,875 feet
	1,250,000 lbs or more	1,500 feet	2,500 feet	2,500 feet
Uncovered formed manure storage structures	500 AU or less	None	None	None
	501 AU to <625,000 lbs	1,000 feet	1,250 feet	1,250 feet
	625,000 lbs to <1,250,000 lbs	1,500 feet	1,875 feet	1,875 feet
	1,250,000 lbs or more	2,000 feet	2,500 feet	2,500 feet
Confinement buildings and covered formed manure storage structures	500 AU or less	None	None	None
	501 AU to <625,000 lbs	750 feet	1,250 feet	1,250 feet
	625,000 lbs to <1,250,000 lbs	1,000 feet	1,875 feet	1,875 feet
	1,250,000 lbs or more	1,500 feet	2,500 feet	2,500 feet
Egg washwater storage structures	500 AU or less	None	None	None
	501 AU to <625,000 lbs	750 feet	1,250 feet	1,250 feet
	625,000 lbs to <1,250,000 lbs	1,000 feet	1,875 feet	1,875 feet
	1,250,000 lbs or more	1,500 feet	2,500 feet	2,500 feet

Distances to Wells

Type of Structure	Public well		Private well	
	Shallow	Deep	Shallow	Deep
Aerobic structure, anaerobic lagoon, earthen manure storage basin, egg washwater storage structure.	1,000 feet	400 feet	400 feet	400 feet
Formed manure storage structure, confinement building	200 feet	100 feet	200 feet	100 feet

Other Distances

Applies to all Confinement Feeding Operations, regardless of animal unit capacity	
Surface intakes of an agricultural drainage well or water source other than major (Excluding farm ponds, privately owned lakes or when a secondary containment barrier is provided)	500 feet*
Wellhead or cistern of an agricultural drainage well or known sinkhole or major water source (Excluding farm ponds, privately owned lakes or when a secondary containment barrier is provided)	1,000 feet
Designated wetlands pursuant to subrule 65.11(4) and Iowa Code section 459.310	2,500 feet
Right-of-way of a thoroughfare maintained by the state or a political subdivision (Exemptions provided in subrule 65.12(2))	100 feet

*200 feet from a water source required for a dry bedded confinement feeding operation structure.

TABLE 6-D (Beef and Dairy Cattle)

Minimum separation distances for expansion of a confinement feeding operations constructed prior to January 1, 1999

Type of Structure (liquid, semi-liquid and dry manure storage)	Size of operation AUC (AU) and AWC (lbs)	Residences, Businesses, Churches, Schools		Public use areas
		Unincorporated Areas	Incorporated Areas	
Anaerobic lagoons and uncovered earthen manure storage basins	500 AU or less	1,250 feet	1,250 feet	1,250 feet
	501 AU to <1,600,000 lbs	1,250 feet	1,250 feet	1,250 feet
	1,600,000 lbs to <4,000,000 lbs	1,875 feet	1,875 feet	1,875 feet
	4,000,000 lbs or more	2,500 feet	2,500 feet	2,500 feet
Covered earthen manure storage basins	500 AU or less	750 feet	1,250 feet	1,250 feet
	501 AU to <1,600,000 lbs	750 feet	1,250 feet	1,250 feet
	1,600,000 lbs to <4,000,000 lbs	1,000 feet	1,875 feet	1,875 feet
	4,000,000 lbs or more	1,500 feet	2,500 feet	2,500 feet
Uncovered formed manure storage structures	500 AU or less	None	None	None
	501 AU to <1,600,000 lbs	1,000 feet	1,250 feet	1,250 feet
	1,600,000 lbs to <4,000,000 lbs	1,500 feet	1,875 feet	1,875 feet
	4,000,000 lbs or more	2,000 feet	2,500 feet	2,500 feet
Confinement buildings and covered formed manure storage structures	500 AU or less	None	None	None
	501 AU to <1,600,000 lbs	750 feet	1,250 feet	1,250 feet
	1,600,000 lbs to <4,000,000 lbs	1,000 feet	1,875 feet	1,875 feet
	4,000,000 lbs or more	1,500 feet	2,500 feet	2,500 feet

Distances to Wells

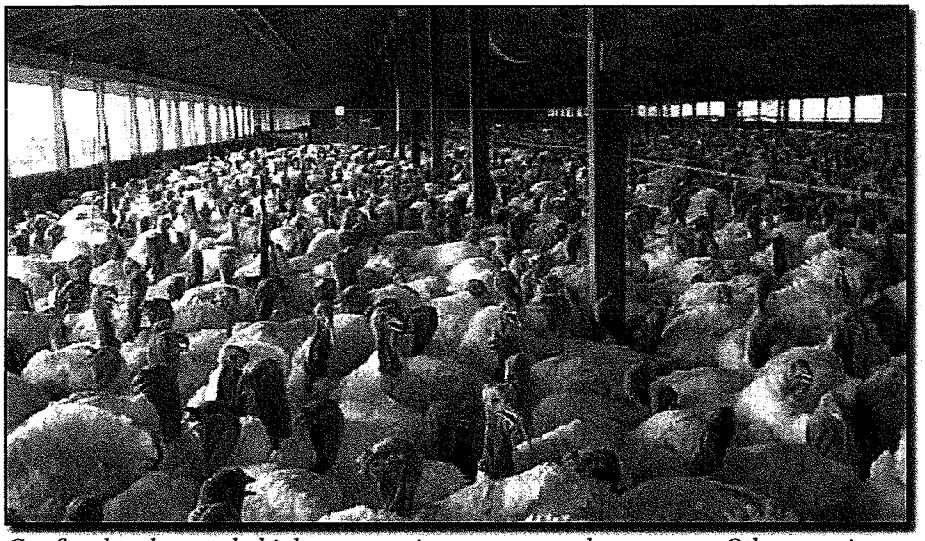
Type of Structure	Public well		Private well	
	Shallow	Deep	Shallow	Deep
Aerobic structure, anaerobic lagoon, earthen manure storage basin, egg washwater storage structure.	1,000 feet	400 feet	400 feet	400 feet
Formed manure storage structure, confinement building	200 feet	100 feet	200 feet	100 feet

Other Distances

Applies to all Confinement Feeding Operations, regardless of animal unit capacity	
Surface intakes of an agricultural drainage well or water source other than major (Excluding farm ponds, privately owned lakes or when a secondary containment barrier is provided)	500 feet*
Wellhead or cistern of an agricultural drainage well or known sinkhole or major water source (Excluding farm ponds, privately owned lakes or when a secondary containment barrier is provided)	1,000 feet
Designated wetlands pursuant to subrule 65.11(4) and Iowa Code section 459.310	2,500 feet
Right-of-way of a thoroughfare maintained by the state or a political subdivision (Exemptions provided in subrule 65.12(2))	100 feet

*200 feet from a water source required for a dry bedded confinement feeding operation structure.

Confinement Dry Manure Stockpiling Regulations



Confined turkey and chicken operations generate dry manure. Other species could potentially generate dry manure and fall under these regulations.

Iowa enacted a law in 2009 that restricts where and how confinement dry manure can be stockpiled when land application must be postponed. Following these rules will help keep runoff from reaching and polluting nearby streams.

Dry manure stockpiles are prohibited on grassed waterways.

They are also prohibited on land with slopes greater than 3 percent unless methods, structures or practices contain the stockpiles manure — such as hay bales, silt fences or temporary earthen berms — to prevent runoff.

Additonal requirements apply if manure is stockpiled for longer than 15 days.

The manure must be land applied within six months of stockpiling in accordance with 567 Iowa Administrative Code (IAC) 65.3 (459, 459B).

Dry Manure Stockpiling for more than 15 days

Stockpiles and qualified stockpile structures must be separated from sensitive areas by the distances in Table 1. To stockpile confinement dry manure for more than 15 days on non-karst terrain, producers can either:

Continued on back

Table 1
Required Separation Distances for Confinement Dry Manure Stockpiles

Terrace tile inlet or surface tile inlet — unless the dry manure is stockpiled in a manner that does not allow runoff to drain from the stockpile to the inlet.	200 feet
Designated area such as: ■ lake ■ abandoned well ■ drinking water well ■ designated wetland ■ water source ■ ag drainage well surface tile inlet* ■ ag drainage well cistern* ■ known sinkhole*	400 feet
High quality water resource (see definition)	800 feet
Residence, business, church, school or public use area for air quality purposes *(Does not apply to stockpiles from small animal feeding operations — confinements of 500 animal units or less. See Table 2 Animal Unit Equivalency Factors on the back side.)*	1,250 feet

** The DNR highly recommends a distance of 800 feet as these are direct conduits to agricultural drainage wells.*

Definitions

Ag drainage well is a vertical opening to an aquifer or permeable substratum which is constructed by any means including but not limited to drilling, driving, digging, boring, augering, jetting, washing or coring and which is capable of intercepting or receiving surface or subsurface drainage water from land directly or by a drainage system.

Confinement feeding operation means an animal feeding operation in which animals are confined to areas which are totally roofed and includes every animal feeding operation that is not an "open feedlot operation."

Dry manure means manure that:

- does not flow under pressure.
- cannot be transported through a liquid pump
- the molecules do not flow freely among themselves but may show a tendency to separate under stress.

High quality water resource is the part of a water source or wetland that the DNR has designated as any of the following:

- A high-quality water (Class "HQ") or a high-quality resource water (Class "HQR") according to 567 IAC ch. 61, in effect on Jan. 1, 2001.
- A protected water area system, according to a state plan adopted by the DNR in effect on Jan. 1, 2001.

Karst terrain is land having karst formations that exhibit surface and subterranean features of a type produced by the dissolution of limestone, dolomite or other soluble rock and characterized by closed depressions, sinkholes or caves. If a 25-foot vertical separation distance can be maintained between the bottom of an unformed manure storage structure and limestone, dolomite or other soluble rock, then the structure is not considered to be in karst terrain.

Long-term stockpile location is an area where a person stockpiles manure for more than a total of six months in any two-year period.

Qualified stockpile structure means a building or roofed structure that is impermeable to precipitation, constructed using wood, steel, aluminum, vinyl, plastic or

Continued on back

DNR

Continued

- Inspect the stockpile every month for runoff and deliver an inspection statement to the DNR, or
- Use a building or an impermeable cover.

Long-term Stockpiling. Where dry confinement manure is stored for more than six months, it must be placed on a constructed impervious base that can support the load of equipment used under all weather conditions. The coefficient of permeability of the base shall be less than 1 $x10^{-7}$ cm (0.00028 feet/day).

On Karst Terrain/Drains to Known Sinkhole

If dry manure is stockpiled on karst terrain, the bottom of the stockpile must be at least 5 feet above the limestone, dolomite or other soluble rock. A professional engineer must submit a soils report to the DNR.

To stockpile for more than 15 days, a qualified building, qualified structure or impermeable cover must be used.

Long-term Stockpiling. On karst terrain, a cover can only be used for long-term stockpiling if the pile is located on reinforced concrete at least 5 inches thick.

Exemptions

A grandfather clause dismisses confinement feeding operations constructed before Jan. 1, 2006, from storage requirements and water quality setbacks unless the operation was expanded after that date or runoff from the stockpile has drained off the property.

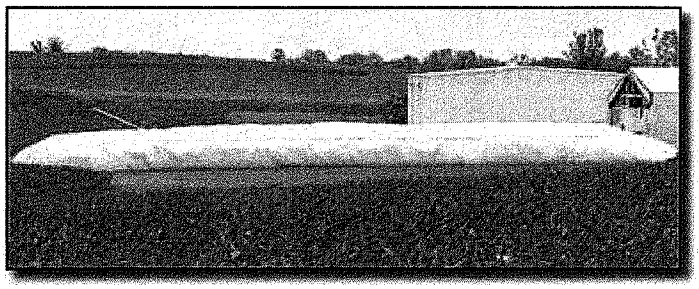
Dry manure delivered to a purchaser as bulk dry animal nutrient product under Chapter 200A is regulated by the Iowa Department of Agriculture and Land Stewardship, unless a water quality violation occurs.

Air quality setbacks (see Table 1) do not apply if the neighboring landowner signs a waiver.

Table 2. Animal Unit Equivalency Factors

Slaughter or feeder cattle	1.0 Units
Immature dairy cattle	1.0 Units
Mature dairy cattle	1.4 Units
Butcher or breeding swine weighing more than 55 lbs	0.4 Units
Swine weighing 15 lbs or more but not more than 55 lbs	0.1 Units
Sheep or lambs	0.1 Units
Horses	2.0 Units
Turkeys 7 lbs or more	0.018 Units
Turkeys less than 7 lbs	0.0085 Units
Broiler or layer chickens 3 lbs or more	0.01 Units
Broiler/Layer chickens less than 3 lbs	0.0025 Units

An animal unit is defined as a measurement based upon the product of multiplying the number of animals of each category by a special equivalency factor as listed above. As an example, 3,000 finishing hogs x 0.4 = 1,200 animal units.



An impermeable cover on a dry manure stockpile controls runoff.

Definitions, *continued*

similar materials and is constructed with walls or other means to prevent precipitation-induced surface runoff from contacting the stockpile.

Qualified stockpile cover is a barrier impermeable to precipitation that is used to protect a stockpile from precipitation.

Stockpile refers to dry manure or dry-bedded manure originating from a confinement feeding operation that is stored at a particular location outside a confinement feeding operation building or a manure storage structure.

Other Requirements

Stockpiles within 1,250 ft. of each other are considered part of the same stockpile.

Producers that need national pollutant discharge elimination system (NPDES) permits must stockpile in compliance with requirements.

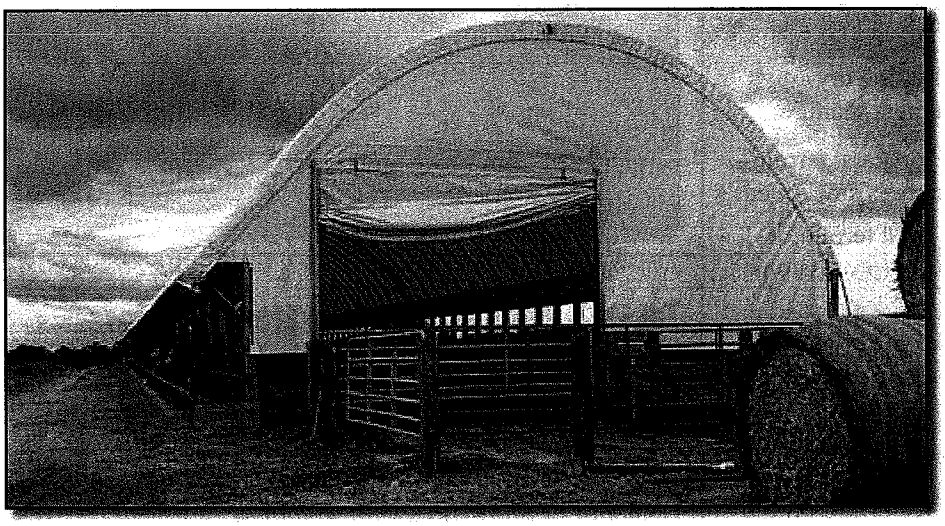
If more than one type of housing for feeding operations is at a site, please contact the DNR field office for manure stockpiling requirements.

Links and Contacts

DNR Field Services
Manchester 563-927-2640
Mason City 641-424-4177
Spencer 712-262-4177
Atlantic 712-243-1934
Des Moines 515-725-0268
Washington 319-653-2135
Gene Tinker, Coordinator, Animal Feeding Operations, 563-927-2640, Gene.Tinker@dnr.iowa.gov
www.iowadnr.gov
Separation Distances for Land Application of Manure
High Quality Water Resources
Dry-Bedded Manure Stockpiling Regulations
Open Feedlot Manure Stockpiling Regulations
IAC 567 Chapter 65 — Animal Feeding Operations

Dry-Bedded Manure Stockpiling Regulations

For Cattle and Swine Confinement Feeding Operations



Hoop confinement building

Hoop and monoslope buildings reduce runoff and can aid livestock producers to meet water quality requirements. They also improve animal comfort and rate of gain.

Recent state regulations allow stockpiling of dry-bedded manure when land application must be postponed, but it must be managed properly.

Stockpiling Regulations

Dry-bedded manure stockpiles are prohibited on grassed waterways where water pools on the surface or in any location where surface water will enter the stockpile.

They are also prohibited on land with slopes greater than 3 percent unless methods, structures or practices contain the stockpiled manure — such as hay bales, silt fences or temporary earthen berms — to prevent runoff.

Stockpiles must be separated from sensitve areas by the distances in Table 1.

Continued on back

Table 1
Required Separation Distances for Dry-bedded Manure Stockpiles

Terrace tile inlet or surface tile inlet — unless methods, structures or practices are used to contain the stockpiled manure	200 feet
Designated area other than a high quality water resource: ■ Known sinkhole ■ abandoned well ■ ag drainage well cistern ■ unplugged ag drainage well ■ ag drainage well surface tile inlet ■ drinking water well ■ designated wetland ■ water source	400 feet
High quality water resource (see definition)	800 feet
Residence, business, church, school or public use area setback requirement is for air quality purposes *(Does not apply to stockpiles from small animal feeding operations — confinements of 500 animal units or less. See Table 2 Animal Unit Equivalency Factors on the back side.)*	1,250 feet

Definitions

Ag drainage well is a vertical opening to an aquifer or permeable substratum which is constructed by any means including but not limited to drilling, driving, digging, boring, augering, jetting, washing or coring and which is capable of intercepting or receiving surface or subsurface drainage water from land directly or by a drainage system.

Alluvial aquifer is an area underlaid by sand or gravel aquifers situated beneath flood plains along stream valleys and includes alluvial deposits associated with stream terraces and benches, contiguous wind-blown sand deposits and glacial outwash deposits.

Confinement feeding operation is an animal feeding operation in which animals are confined to areas which are totally roofed and includes every animal feeding operation that is not an "open feedlot operation."

Dry-bedded manure is manure from cattle or swine that:

- does not flow under pressure
- cannot be transported through a liquid pump
- contains bedding.

Dry-bedded confinement feeding operation is a confinement feeding operation in which cattle or swine are confined to totally roofed areas and in which all manure is stored as dry-bedded manure. Unless specifically stated otherwise, all requirements in Division I of 567 – Chapter 65 apply to dry-bedded confinement feeding operations.

Dry-bedded confinement feeding operation structure refers to both a dry-bedded confinement feeding operation building or a dry-bedded manure storage structure.

Dry-bedded manure confinement feeding operation building is a building used in conjunction with a confinement feeding operation to house cattle or swine and in which manure from the animals is stored as dry-bedded manure.

Dry-bedded manure storage structure is a covered or uncovered structure, other than a building, used to store dry-bedded manure.

Continued on back

Stockpiling Regulations *continued*

Producer must stockpile in compliance with national pollutant discharge elimination system requirements.

The manure must be land applied within six months of stockpiling in accordance with 567 Iowa Administrative Code (IAC) 65.3 (459, 459B).

No grandfather exception applies to stockpiling dry-bedded manure as there is for dry confinement manure.

Dry-bedded manure cannot be stockpiled on karst terrain or over an alluvial aquifer unless the manure is stockpiled:

- at least 5 feet above the limestone in karst terrain or the sand and gravel in an alluvial aquifer (professional engineer to submit soils report) and
- on reinforced concrete at least 5 inches thick that meets concrete standards in 567 IAC 65.15 (14) "a"(2) paragraphs 1, 3, 4, 6 and 8.

Stockpiles within 1,250 feet of each other are considered part of the same stockpile.

The air quality setback of 1,250 feet does not apply if the neighboring landowner signs a waiver.

If more than one type of housing for feeding operations is at a site, please contact the DNR field office for manure stockpiling requirements.

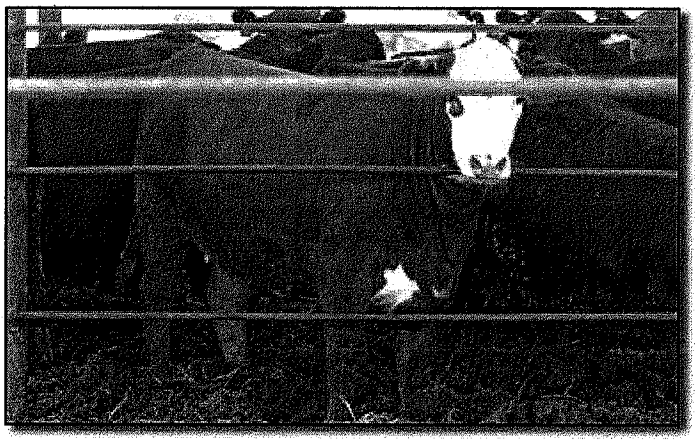
Definitions, *continued*

High quality water resource is the part of a water source or wetland that the DNR has designated as any of the following:

- A high-quality water (Class "HQ") or a high-quality resource water (Class "HQR") according to 567 IAC ch. 61, in effect Jan. 1, 2001.
- A protected water area system, according to a state plan adopted by the DNR in effect Jan. 1, 2001.

Karst terrain is land having karst formations that exhibit surface and subterranean features of a type produced by the dissolution of limestone, dolomite or other soluble rock and characterized by closed depressions, sinkholes or caves. If a 25-foot vertical separation distance can be maintained between the bottom of an unformed manure storage structure and limestone, dolomite or other soluble rock, then the structure is not considered to be in karst terrain.

Stockpile is dry manure or dry-bedded manure originating from a confinement feeding operation that is stored at a particular location outside a confinement feeding operation building or a manure storage structure.



Dry-bedded confinement

Table 2. Animal Unit Equivalency Factors

Slaughter or feeder cattle	1.0
Immature dairy cattle	1.0
Mature dairy cattle	1.4
Butcher or breeding swine weighing more than 55 lbs	0.4
Swine weighing 15 lbs or more but not more than 55 lbs	0.1

An animal unit is defined as a measurement based upon the product of multiplying the number of animals of each category by a special equivalency factor as listed above. As an example, 3,000 finishing hogs x 0.4 = 1,200 animal units.

Contacts and Links

DNR Field Offices

Manchester	563-927-2640
Mason City	641-424-4073
Spencer	712-262-4177
Atlantic	712-243-1934
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Separation Distances for Land Application of Manure

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Open Feedlot Manure Stockpiling Regulations

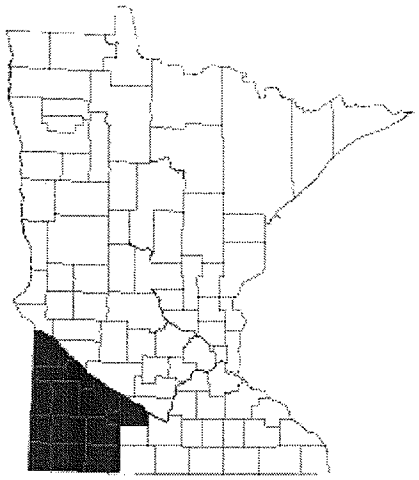
Confinement Dry Manure Stockpiling Regulations

IAC 567 Chapter 65 — Animal Feeding Operations

Minnesota Pollution Control Agency

Ground Water Profile:

Southwest Region



This is a ground-water profile for Minnesota's Southwest Region, which is comprised of Brown, Cottonwood, Jackson, Lac Qui Parle, Lincoln, Lyon, Murray, Nobles, Pipestone, Redwood, Rock and Yellow Medicine Counties.

HYDROGEOLOGY:

- Scattered, shallow alluvial sands and limited, buried sand aquifers are present.
- Low-yield crystalline bedrock is vulnerable to contamination at or near the surface.
- The highest yielding aquifers in this region are mostly narrow, channel outwash deposits.

QUANTITY ISSUES:

- Aquifers located here tend to be low yielding and not as well defined as elsewhere in the state.
- The Sioux Quartzite aquifer is near the surface in much of the region and is known for its low yield and high vulnerability to contamination.
- Many residents of this region are now served by rural water supply systems.

QUALITY ISSUES:

- Wells completed in the buried sand and gravel and Cretaceous aquifers often yield water of poor natural quality (high sulfate and total dissolved solids).
- Channel aquifers are highly susceptible to contaminants, including nitrate from feedlots, agriculture, and human wastewater.
- Water quality problems are often associated with augered and tiled wells which are common in this area.
- Residents rely on rural water supply systems because domestic wells in the region may be contaminated with nitrate nitrogen.

INFORMATION NEEDED:

- Yield assessments of aquifers in this area are needed.
- Better definition of impacts of agriculture on ground-water quality is needed.
- Future role of rural water supply systems should be better defined.
- Well owners need to be better educated to protect their wells from agricultural practices.

DESIRED ACTIONS:

- Monitoring points (good wells) should be retained for water level and water-quality measurements.
- Define locations, extent, and chemical quality of deeper aquifers.
- Educate land owners on land-use practices to protect wells and shallow ground water, including agricultural chemical handling and runoff.
- Many old wells need to be replaced with the construction of new wells.
- Continue the ground-water exploratory drilling program beyond the 1996-97 biennium.

Large Scale, Corporate Hog Operations:
Why rural communities are concerned and what they should do

John Ikerd
Agricultural Economist
University of Missouri, Columbia

I was recently asked by a rural advocacy group in Missouri to list some logical reasons why rural community leaders should be concerned about the impacts of livestock factories on their communities? I considered this to be a reasonable request and thus developed a list of reasons why I think rural residents should question whether or not they want large-scale, corporate hog farms to locate in their communities. Those reasons seem to make a logical starting point for a paper concerning why rural communities are concerned about large-scale corporate hog operations and what they should do about them.

As I indicate in my response to that request, there is no scientific consensus on this issue. Thus, there is no set of scientific "facts" to either prove or disprove the validity of these concerns. Research exists to support many of the concerns on my list, even though they cannot be proven. However, most of the concerns on the list are based primarily on logical reasoning and common sense. Some may dismiss these "logical" concerns as illogical, uninformed, or inconsequential. But, such assessments simply represent differences in "beliefs," not proven facts or some unique knowledge of reality. The people of rural communities have a right and responsibility to weigh the evidence and logic on both sides of this issue and to make their own decisions.

Top ten reasons for rural communities to be concerned about large-scale, CAFOs

A "top ten list" wasn't chosen just to be cute or catchy. Ten is enough to get the point across, but not so many as to overdo discussion of the issue. Also, I wanted to start at the bottom of my list and work my way to the top.

Concern #10. Hogs stink

Odor is at the top of the list for many opponents of large-scale hog farms. The most vocal opponents tend to be those affected most directly – those who wake up most days to the smell of hog manure. To a hog producer, hog manure may "smell like money," but to the neighbors, it just "smells like hog manure." There are legitimate human health concerns associated with air quality surrounding large hog operations. Thus, the odor problem goes beyond the very real nuisance of living with stench in the air. Odors associated with giant hog farms affect the lives of people for "miles around," not just those on adjoining farms. Few would be willing to stay in, or move into, such a community if they have an opportunity to locate elsewhere. Odor ranks only 10 on my list because something could possibly be done to mitigate its impacts, such as using odor-reducing technologies, compensating those most affected and locating facilities so as to minimize impacts of the greater community.

Concern #9. The work is not healthy for people

A large confinement hog facility is not a pleasant place to work. Known health risks are associated with continuously breathing air that arises from manure pits in confinement hog facilities. Health problems cost money in lost wages and health care costs. But more important, an unhealthy workplace can destroy peoples' lives. History has proven that people will choose to work in dangerous work environments when they are desperate for jobs. Health risks can be life threatening, so I rank worker safety above odor problems. But as in the case of odor, health problems can be mitigated by protecting workers from the noxious fumes, by limiting exposure, and by keeping people with other health problems out of confinement facilities.

Concern #8. Piling up too much "stuff" in one-place causes problems

If you spread out the hogs and let hog manure lay where it falls in a pasture, it doesn't bother anyone very much. But if you start collecting it, flushing it, spreading and spraying it around – all normal practices in confinement hog operations – it becomes air pollution. Water pollution also is a symptom of the same basic problem -- too much manure in one place. The difference between the hog lagoon spills, such as those in Missouri and North Carolina, and the normal runoff from a hog pasture is a simple matter of concentration. When you put a lot of hogs in the same place, you have to collect and store the waste. If it gets into the ground

water or gets flushed into streams, it kills fish, clogs streams and lakes with algae, feeds water born disease organism, and wreaks havoc in the environment.

In addition, manure on diversified hog farms normally is spread back onto cropland where the feed grain was grown. Most of the nutrients used to grow the crops are returned to the soil. But, when feed grains from specialized crop farms are shipped to distant hog-factories, the nation's future productive capacity is being stacked up and flushed out into places where crops can't grow. We can treat the symptoms – air pollution and water pollution – but the basic problem of piling up too much stuff is inherent within the system of large-scale, concentrated production.

Concern #7. Consumers have little if anything to gain

Large-scale, corporate hog production is frequently justified to the general public as a more efficient, lower cost, means of producing higher quality pork. The facts of the situation simply do not support such a claim. The average consumer spends just over 10 percent, a dime out of each dollar, of their disposable income for food. About 10 percent, a penny out of the dime, is spent for pork. The costs of live hogs make up only about 35 percent of that penny. The rest goes for processing, packaging, advertising, transportation, and other marketing costs.

Farm record data have shown that costs of large-scale hog operations are only slightly lower than costs of "average" commercial hog producers. Even if production costs were five percent less, about $2/cwt of live hog; the "maximum" savings to consumers would be less than two cents per dollar spent for pork at retail. At best, total food costs would be two-tenths of one percent less and consumers on average would spend only "two-one-hundredths of one percent" less of their income for food. Any savings would be lost in rounding error in consumer food cost statistics. With a handful of large hog producers and packers gaining control of the industry, it seems far more likely that in the long run pork prices would go up rather than down as a consequence of further industrialization.

The argument that factory pork would be higher in quality doesn't hold either. Pork would be more uniform because it would all come from the same basic genetic stock, as is currently the case with chickens. However, consumers have different tastes and preferences – different perceptions of quality. Making all pork "the same" would not necessarily please more consumers. Greater profit for producers and processors, not lower costs or higher quality, is the driving force behind the current trend toward industrial hog production. The only ones who really need to shave another penny or two off production costs are those who are trying to export more pork into highly competitive world markets. That doesn't include many hog farmers or pork consumers. So, why should the general public support industrial hog production?

Concern #6. Continuing regulatory problems are inevitable

Without regulations, big hog operations will impose costs on their neighbors – air pollution, water pollution, and others -- that are not part of the historic costs of producing hogs. It will cost money for hog factories to deal with "externalities" such as air and water pollution. No "bottom-line" driven hog operation will incur those costs unless they are forced to do so by government regulations – federal, state, or local.

Family farmers are people with human feelings and values, and most feel some sense of responsibility to their communities and the environment. Family farmers at least have personal incentives to be stewards of the environment and good neighbors, regardless of how they choose to behave. Public corporations have no such incentives. They are not people. Corporations have no heart or soul. Stockholders often are so detached from their investments they don't know or care what stocks they own – just as long as they make money. Local managers and workers may be good people who really care about the community, but when it comes to keeping their job, they must put profits and growth ahead of community. Professed corporate support of local communities, by necessity, can be nothing more than another strategy for profit and growth. Thus, government regulation and continual conflict are an inherent fact of corporate life.

Concern #5. Hog factories destroy public confidence in agriculture

Over the decades, family farmers have built up a vast treasure of public confidence and good will. Many people in the cities either grew up on farms or have parents or other close relatives whom either now are or once were family farmers. The "farm family" conjured up images of people who are hard working, moral, honest, solid,

dependable, trustworthy, caring, and responsible. These images have been a valuable source of wealth for farmers – although not widely recognized as such.

Farmers have been awarded special privileges, exemptions, and variances under a whole host of public policies -- from taxation to environmental regulations -- because they were trusted to behave in the public interest. Support of "family farms" has been an important part of the rhetoric of every farm bill that has passed congress. Farmers have also enjoyed a special status "as people," apart from any monetary benefits. They have been respected and trusted. However, bad publicity surrounding large-scale, corporate hog production is using up the farmer's stock of public confidence and good will at an alarming rate. Negative stories have appeared on every major television network over the past few years. When Ms. Magazine runs a feature article on the ills of corporate hog farming, as they did in 1997, we can conclude that the story has just about made the full circuit of public opinion shapers. Family farms will be paying for this loss of public trust for decades, if not forever.

Concern #4. Future of the community is turned over to outside interests.

Rural people need to take charge of their own destinies if they expect to sustain a desirable quality of community life for themselves, their children, and future generations of rural Americans. Quality of life is about much more than just creating more jobs and making more money. Quality of life is also about positive moral and social values and being responsible caretakers of the community as a place. Sure, people need jobs and need to make a decent living. But, jobs and high wages didn't save the cities from decline and decay and jobs won't save rural communities either. When an apparent solution to a problem comes from someone else, from outside, you can just about bet that the benefits will be going to someone else from outside as well.

Some rich and powerful outsiders have their own problems, and they have their eyes on rural communities as places to solve them. Sparse population, trusting people, and lack of jobs in rural areas are seen as ideal opportunities. They are looking for someplace to "dump stuff." An Industrial society creates a lot of "trash," whether in the form of garbage, toxic chemicals, or hog manure. Most "outsiders" promoting rural development schemes have something they need to "dump." Jobs just aren't enough compensation for turning a community into a "dump." Rural people need to take control of their own destiny and build the kinds of communities in which their children and their children's children will choose to live and grow. The solutions to the problems of rural Americans are in the hands, hearts, and minds of rural people themselves, not in outside investment and corporate control.

Concern #3. The decision making process can rip communities apart

The process of decision making may be more important than the decision itself. Anyone who has been a part of a family has experienced this first hand. The memory of an act that triggered a family feud has long since faded, but the feud goes on. Feuds result from a loss of confidence and trust, regardless of the context within which the loss takes place. The large-scale, corporate hog farm issue is one of the most contentious issues to confront rural America in recent history.

The social fabric of rural communities has been ripped apart by controversy surrounding the introduction of large-scale, corporate hog operations. There seems to be no middle ground. Some people seem determined to bring in the big hog operations, by almost any means, and others seem just as committed to keep them out, by almost any means. Almost everyone eventually seems to feel obligated to take sides. The larger question in such communities is not whether the hog factories come in or stay out, but can the community ever heal the wound left by the fight?

A healthy, unified community can deal with almost any problem, including a large-scale corporate hog farm on the outskirts of town. A sick, bitterly divided community is incapable of much more than survival, regardless of its other advantages and opportunities. The future of rural America depends on communities of people being able to work together for their common good. The divisiveness of the decision making process, presumably, could be avoided. But, the consequences of failing to do so are so destructive that it ranks near the top of my list.

Concern #2. Hog factories degrade the productive capacities of rural people

Factories "use up" people. Assembly line work is "non-thinking" work. When you work on an assembly line, you simply do what you are told as fast as you can for as long as you can. I know. I have been there. Large-scale hog operations may not be assembly lines, but the principle is the same. Big hog operators do not want people who know anything about raising hogs. They want people who can be trained to do what they are told to do without thinking. An experienced hog farmer might start thinking, asking questions, and mess up their process. Hog factories, like other factories, are looking for people who are dependable, who know how to carry out orders, and will work hard for a little money.

On balance, large-scale, industrial hog operations destroy more jobs than they create. A driving force behind industrialization is to substitute capital and technology for labor and management – to make it possible for fewer people to produce more. Large-scale hog operations concentrate the jobs created in one place and call it economic development. The jobs lost elsewhere are ignored or denied. The numbers of independent hog farmers displaced elsewhere will be greater than the number of jobs created in new large scale hog operations. Hog factories replace more independent hog farmers with fewer assembly line workers.

Other kinds of factories have come to rural America in the past. When these factories have found people in other regions, or in other countries, who would work even harder for less, they moved on. Corporately owned factories have no roots. They leave behind a workforce that doesn't know how to do anything other than what they are told. Intelligent, thinking, capable, independent people are transformed into detached, non-thinking people who may be psychologically incapable of earning a living without depending on someone else to tell them what to do. Our cities currently are plagued with such people -- people whose capacities have been degraded by factories long since gone. It just doesn't seem to make sense to do the same thing to rural people. When we replace independent, family hog farmers with hog factories we are degrading the most valuable resource rural areas have to support future development – rural people.

Concern #1. Tomorrow's problems are disguised as today's solution

My number one concern regarding large-scale, corporate hog operations is that rural communities will see them as "the solution" to today's problems without seeing them as a potential "source" of problems for tomorrow. Maybe there are some communities so desperate for jobs that it makes sense to take the risks. Maybe they feel they have to do something today to give them a chance to do something better tomorrow. But, hog factories are a short-run solution, at best, that may create more long run problems than they solve today. Low-wage, assembly-line-like jobs should be viewed as a stop gap strategy suitable only for communities with no other options. Sooner or later non-thinking jobs will be done somewhere else on the globe, where people will work harder for less money and are accustomed to doing whatever they are told – by those who have no other options. In the longer run, all non-thinking jobs will be done using computers and robots – not by people anywhere.

The real opportunities for people to lead successful lives in the future will be in "thinking" work. The human mind is uniquely capable of complex thought. Almost anyone is "smarter" than a computer. But, people need to develop their unique human abilities to think. We need to accept the responsibility for thinking and for creating thinking jobs for ourselves and for others. As long as rural people think their problems are solved, or will be solved by someone else, they see no incentive to begin doing the things they need to do to ensure the future of their community.

The primary advantages for rural areas in the twenty-first century will be the unique qualities of life associated with open spaces, clean air, clean water, scenic landscapes, and communities of energetic, thinking, caring people. Communities that sacrifice these long run advantages for short run economic gains may have a difficult time surviving in the new century.

Thus, my number one concern is that large-scale, corporate hog operations are tomorrow's problem disguised as today's solution. They may keep rural people from doing the things that need to be done today to ensure the future of their communities. Large-scale, corporate hog operations will not create communities where our children and their children will choose to live and grow. Communities with a future must take positive actions today to ensure a desirable quality of life for themselves, their children, and rural children of future generations.

Why Do Rural Communities Accept Confinement Animal Feeding Operations?

Admittedly, there are reasonable arguments that can be used to support bringing large-scale confinement animal feeding operations (CAFOs) into a rural community. Community leaders who support such operations typically argue that people in their community:

- Need jobs in to replace those lost to globalization,
- Need a higher tax base to provide rural services,
- Need to bolster their declining agricultural economy,
- Know that other communities will accept these operations if they don't,
- Feel that they can't stand in the way of progress,
- Believe big operations can better afford modern pollution prevention technologies,
- Feel that local opposition is just another case of "not in my backyard," thinking.

There are logical responses to each of these arguments, but each also contains elements of truth. One thing nearly all pro-CAFO arguments have in common is their foundation in short-run, self-interest economics. They are based on a deeply held faith that the market place is the best means of allocating resources – whether it is allocation of people among alternative occupations, land among alternative uses, money among investments, or people among communities. Those things possible and profitable shall be done. People have a right to protect themselves and their property from damage caused by others, but beyond that, the economics of the marketplace shall prevail. A community is nothing more than a collection of individuals that happen to be located in geographic proximity to each other. These are typical assumptions of self-interest economics.

After all, corporate investors are putting their money into CAFOs because they expect to make profits. Investments create jobs and enhance the local tax base. If CAFOs are more cost efficient than smaller farming operations, even if marginally so, traditional family farmers will inevitably be forced out of business -- so the argument goes. Why not give local farmers a chance to go to work for a profitable agricultural corporation? We know these Corporations are going to invest somewhere, so it might as well be here. There are always costs associated with anything that generates benefits. The opponents just want someone else to bear those costs.

They reason that if environmental problems arise, it will be easier to work them out with a few large operations than many small ones. The big operations have the money to invest in the modern waste handling facilities that ultimately will be required of everyone. The technology is available, it's profitable, so it's both futile and foolish to stand in the way of economic progress. The people who are opposed to these operations are accused of being out of touch with economic reality. Opponents of CAFOs are labeled as Luddites – as people who oppose progress or just want to keep things as they are.

If self-interest economics prevail, there is every reason to believe that CAFOs eventually will totally dominate animal agriculture in America. And, corporations will locate CAFOs pretty much wherever they choose, regardless of the ecological and social consequences. They will avoid locating them in heavily populated areas to minimize nuisance law suites. But, money invested in CAFOs will seek its place of highest return. The only way to successfully challenge this outcome it to challenge its basic premise – the right of private profits to prevail over public good – and to uphold the rights of people to prevail over the pursuit of profits in protecting their communities and shaping their destinies.

Sustainability: The Challenge to Land Use Economics

Current land use decisions in the United States, including location of large hog operations, have their foundation in economic theory as it relates to the concept of private property. Persons who hold ownership rights to property may do with it pretty much as they see fit, including exchange ownership rights with others, as long as it does not interfere with the private property rights of others. Any restrictions on individual land use are limited to uses that might affect the use rights held by other individuals.

With relatively minor exceptions, land use decisions are determined by the economics of the market place. Provisions are made through laws of eminent domain to acquire private property for public use, without the consent of owners, but not without just economic compensation to current landowners. Land uses of a criminal nature, deemed to be of clear public harm, may be restricted without compensation. Land use zoning may restrict land use as well. But in reality, economic considerations commonly dominate planning and zoning decisions. The question becomes, how can economic development be maximized with the minimum negative

impact on community residents. Requests for changes in zoning are typically motivated by a desire to put land to a higher economic use. Opposition to changes typically is motivated by the desire to protect private property rights. It is a rare community that uses the tools of planning and zoning to ensure the long run ecological and social well being of the community as a whole.

So, with minor exceptions, private property may be put to its highest economic use. The concept of highest economic use gives legitimacy to competing private property rights, but commonly ignores or denies any right of the community, or public as a whole, to participate in all land use decisions. Economic theory treats a community as a collection of individuals, not as an entity with rights separate from, or in addition to, those of individuals of which the community is composed. In addition, conventional economics gives no consideration to potential ownership rights of future generations. Rights of intergenerational transfer of ownership are based on the premise that to prohibit or limit such transfers would unjustly restrict current private property rights. Free market economics makes no provision for future generations, other than those reflected in the self-interests of current decision-makers. And economics drives land use decisions.

The question of long run sustainability presents a serious challenge to conventional economic thought as the foundation for land use decisions. Over the past decade, many different people have defined sustainable development, of which sustainable agriculture is but one part, in many ways. However, the underlying theme of nearly all such definitions is one of intergenerational equity – a responsibility to meet the needs of the current generation while leaving equal or better opportunities of those of all generations to follow. In more common language, sustainability development applies the Golden Rule across generations – doing for future generations as we would have them do for us.

The three cornerstones of sustainability are ecological soundness, economic viability, and social justice. The three are not separate goals or objectives, but instead are three separate dimensions of the same whole -- as with the three dimensions of a box; height, length, and width. Any object lacking any one of those three dimensions quite simply is not a box. Any system of development that is not ecologically sound *and* economically viable *and* socially just quite simply is not sustainable over time. All are necessary and none alone or any pair is sufficient to ensure sustainability.

Thus, sustainability requires that we look beyond the economics of short-run, self-interest to the broader set of issues affecting quality of life or human well being over time. Sustainability requires that we broaden our economic thinking to consider the long run health and productivity of the natural ecosystem, not just the optimum means by which it may be exploited for our short-run gratification. Sustainability requires that we broaden our economic thinking to consider the well being of the community, or society, as a whole, not just sum the welfare of individuals who make up a community or society. The economics of self-interest is an important dimensions of sustainability, but it is but one among three. Things ecological, social, and economic must be considered as complementing dimensions of the same whole, not as competing objectives that can be pursued separately.

Economic Implications for Sustainable Land Use

The following is a short discourse on the economics of land use under conventional and sustainable economic assumptions. For some readers, this discussion will be unnecessary, and they may feel free to skip to the next section. It is included for the benefit of those who might be skeptical regarding whether or not the conclusions of this paper are based on sound economic logic. They are.

From a short-run economic perspective, production from a given piece of land should continue to be increased as long as the value of additional production exceeds the added cost of creating that production. Land is considered as a *fixed* economic resource -- its quantity cannot be increased -- and all other inputs such as hogs, feed, and labor are considered to be *variable* – more or less may be used on a given piece of land. The fundamental economic question is; " what quantity of variable inputs should be applied to a given amount of fixed resource?" In terms of hog production, the answer is: the number of hogs or size of production unit, and the number of production units in a given area, should be increased as long as the value of adding one more hog or production unit exceeds their addition to costs.

The economic optimum scale of hog production has increased dramatically over the past few years. New production technologies have allowed hog producers to avoid many of the previous problems of large-scale production – such as disease and labor problems. Changes in the food system have created opportunities for

profitable integration of production and marketing activities -- favoring large-scale, corporate hog operations over individually owned family farms. Thus, the costs associated with larger scale production have declined and the returns from large-scale, corporate production have increased. There is little doubt that the dramatic increase in large-scale CAFOs has been driven by economics – by corporate greed and the pursuit of profit. However the economic arguments that support CAFOs are valid only from the perspective of economics of short-run, self-interest.

The conclusions are totally different if we instead take a long run, sustainable economics perspective of land use questions associated with large-scale hog operations. In the long run nearly all the agricultural inputs that are *variable* in the short run are *fixed*. For example, fossil fuels, fertilizers and pesticides for feed production, machinery, and many building materials are all derived from finite, non-renewable stocks of natural resources. Thus, their long-run supply is *fixed*, even though their short run use may be *variable*.

In the long run, our only truly *variable* resource is solar energy. Living organisms, including people, represent renewable resources, but living organisms are dependent on finite natural resources as well as solar energy. Every productive resource on earth can realistically be depleted over some finite period of time. But, the continuing supply of energy from the sun is expected to continue for billions of years into the future.

Geographic space is required to capture solar energy, at least for agricultural use. Land represents space. Thus, land – as space – serves as a proxy for solar energy, the only long run, *variable* resource. Of course, land has characteristics other than space -- such as organic matter, texture, and water holding capacity – which may influence its productivity and value. But, these non-spatial aspects of land are finite, and thus, may be depleted over time. Land as space, while fixed in total at any point in time, represents a virtually infinite supply of solar energy that may be utilized in varying quantities over time, and thus, represents a *variable* long run resource.

Ironically, those things that are variable in the short run are fixed over the long run, and the one thing most fixed in the short run, space, represents the only variable long run resource. As we should expected, things that appear to be optimum from a short run perspective are far from optimum when one takes a long run perspective.

Solar energy in not only variable -- it is also *free*. The sun is the only resource that we don't have to pay for, by one means of another. Thus, in the long run, land – as space -- must be considered as *free*. Economics dictates that we maximize production from free resources if we are to maximize profits. When space is considered to be free, the profit maximizing use of all non-renewable inputs will be at the point of their minimum cost per unit of production. In hog production the optimum would be at the point of maximum production per pound of feed or per hour of labor, not maximum profit from a production unit or for a given corporation.

Maximum production *per unit* of non-renewable input will result in maximum *total* production from a given quantity of input over time – and maximum contribution to sustainable production. If land, as space, is allowed to take on a positive market value, less land will be used relative to other production inputs – feed, labor, capital, and equipment -- resulting in these non-renewable inputs being used up at faster than optimal long run rates. This conclusion is quite different from conventional short-run economics which treats land as a marketable commodity and focuses on maximizing profits for the firm or corporation, rather than maximizing long run benefits to the community or society.

Implications for CAFOs in Rural Communities

So what does all this mean for confinement animal feeding operations in rural communities? It means if short run economics is allowed to prevail, concentration of hogs in a given area will increased as long as each additional unit of production – increase in size or number of CAFOs --adds more to total value of production than it adds to total costs. But, it also means if rural communities want to *sustain* development over the long run they cannot allow short-run economic self-interest to prevail.

Eventually, the size of CAFOs may be limited by rising costs. For very large operations, costs of production may eventually rise because feed and other inputs have to be shipped in and products shipped out from and to increasingly distant locations. But in reality, something other than economic scale of production typically limits the size and number of CAFOs in a given area. Costs associated with such things as foul odors, water pollution, worker health, displaced farmers, degradation of human potential, and destruction of communities are

all considered to be "externalities," if considered at all, in short-run, self-interest economics. The limit of size typically is not one of internal economics, but rather one of external pressures.

External costs, by definition, are costs not imposed by the market place. Thus, those who are damaged must impose such costs – through law suites, government regulations, and social pressures from the surrounding community. External costs typically limit the growth of CAFOs within any given area. But, the economics of self-interest provide the constant and relentless motivating force for those who operate CAFOs to do the things that result in law suites, to violate government regulations, and bribe and coerce the community into accepting their presence. CAFOs almost always see opportunities to increase profits if external constraints can be overcome, avoided, or removed.

The existence of externalities cause those who operate CAFOs to choose those areas least willing and able to impose external costs of the corporation, which allows them to operate as near as possible at the short-run, self-interest economic optimum size. The most important spatial requirements for CAFOs at present appear to be space for dispersing foul odors in the air and space for spreading manure on the land. Rural areas are "valued" as dumping grounds for stench and manure – things other people don't want to have around. Thus giant animal feeding factories have consistently located in remote, economically depressed rural areas. It all makes logical short-run, self-interest, economic sense. But, it is all long run, sustainable economic nonsense.

What should rural communities do?

Rural people must become actively involved in shaping the destiny of their communities. They cannot rely on some "invisible hand" of economics to create a positive future. The "invisible hand" has been severely crippled, if not cut off, as an economy made up of small proprietorships has been replaced by an economy dominated by large corporations. Rural people must assert their right put their long run, community interest ahead of the short-run, self-interest of those who invest in and operate CAFOs. Such operations cannot even be justified on economic grounds, when one takes a long-run economic perspective. Nor can the impacts of CAFOs on environmental quality and social justice be tolerated if communities are concerned about their long-run sustainability.

Markets cannot be allowed to allocate the use of land as space. This is the most important conclusion of the foregoing illustration of short run versus long run economics. Markets place positive prices on economic inputs, resources, and products. Those things that are most scarce – that are less available relative to the aggregate desire and ability to posses them – will command the highest market prices. Higher prices both ration the scarce supplies among those who are willing and able to pay and provide an incentive for increased production to reduce the scarcity. But land, as space, cannot be allowed to have a positive price without misallocating its use, and higher land prices quite simply cannot create more space. Land prices guide land use to its highest valued short-run economic alternative – whether for residential developments, hog factories, farming, or wilderness. Those using conventional economic theory have falsely assured us that society will realize the highest total value from a given stock of land by allowing free markets to allocate land use.

Some portion of the total value of land will reflect its inherent productive capacity, whether in agriculture, recreation, or other land-based production processes. That portion of land value can be allocated by market prices. However, much of the value of land represents its value as space -- a geographic place to carry out some activity, or simply as space to be held or controlled. Any market value placed on land as space will cause it to be used too intensively, using too many inputs on too little land, and will deplete resources at a faster than optimum rate. Thus, concern for long run sustainability will require a rethinking of fundamental concepts of private property, specifically of what it means to *own* land.

The first reaction of many will be to rise in defense of "private property rights" – the right to use their land as they see fit. However, when markets are allowed to dictate land use those with less money can easily be deprived of the right to use land as they see fit by those with more money. Those with more money may bid up land prices to the point were current users cannot afford to pay their property taxes or possibly justify not selling out to the highest bidder. The ability of one farmer to use their land may be affected by another's land being purchased by an outside investor – the existence of a large CAFO in a county may bring on regulations that preclude existing hog farmers from further expansion. Farmers who would prefer to be good community citizens and ethical stewards of their land may be forced by competition from outside investors to exploit their community and the their land in order to stay in business. Insisting on unencumbered use of private property

may be far more restrictive on use of private property by local landowners than would their participation in a community-based land-use decision making process.

The concept of private property has never meant the right to do whatever one chooses with the property they own. *Conditional ownership* was always implied, if not always stated. A new condition needed to ensure sustainability is one that denies any right to degrade the land or the surrounding community, just because one owns the right to use their land. Thus, the owner of land cannot possess, and thus cannot convey to another, the right to use land is ways that are inconsistent with long run societal well being. If the community, rather than the individual, makes the ultimate decisions regarding how land is used, land as space will have no market value because there will be no right of alternative use for its owner to convey. Its price will reflect only that portion of its value that is associated with its potential productivity in its current use.

What should rural communities do? They should demand their right to be protected against the economic tyranny of the marketplace by making logical, long run land use decision for their communities. They should refuse to allow the long run economic, ecological and social well being of their communities to be degraded in the pursuit of short-run, economic self-interests. They should demand the right to allocate land use within their community by means other than market prices – and to exceed any set of state or national health and environmental standards to protect the community if necessary.

Traditional remedies such as law suites and environmental regulations will not provide lasting solutions. Traditional remedies are based on the principle of conflicting self-interest, rather than the collective interest of the community as a whole. Law suites, at best, only compensate individuals who are damaged by the actions of another – even in the case of class actions. Environmental regulations invariably reflect some compromise among conflicting individual interests, which settles to some minimum common denominator in a society driven by short-run, self-interest. Communities must find the courage and the means to act as a whole, for the long run well being of the community as a whole, both now and forever. This is not a matter of compromise among conflicts; it is a matter of harmony within.

Communities may use zoning laws to pursue their objectives where they are allowed to do so under current state law. Communities may also use health and environmental regulations to protect the people and the land where such laws at the local level are allowed. In cases where state or national laws prevent a community from protecting itself from exploitation, the laws must be changed. But, all current restraints on CAFOs are only "band aid" treatments for a potentially fatal disease. Those with the greatest economic interests ultimately will prevail. New means must be found for allocating land use that will remove any economic incentive for degrading the land. Land must be treated as a commonly managed natural resource, rather than an economic commodity that can be bought and sold to the highest bidder.

The inherent common property nature of land as space certainly is not a new concept. In 1796 revolutionary writer Thomas Paine, in his paper, Agrarian Justice, pointed out that all land was initially held in common. Thus, the previous removal of land from the commons deprived those of later generations of their common birthright – the right of access to land. Initially, land could only be removed from the commons if as much land and as good of land was left for any others who chose to claim it. Consequently, land taken from the commons had no market value -- by definition, it could not be scarce. A similar argument can be made to support the rights of future generations to as much land as good of land as we have today. And to protect this right, land as space cannot be allowed to have a market value.

Economist, Henry George in his 1879 book, "Progress and Poverty" proposed that all use value of land be taxed away to prevent the pricing of land as a market commodity. A more logical approach today might be devise a policy for capturing any increases in land values attributable to rezoning for higher market valued uses in order to compensate those whose land is rezoned to lower-valued uses. This would remove any economic incentive for current of future owners to rezone land to either higher or lower valued uses, and would make it much easier for the community as a whole to make logical long run land use decisions. A similar capturing of capital gains in land values attributable to growing population demands would remove speculative incentives for land ownership and would generate public funds to sustain and enhance the productivity capacity of land.

Sustainable development ultimately will require that land use decisions be made by means that find harmony among long-run economic, social, and ethical or moral concerns. It makes no more sense to buy and sell the right to *misuse* land than to buy and sell the right to misuse another person. Land, particularly land as space, is a fundamental resource upon which all life depends. It cannot be allowed to belong to anyone individually or to

us in total as a collection of individuals -- just as people cannot belong to other people. Land belongs to the earth just as people belong to the earth, to the collective *us* as a whole – inseparable, indivisible, across all generations.

We may logically buy and sell those things that enhance the productivity of land -- for those uses with impacts that fall within the realm of legitimate self-interest. But we cannot allow markets to allocate the use of land as space. We may logically decide some land use issues by a vote of the people -- for those uses with impacts that fall within the realm of the community of interest. But, many uses of land as space have impacts on future generations, and future generations cannot vote. Such land use decisions must reflect our fundamental values concerning the responsibilities of being human. Such issues cannot be resolved by economics or politics, they rest on a fundamental code of ethics or morality. They arise out of a consensus of what is fundamentally right and wrong.

Many issues concerning the natural environment are fundamentally moral or ethical issues. We should not be buying and selling pollution rights, because no individual has the moral right to pollute in the first place, and thus, has no right to sell it. Businesses may argue that society has given them that right, through the political process. But, no society has the right to pollute, so it cannot convey that right to a business or anyone else. Pollution of the environment is fundamentally, morally wrong, the same as it is morally wrong to kill, to steal, or enslave. The environment can assimilate some level of waste, as society can tolerate certain amounts or kinds of killing, stealing, or enslaving. But, those things are still morally and ethically wrong, regardless of the ability of society to survive them. We don't condone or encourage them by allowing people to openly buy or sell the right to enslave another person, nor vote on whether one person should be allowed to kill another for personal reasons. We cannot prevent pollution, but is always morally wrong to degrade the natural environment.

It is also morally wrong for one person to exploit another person for personal, economic gain. The short-run economics of self-interest makes no provision for avoiding such exploitation. Those who have fewer opportunities are forced to do the jobs that others can avoid at wages lower than others would be willing to accept. Pursuit of short-run profit dictates that people be hired to works as hard as they can be made to work at wages as low as they will accept. There is not short run economic incentive for businesses to invest in improving the productive capacity of people if there are already people available who possess the skills and abilities needed. But, communities have a very large stake in maintaining the productive capacities of their members. In essence, a community *is* the collective whole of its people. If we allow the people of our community to be degraded, our community is degraded. If we allow our communities to be degraded, human society will be degraded.

No one has the wisdom to plot a true course toward a sustainable human society. At this point in time, we simply don't know how we can meet the needs of the current generation while leaving equal or better opportunities for those of future generations. But, we are beginning to learn some things that we cannot do. We cannot allow the economics of short-run, self-interest to determine the *use of our land and our people.* We know that the relentless pursuit of profits and growth will degrade both our natural and human resources, and will not leave as much and as good as we have today for those of future generations.

We also know that we cannot allow large, corporate organizations, such as those operating CAFOs, to do whatever they want to do wherever they have the money and/or can buy the votes to do it. Rural America may well be the place where America makes a historic stand for sustainability – just as the cities of the South gave birth to the Civil Rights movement. The first rural community to declare and defend the fundamental moral and ethical right of its people to determine how land is used may be remembered much as Rosa Parks is remembered for refusing to move to the back of the bus in Montgomery.

The most significant long-run social, economic, and cultural impacts of CAFOs on rural communities could well be the beginning of a new revolution -- a revolution that ultimately will discard the outdated paradigm of short-run, self-interest economics for a new paradigm of sustainable economic, ecological, and social development.

Adverse Health Effects Of Hog Production
A Literature Review

Ammonia emissions from hog farms pose a serious public health threat.

- Ammonia emissions from hog farms react with other gases in the air to form fine particle pollution, a public health threat linked to decreased lung function, cardiovascular ailments and most seriously, premature death.[1]
- Recent analysis by NC State University (NCSU) researchers shows that fine particulate pollution is higher in Raleigh (and likely for all of the Triangle area) when air masses cross the high density hog counties on the way to Raleigh.[2] This analysis also found fine particulate levels in a rural town (Kenansville) in a high density hog county were very high relative to what would be expected.
- The 2003 National Academy of Sciences[3] report identified atmospheric ammonia nitrogen emissions as the most significant public health threat from Animal Feeding Operations[4] on a regional scale.
- Reducing ammonia emissions from Animal Feeding Operations makes sense not only for the obvious public health benefits, but also for economic reasons. The Benefit Cost Analysis conducted by Research Triangle Institute for the NCSU hog waste management evaluations found that a 50% reduction in ammonia emissions from hog farms in eastern NC will provide an estimated $190 million a year in benefits from avoided health impacts.[5]

Air emissions from lagoons, sprayfields and hog houses have been linked to neurological and respiratory problems.

- Subjects in a controlled exposure chamber who were exposed to air from hog operations for one hour reported headaches, eye irritation and nausea.[6]
- Unpleasant odors have been found to be a nuisance and emotional stressor on neighbors,[7] and are known to contain irritants that can cause damage to mucosal linings in the nose, throat and respiratory tract.[8]
- The 2003 National Academy of Sciences report identified odor as the most significant concern for local communities among the suite of air emission problems from Animal Feeding Operations.
- Researchers from the UNC School of Public Health and Duke University found that neighbors exposed to odors from hog operations showed evidence of reduced immune system function.[9]
- Evidence is also emerging that indicates that the health of citizens living near hog operations is negatively affected.[10] Research in Iowa and North Carolina showed that neighbors living within three miles of hog operations experience elevated levels of respiratory complaints relative to those living near other animal production operations or crop production.[11,12]
- Abhorrent odors can be exacerbated by the smell and sight of rotting flesh from hog carcasses that are often stored in "dead boxes" close to neighbors' property lines. "Dead trucks" that transport hog carcasses to rendering facilities also emit odor

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Hydrogen Sulfide Emissions

- Hydrogen sulfide (H_2S) is a colorless gas with a strong odor of rotten eggs that is detectable at concentrations as low as 0.5 ppb (0.0007 mg/m^3). Acute exposures to H_2S at 2 – 10 ppm have been associated with respiratory and cardiovascular effects, and people with asthma appear to be more sensitive to H_2S reporting headaches following 30 minute exposures to 2 ppm.[13] The EPA also reports that acute occupational exposures have been associated with a variety of central nervous system (CNS) transitory symptoms, such as dizziness, nausea, headache, and at higher exposure concentrations, serious conditions such as "abrupt physical collapse" and pulmonary edema.[14]
- The 2003 National Academy of Sciences report, noting hydrogen sulfide's risks to public health, recommended that the EPA and USDA should develop process-based mathematical models for atmospheric emissions of hydrogen sulfide, along with ammonia and methane, to identify management changes that decrease emissions.
- Of particular concern is the susceptibility of children to neurological effects associated with H_2S exposure.[15]
- The EPA Office of Air Quality Planning and Standards is in the process of re-evaluating H_2S toxicity to determine if it requires specific regulation.[16] The neurotoxicity has been cited as one of the principle reasons for increased scrutiny.
- In light of these efforts by the EPA Office of Air Quality Planning and Standards, it would seem reasonable and practical to continue to collect emissions data, and use this information in the evaluation of potential health impacts that can be used to inform the decision-making process by the Office of Air Quality Planning and Standards. It is premature to cease collecting this information at a time when an analysis of the exposure conditions is warranted.

Hog waste contains disease-causing pathogens & increases antibiotic resistance.

- Hogs and humans share many of the same disease organisms. Large quantities of antibiotics, many closely related to those used to treat humans, are used by pork and other livestock and poultry producers.[17]
- Environment Defense reported in 2005[18] that North Carolina's animal production industry, which is largely comprised of hog and poultry production, is estimated to use three million pounds of antibiotics annually. This is approximately the same amount of antibiotics that is estimated to be used *nationally* to treat humans.
- The vast majority of antibiotics are administered not to treat disease but rather to promote growth or to compensate for the crowded, stressful and often unhygienic conditions in industrial-scale livestock operations. An expanding body of evidence[19,20] links this frequent exposure of antibiotics to the development of antibiotic-resistant pathogens, contributing to the problem of reduced antibiotic effectiveness in humans, a growing health concern in the United States.
- There are also concerns about the exposure of workers or neighbors to antibiotics in the dust generated in the hog confinement facilities, which are vented to the outdoors.[21,22]

Evidence indicates adverse impacts on workers' and children's health.

- An enormous amount of research exists to document the serious negative impacts to swine confinement house workers.[23] Effects include respiratory symptoms, reductions in pulmonary function and increased bronchial responsiveness.
- Researchers in Iowa found a high prevalence of asthma in children living on hog farms, especially farms that added antibiotics to feed.[24,25]
- A North Carolina study of 58,169 children found a 23% higher prevalence of asthma symptoms among students attending schools where staff noticed livestock odors indoors twice a month or more.[26]

Manure land application rates at hog Animal Feeding Operations result in high levels of pollutants in groundwater and pose risks for drinking water wells.

- Ground water nitrate levels beneath animal waste sprayfields are typically found to range from 10 to 50 parts per million (ppm).[27] The drinking water standard for nitrate is 10 ppm. Even wells drilled to clean aquifers below surface contaminated groundwater aquifers are at risk because well casing construction flaws can allow leaks of highly contaminated groundwater into drinking water wells.
- Results from a free well-testing program for people living adjacent to hog farms in North Carolina in 1996 found more that 10% of the wells tested failed to meet drinking water standards for nitrate. Three wells had nitrate concentrations in the 70 – 100 ppm range. The NC Department of Health and Human Services found that the results of the well testing program "*...illustrate a potentially serious groundwater problem to the people utilizing wells near Industrial Livestock Operations in five counties in eastern North Carolina.*"[28]

Community health experts are recommending safeguards to protect the health of rural residents.

- Based on the 2003 American Public Health Association's review of evidence of the health and economic impacts of concentrated animal feeding operations (CAFOs)[29,30] and "evidence, albeit less certain, indicating impacts on children and CAFO neighbors from exposure to large concentrations of manure and their subsequent emissions of dust, toxins, microbes, antibiotics and pollutants in the air and water," the Association resolved that it would:

> *[U]rge federal, state, and local governments, and public health agencies to impose a moratorium on new Concentrated Animal Feed Operations until additional scientific data on the attendant risks to public health have been collected and uncertainties resolved.*

Community health experts are recommending safeguards to protect the health of rural residents. (continued)

- The American Public Health Association's recommendations were recently endorsed by a collection of American and European environmental scientists brought together in a symposium and workshop organized by the University of Iowa's Environmental Health Science Research Center and sponsored by the National Institutes of Environmental Health Sciences. The endorsement emerged from an expert community health workgroup assembled at the workshop in 2004, the results of which were recently published.[31] The workgroup found that "*...sufficient research exists to support action to protect rural residents from the negative community health effects of CAFOs....*" Furthermore, the expert workgroup recommended that permitting of CAFOs should include: consideration of total animal density in a watershed; environmental impact statements; public meetings and local decision making; regulation with standards applied to general industry with similar levels of emissions and type of waste handling; and bonding for manure-storage basins for performance and remediation.

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ANTIMICROBIAL RESISTANCE: HOW? WHY? AND WHAT TO DO WHEN YOU ENCOUNTER IT

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DEFINITIONS AND KEY CONCEPTS

Colonization is the existence of a mixed population of bacteria on or, under certain circumstances, within an organism. *Infection* is the existence of bacteria outside their normal niche, in association with inflammation and pathologic changes. When contemplating the use of antimicrobials in any patient, it is important to recall that both the colonizing and the infecting bacteria will come into contact with administered pharmaceuticals.

Virulence is the ability of a pathogen to invade, multiply, persist, or otherwise establish itself within an organism outside its normal niche; effectively, it is the ability to cause infection. Examples of virulence features include fimbriae, motility, or production of biofilms or toxins by the microbe. Meanwhile, *antibiotic resistance* is the ability of a microbe to survive exposure to an antimicrobial that is expected to kill it. "Expected to kill it" here implies that the microbe possesses an appropriate target for the antimicrobial agent. For example, *Escherichia coli* is not "resistant" to itraconazole; *E. coli* simply lacks ergosterol, which is the target of itraconazole. Resistance to antimicrobials is not inherently a virulence feature. A bacterium that lacks the ability to invade a host and establish itself as a pathogen is not virulent, no matter how resistant it

53 cases (1989-1998). JAVMA. 2001;218:77-82.

might be to antibacterial agents. Antimicrobial resistance typically becomes important to us as clinicians *after* a microbe has demonstrated that it has sufficient virulence to cause infection.

Bacteria resist destruction through a number of structures or strategies, many of which can be amplified or selectively expressed as needed. Four major strategies for antimicrobial resistance include:

- Direct destruction of the antimicrobial agent
- Alteration of the site at which the agent would bind
- Alteration of the porins that allow the agent access to cellular structures
- Alteration of efflux pumps that remove the agent from the cell

β-lactamases are enzymes with resistance features that directly destroy the antimicrobial agent, in this case β-lactams such as penicillin. β-lactamases are secreted by the bacteria and enzymatically degrade the drug as it arrives in the vicinity. To combat this resistance feature, we will often combine β-lactam antibiotics with additional drugs such as clavulanate or sulbactam to inactivate the β-lactamase.

In an example of alteration of target sites, β-lactam antimicrobial agents work by binding to the bacterial surface antigen penicillin-binding protein (PBP) in the cell wall and physically disrupting cell wall structure, thereby causing the bacteria to die. Some staphylococci have constitutive resistance to β-lactams because the normal target site for the antimicrobial agent (PBP) is substituted by a structural variant, PBP-2. PBP-2 allows for only weak binding by β-lactam antimicrobials; thus they cannot exert their effect on cell wall structure.

Porins are cell surface structures that allow passage of substances into and out of the cell. As many antimicrobial agents exert their effects within the cell, they must pass through porins to arrive at target sites. Some bacteria with resistance to fluoroquinolones achieve this resistance

through alteration of porins, excluding the drug from its target site of DNA gyrase inside the cell. Porin alterations can include changes in size, shape, or number and as such can have a graded effect.

Finally, efflux pumps are features of cell membranes that enable the cell to excrete wastes. Under the selection pressure of an antimicrobial, bacteria can upregulate expression of efflux pumps, alter the specificity of efflux pumps, or acquire new efflux pumps by genetic transfer from other bacteria.

Bacterial resistance is not a new phenomenon. As long as there has been evolution, organisms have proliferated if they have successfully survived the challenges of their environments. Within a diverse population, certain bacteria can be expected, by chance, to display more effective efflux pumps or better porin exclusion when faced with antimicrobial agents. These subgroups will preferentially survive as the population at large is exposed to the antimicrobial agent. Consequently, the resistant phenotype will become more prevalent.

As some bacteria are capable of exchanging genetic material horizontally, the genes encoding this resistance phenotype may also spread, including spreading to populations of bacteria that have not yet encountered the antimicrobial agent in question. Many of our antibiotics were originally derived or developed from products secreted by fungi. These fungal toxins enabled the fungi to outcompete bacteria for space on some figurative primordial rock; bacteria have faced this selection pressure for millennia. However, over the past 70 years or so, we clinicians have introduced these fungal toxins into more and more environments (including in

or on other organisms), at higher and higher concentrations, to more and more species of bacteria. So it is important to understand that resistance behavior by bacteria is not new; our medical practices have simply increased the pressure on bacteria to display it.

DETECTION OF RESISTANCE

As clinicians, we suspect or confirm antimicrobial resistance in 2 major ways. The first way, clinical failure, is less specific but may feel more compelling. Failure to respond to a selected antimicrobial agent may be detected in a single patient. This apparent resistance may be misleading because a myriad of factors may explain a treatment failure within a single case. However, it may also be observed that a patient with a recurrent infection, such as pyoderma or urinary tract infection, previously exhibited prompt response to an antimicrobial agent that does not seem to be producing a response at the current time. Also, there may be a disease or syndrome in the clinic population that a clinician had previously treated successfully with Drug A and for which most patients now seem to require Drug B. These types of clinical experiences produce anxiety for both the clinician and the client; it is also these types of experiences that at tract media attention and public concern about antimicrobial resistance.

A more specific mechanism for documenting resistance is the use of culture and sensitivity testing. This is not always feasible, practical, or timely for a given patient or site of infection. However, it is important not to use cost as an argument against culture and sensitivity testing because the costs associated with ineffective therapy (in client time, patient morbidity, and ultimate purchase of a sequence of treatments) will commonly outweigh the cost of culture and sensitivity testing.

Bacterial culture can be an imperfect test. Certain microbes are difficult or slow to culture. In multi-agent infections, rapidly growing bacteria may outcompete more slowly growing ones, leading to the lack of recognition that the slowly growing ones were present. The clinician must remain aware that culture results, while informative, may not always provide the complete picture.

Sensitivity testing can also be complex. Two major systems for sensitivity testing are commonly used in commercial laboratories: disk diffusion and broth dilution. In disk diffusion, paper disks soaked with antimicrobial agents are dropped onto a plated culture of the bacterial isolate. The antimicrobial agent diffuses from the paper across the agar at a predictable rate. Where it contacts the lawn of bacteria, effective killing is detected by clearance of the agar in a ring around the disk. The diameter of that cleared ring is measured, and the efficacy of the antimicrobial can be estimated by the predicted concentration of the antimicrobial agent at the farthest distance from the disk where bacteria were killed (cleared). This information is combined with standardized tables that predict achievable antimicrobial concentrations in patient tissues using tolerable doses of medications to generate an assessment of the bacteria as "susceptible" or "resistant" (S or R) to each particular antimicrobial agent. One disadvantage of this global S or R designation is that it may fail to take into account the opportunity for use of alternate dosing strategies to achieve higher than typical concentrations of the antimicrobial in certain locations or species. In this way, a global R may underestimate the efficacy of a particular antimicrobial agent in a specific circumstance.

Broth dilution is the more labor-intensive strategy, but it may mitigate some of the disadvantages of disk diffusion. In broth dilution the targeted bacteria are grown in liquid medium rather than plated. Antimicrobial agents to be tested are serially diluted to measured concentrations in liquid suspension. An inoculum of bacteria is combined with each dilution of the antimicrobial agent to generate a series of separate cultures with known antimicrobial concentrations. These cultures are incubated a second time either by remaining in their liquid medium or by plating onto agar. The lowest concentration that prevents the growth of bacteria (the minimum inhibitory concentration, or MIC) is reported. Most labs also offer interpretive comments or charts estimating whether such an MIC is likely to be effective in vivo, that is, S or R. However, awareness of the precise concentration that had an antimicrobial effect enables the clinician to assess the clinical situation for opportunities to achieve an effective concentration in the specific patient's specific site of infection.

MANAGEMENT OF PATIENTS WITH RESISTANT INFECTIONS

Resistant infections are the reality of clinical practice. When faced with resistant infections, our knee-jerk reaction is to escalate therapy to the next generation or class of antimicrobial agents. When guided by culture and sensitivity testing, this may be both prudent and effective. However, there is increasing evidence to support the use of *no* therapy for certain types of asymptomatic infec-tions, such as asymptomatic bacteriuria.[1,2] Furthermore, there are cases in which local therapy, with or without antimicrobials as part of that local approach, may be more effective than systemic therapy. Consideration must also be given to optimizing the patient's

systemic health when possible, to enable its own natural defenses to more effectively target the infection.

Wounds are the ideal situation in which to consider local therapy in lieu of escalation of systemic antibiotic therapy. Copious lavage with liters of warm sterile saline or dilute lactated Ringer's solution (LRS) can substantially reduce bacterial contamination, leaving a smaller infectious challenge for the patient to fight. Debridement of nonvital or severely contaminated tissue also improves wound health, enabling more effective penetration by leukocytes into the site through better perfused tissue. Covering wounds minimizes the introduction of additional environmental contaminants, enables application of topical therapies, and may assist with further debridement. Topical agents that may combat local wound infection include chemical detergents (such as potentiated Tris-EDTA products), which physically disrupt cell membranes; metal ions (such as silver-containing dressings or solutions), which disrupt several bacterial cell enzymatic functions; and osmotic agents (such as honey), which cause bacterial dehydration and death.

When systemic therapy is needed, use of culture and sensitivity testing to guide antimicrobial choice is the most effective strategy for the patient. The use of broth dilution testing, yielding a numeric MIC, allows the clinician to consider alternate routes, doses, or intervals for antimicrobial agents that may be both safe and effective. The most common example of the utility of MIC testing is in the setting of symptomatic or complicated urinary tract infection. Many of our familiar antibiotics, including β lactams and fluoroquinolones, are extensively excreted in the urine both as unchanged drug and as bioactive metabolites. Urinary

concentrations of these agents far surpass the concentrations easily achieved in blood, organs, or muscle at safe and tolerated doses. But it is achievable blood concentration that is used to generate the S and R designations reported from disk diffusion and provided as interpretation with many MIC reports, so these designations may be misleading when the target site is urine. If the MIC itself is evaluated against published tables of achievable urinary concentrations of common antimicrobials,[3] a drug can often be found that will significantly exceed the microbial MIC in the urine. Depending on patient background health and complicating factors, it is recommended that a drug concentration of 4 or more times the microbial MIC is achieved at the target site. With knowledge of the pharmacology of antimicrobials and access to the numeric MIC, the clinician can evaluate the likely efficacy of the drug in the urine specifically.

BEST PRACTICES FOR MINIMIZING RESISTANCE

Even in the setting of best practices, resistance is likely to proliferate. Bacteria are evolutionarily inclined to respond to selection pressure by expressing resistance features and are capable of horizontal genetic transfer. It is also important to recall that the microbial community of any given patient is extensive and diverse and that all microbes within it (not just those at the site of infection) are exposed to administered antimicrobials. Cutaneous commensals and gastrointestinal flora currently causing no pathology experience selection pressure toward resistance when bacterial pneumonia, for example, is treated. This creates the opportunity for these bacteria to display antimicrobial resistance should they ever cause infection.

Those risks are present under circumstances of ideal antimicrobial use, and inappropriate antimicrobial use expands the risk for contributing to global resistance. Suboptimal antimicrobial

dosing promotes survival of bacteria with low-level resistance. These organisms may have been killed by standard dosing but survive when the pressure is less. Given the nature of horizontal transmission of genetic elements among bacteria, this low-level resistance phenotype spreads, leading to the need for higher and higher doses of antimicrobials to treat "wild-type" bacteria. Similarly, suboptimal duration of therapy may allow recovery of a tiny, most resistant portion of the bacterial population that can then expand and share that higher-level resistance with the global bacterial community. Optimal duration of therapy for many illnesses in veterinary medicine is not known or has not been rigorously tested; development of evidence-based professional guidelines would improve our ability to use antimicrobials effectively.

When antimicrobials are used for purposes other than treatment of bacterial infections, additional issues are raised. Prophylactic use of antibiotics, in most cases, promotes resistance among all the patient's flora without addressing any problem for the patient. Use of antibacterial agents for viral infections or non-infectious diseases just to "cover the bases" or in response to client pressure again creates opportunities for development of resistance without benefiting the patient in any way. This is a difficult, but necessary, conversation to have with clients, colleagues, and trainees. Certain antibiotics are used as growth promotants in postgastric fermenting production animals because the gastrointestinal flora inherently resistant to these antibiotics also happen to be those that enhance carbohydrate feed conversion efficiency. While it is extremely logistically problematic to envision universal modification of the timeline over which food animals achieve conventional market weights, this, too, is a conversation that needs

to happen. Recall that all the microbes in or on these production animals are being exposed to the antibiotics being used as growth promotants, and these increasingly resistant flora will populate the production facilities, the transport systems, the local environment, the watershed, and so on.

Judicious use of antimicrobials guided by culture and sensitivity testing is necessary for optimal patient care. It is also the first step toward minimizing the global progression of antimicrobial resistance. Use of MIC testing may help reveal antimicrobial agents that may be effective in specific circumstances, and the use of local therapy is valuable to mitigate the need for extensive systemic therapy. Client education both about how to effectively administer prescribed antibiotics, and about why antimicrobials may not be appropriate to prescribe, is paramount.

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ANTIBIOTIC RESISTANCE GENES AND RESIDUES IN WATER AND SOIL IN CLOSE PROXIMITY TO SWINE PRODUCTION FACILITIES

Sponsoring Institution	National Institute of Food and Agriculture	**Project Status**	TERMINATED
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Reporting Frequency	Annual	**Accession No.**	0204870
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ANIMAL SCIENCES

Non Technical Summary
Increases in animal production have raised environmental quality issues concerning the effects of animal waste disposal on quality of surface and groundwater. A common practice is the use of on-site abatement lagoons or deep pit systems followed by land application of stored waste. Leakage or seepage from these storage structures and land application create a risk for bacterial contamination of surface water and underlying groundwater. Few studies have traced this contamination and linked it to animal agriculture. The studies proposed here will determine the extent, persistence and distribution of contaminants originating from animal agriculture in soil, surface- and groundwater systems. This information is crucial to understanding fundamental processes of bacterial, antimicrobial and inorganic contamination in watershed systems.

Animal Health Component (N/A)

Research Effort Categories

Basic	100%
Applied	(N/A)
Developmental	(N/A)

Classification

Knowledge Area (KA)	Subject of Investigation (SOI)	Field of Science (FOS)	Percent
112	0210	1100	100%

Knowledge Area
112 - Watershed Protection and Management;

Subject Of Investigation
0210 - Water resources;

Field Of Science
1100 - Bacteriology;

Keywords

antibiotic resistance	tetracycline	erythromycin	groundwater
antibiotic residues	residue analysis	genes	water pollution
soil pollution	swine	livestock production	polymerase chain reaction
molecular genetics	soils	surface waters	lagoons
pollution control	bacterial genetics	watershed management	manures
sediments	tylosin	water flow	dna fingerprinting

Goals / Objectives
Objective 1. Analyze bacterial population profiles in manure, ground- and surface-water, sediments and soil that correlate to antibiotic resistances using molecular-based methods. Objective 2. Identify and quantify genetic fingerprints of both tetracycline and erythromycin resistance genes as a method of tracking the dissemination of antibiotic resistance genes and hence source of groundwater contamination. Objective 3. Determine the occurrence and amounts of two common antibiotics used in the swine industry, tetracycline and tylosin, in soil, surface and groundwater. Objective 4. Integrate the microbiological and chemical data using a numerical model of groundwater flow and transport to quantitatively assess the hydrogeologic data and interpret the movement of contaminants.

Project Methods
We propose to extend our study by conducting an additional three-year study on the three Illinois swine production facilities investigated previously. The main goal of the research remains to determine the long-term impact of microbiological and chemical contamination on both surface and ground water surrounding and underlying each site. Thus, sampling frequency will be reduced and coverage increased by sampling of soil, surface and groundwater. One facility (site A) has recently changed its antibiotic use strategy eliminating the use of antibiotics as growth promotants which makes an extended study of bacterial populations and antibiotic resistance gene profiles invaluable. This research combines a number of innovative methods to: 1) detect and identify fecal bacterial indicators using molecular-based methods, 2) identify and quantify genetic fingerprints of both tetracycline and erythromycin resistance genes as a method of tracking the dissemination of antibiotic resistance genes and hence source of fecal contamination, 3) determine the occurrence and amounts of two common antibiotics used in the swine industry, tetracycline and tylosin, in soil, surface and groundwater, and 4) integrate the microbiological and chemical data using a numerical model of groundwater flow and transport to quantitatively assess the hydrogeologic data and interpret the movement of contaminants.

Progress 09/15/05 to 09/14/09

Outputs
OUTPUTS: To monitor the dissemination of resistance genes into the environment, we determined the occurrence of tetracycline resistance genes (Tcr) in groundwater underlying two swine confinement operations. A monitoring well network was established around the lagoons at each facility, and each network consisted of sixteen wells and six wells at Sites A and C, respectively. Groundwater (n = 124) and lagoon (n = 12) samples were collected from the two sites at six sampling times from 2000 through 2003. Total DNA was extracted and PCR was used to detect seven Tcr [tet(M), tet(O), tet(Q), tet(W), tet(C), tet(H) and tet (Z)]. The concentration of Tcr was quantified by real-time qPCR. To confirm the tet gene source in groundwater, comparative analysis of tet(W) gene sequences was performed on groundwater and lagoon samples. Manure treatment lagoons and storage pits were always found to contain every tet gene for which surveys were conducted, and, likewise, five out six erm genes found at these sites were detected in nearly every lagoon sample. A subset of groundwater wells at site A were found to contain both tet and erm genes with much higher frequencies than other wells, and the detection frequencies of most tet and erm genes for these wells were close to 100%. The PCA plotted these wells near the points representing lagoon samples, because they often contained the same genes that were found in lagoons. These "impacted" wells (A6, A8, A9, A11, A12) were all located in close proximity to the source lagoon, and most of them were situated in a relatively porous aquifer that bisected the lagoon. Chemical indicators of lagoon leakage, such as chloride and ammonium concentrations, were previously seen to be elevated in these impacted wells. The number of antibiotic resistance genes in other wells, including background wells, was extremely variable over time, with a tendency for the detection frequencies of many genes to be quite low. Detection frequencies of all antibiotic resistance genes were low in wells at Site C, where subsurface geology is relatively impermeable, and

significant lagoon leakage has not previously been seen. Antibiotic resistance gene pools in soils were impacted by the addition of manure. Background detection frequencies of tet genes in soil were close to zero, but immediately after manure injection, it was possible to detect all tet genes for which surveys were conducted in most soil samples. Over time, the detection frequency of some tet genes (tet(M), tet(O), tet(H), tet(Z)) returned to near-zero, while others (tet(Q), tet(W), tet(C)) persisted. The detection frequencies of tet (C) and tet(W) genes remained high five months after manure injection, and at site C the tet(C) gene was still detectable in many soil samples eighteen months after manure injection. PARTICIPANTS: Nothing significant to report during this reporting period. TARGET AUDIENCES: Nothing significant to report during this reporting period. PROJECT MODIFICATIONS: Nothing significant to report during this reporting period.

Impacts

Our research is aimed at understanding the fundamental processes that control the origin, fate and transport of antibiotic residues and antibiotic resistance genes from swine waste into surface water, soil after land application of manure, and underlying groundwater. This will impact the siting of Confined Animal Feeding Operations (CAFO's) and the disposal of animal wastes by land application based on their resistance gene diversity and load and their impact on water quality. Issues of animal waste treatment and water quality control must be addressed in ways that minimize the risk of chemical and microbiological contamination in the environment. The nation's water resources are fundamental to the productivity and health of crop, range and forested lands and our future is dependent on a reliable and sustainable supply of fresh unpolluted water. Based on the findings of this study, we envision multiple sources and interactions of antibiotic resistance genes in the environment. It is likely that both contaminated and uncontaminated environments each have a unique indigenous resistance gene pool, and that a part of this diverse gene pool could be shared within the immediate surrounding environment. The extent of contamination from CAFO's would likely depend on the level and type of antibiotics used and the transport and flow of these genes between pools in the environment. In this concept, gene sequences shared between animal waste and the impacted environment are considered as the candidate(s) for the disseminative agent of antibiotic resistant determinants from CAFO's into the surrounding environment. In conclusion, animal waste seeping from unlined lagoons at two swine confinement facilities had an impact on the dissemination of tetracycline resistance genes into groundwater underlying the facility. Thus, these type of facilities can be a reservoir of antibiotic resistance genes. However, the magnitude and extent of antibiotic resistance gene migration resulting from lagoon seepage will likely depend on local hydro-geological conditions. These results highlight the difficulty of establishing proper "negative controls" for environmental antibiotic resistance work, and, more importantly, they point to the existence of a "native" antibiotic resistance gene pool within the environmental microbiota. However, the spatial and temporal patterns of antibiotic resistance genes at these three sites suggests that exposure to swine waste is an important factor in the spread of antibiotic resistance. Different genes have differential abilities to persist in soils and waters, which suggests that a "gene ecology" perspective, which includes the recognition that genes may differ in their capacity to find new hosts via horizontal gene transfer, will be important for assessing the impact of agricultural activities on antibiotic resistance.

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Progress 09/15/07 to 09/14/08

Outputs
OUTPUTS: Two swine confinement facilities, designated sites A and C were the focus of study. The antibiotic regimens at both sites included chlortetracycline and tylosin. Hog manure at these sites was treated in open, unlined lagoons before being applied as fertilizer to onsite (site A) and offsite (Site C) farm fields. DNA was extracted from water and soil sampling and detection of antibiotic resistance genes was accomplished by PCR using primers that have been described elsewhere. Manure treatment lagoons and storage pits were always found to contain every tet gene for which surveys were conducted, and, likewise, five out six erm genes found at these sites were detected in nearly every lagoon sample. A subset of groundwater wells at site A were found to contain both tet and erm genes with much higher frequencies than other wells, and the detection frequencies of most tet and erm genes for these wells were close to 100%. The PCA plotted these wells near the points representing lagoon samples, because they often contained the same genes that were found in lagoons. These "impacted" wells (A6, A8, A9, A11, A12) were all located in close proximity to the source lagoon, and most of them were situated in a relatively porous aquifer that bisected the lagoon. Chemical indicators of lagoon leakage, such as chloride and ammonium concentrations, were previously seen to be elevated in these impacted wells. The number of antibiotic resistance genes in other wells, including background wells, was extremely variable over time, with a tendency for the detection frequencies of many genes to be quite low. Detection frequencies of all antibiotic resistance genes were low in wells at Site C, where subsurface geology is relatively impermeable, and significant lagoon leakage has not previously been seen. Antibiotic resistance gene pools in soils were impacted by the addition of manure. Background detection frequencies of tet genes in soil were close to zero, but immediately after manure injection, it was possible to detect all tet genes for which surveys were conducted in most soil samples. Over time, the detection frequency of some tet genes (tet(M), tet(O), tet(H), tet(Z)) returned to near-zero, while others (tet (Q), tet(W), tet(C)) persisted. The detection frequencies of tet(C) and tet(W) genes remained high five months after manure injection, and at site C the tet(C) gene was still detectable in many soil samples eighteen months after manure injection. PARTICIPANTS: Not relevant to this project. TARGET AUDIENCES: Not relevant to this project. PROJECT MODIFICATIONS: Non-funded extension until September 2009 has been awarded.

Impacts
Using a cultivation-independent, PCR-based approach, we have been able to detect a number of different classes of tetracycline- and erythromycin-resistance genes (tet and erm, respectively) in the groundwater adjacent to hog waste treatment lagoons. This suggests that treatment lagoons at animal production facilities can serve as reservoirs of antibiotic resistance. We have also found these genes in soils that have been amended with pit- or lagoon-treated manure as fertilizer. Positive detections of these genes have come from background "control" wells that are upgradient of the source lagoons, as well as from background soil samples collected from farm fields prior to manure injection (that is, fields that have been unmanured for at least three years). These results highlight the difficulty of establishing proper "negative controls" for environmental antibiotic resistance work, and, more importantly, they point to the existence of a "native" antibiotic resistance gene pool within the environmental microbiota. However, the spatial and temporal patterns of antibiotic resistance genes at these three sites suggests that exposure to hog waste is an important factor in the spread of antibiotic resistance. Different genes have differential abilities to persist in soils and waters, which suggests that a "gene ecology" perspective, which includes the recognition that genes may differ in their capacity to find new hosts via horizontal gene transfer, will be important for assessing the impact of agricultural activities on antibiotic resistance.

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Progress 09/15/06 to 09/14/07

Outputs
To monitor the dissemination of resistance genes into the environment we determined the occurrence of

tetracycline resistance genes (Tcr) in groundwater underlying two swine confinement operations. A monitoring well network was established around the lagoons at each facility, and each network consisted of sixteen wells and six wells at Sites A and C, respectively. Groundwater (n = 124) and lagoon (n = 12) samples were collected from the two sites at six sampling times from 2000 through 2003. Total DNA was extracted and PCR was used to detect seven Tcr [tet(M), tet(O), tet(Q), tet(W), tet(C), tet(H) and tet(Z)]. The concentration of Tcr was quantified by real-time qPCR. To confirm the tet gene source in groundwater, comparative analysis of tet(W) gene sequences was performed on groundwater and lagoon samples. All seven Tcr persisted in groundwater during the three-year monitoring period at both sites. At Site A, the level of detection frequency and concentration for Tcr was correlated with other inorganic contaminants associated with animal waste seepage. This result indicates that seepage from the lagoon influenced the distribution of Tcr in groundwater underlying Site A. Comparative analysis of tet(W) sequences revealed that the impacted groundwater contained almost identical gene sequences (99.8% identity) with that found in the lagoon. This result supports the dissemination of Tcr from the lagoon into groundwater. Novel sequence clusters and unique indigenous resistance gene pools were also found in the groundwater. Thus, the source of resistance genes is not only swine manure, but also the natural environment.

Impacts
Based on the findings of this study, we envision multiple sources and interactions of antibiotic resistance genes in the environment. It is likely that both contaminated and uncontaminated environments each have a unique indigenous resistance gene pool, and that a part of this diverse gene pool could be shared within the immediate surrounding environment. The extent of contamination from CAFO's would likely depend on the level and type of antibiotics used and the transport and flow of these genes between pools in the environment. In this concept, gene sequences shared between animal waste and the impacted environment are considered as the candidate(s) for the disseminative agent of antibiotic resistant determinants from CAFO's into the surrounding environment. In conclusion, animal waste seeping from unlined lagoons at two swine confinement facilities had an impact on the dissemination of tetracycline resistance genes into groundwater underlying the facility. Thus, these type of facilities can be a reservoir of antibiotic resistance genes. However, the magnitude and extent of antibiotic resistance gene migration resulting from lagoon seepage will likely dependent on local hydro-geological conditions.

Publications

- Koike, S., Krapac, I.G., Oliver, H.D., Yannarell, A.C., Chee-Sanford, J.C., Aminov,R.I. and Mackie, R.I. 2007. Monitoring and source tracking of tetracycline resistance genes in lagoons and groundwater adjacent to swine production facilities over a 3-year period. Appl. Environ. Microbiol. 73:4813-4823.

Progress 09/15/05 to 09/15/06

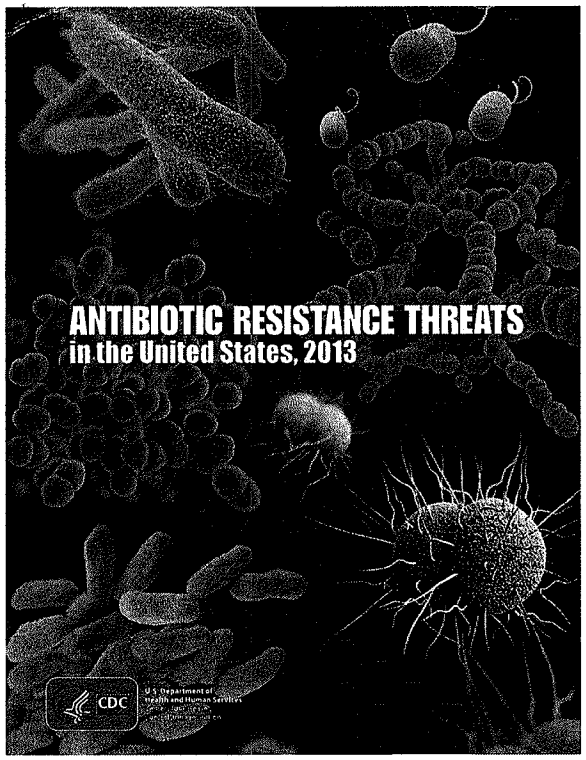
Outputs
Progress over the initial year of the grant has been limited to the first objective of our proposal, namely to monitoring inorganic chemical quality, tetracycline and macrolide concentrations in surface-and ground-water, sediments, soil, and manure. Manure, water, and soil samples have been collected at three swine confinement facilities designated as site A, C, and E. Sites A and C use lagoons for manure treatment and storage while Site E uses a deep pit for manure storage. Manure is applied to agricultural fields near site A and E but applied off-site at site C. Manure is generally applied to the fields either or both in the fall after crop harvest and in the spring prior to crop harvest. Multiple manure samples have been collected from either the lagoons or deep pit prior to manure application. These samples have been composited and will be analyzed to determine the source concentrations of tetracyclines, macrolides, inorganic, and microbial constituents. In addition, a combination of surface soil grab samples, and both shallow and deep soil cores has been collected pre- and post- manure application to determine the distribution of antibiotic resistant bacteria and genes and antibiotic residues in the soil profile to provide for an understanding of the transport of antibiotic resistance genes into surface and groundwater. Soil samples collected pre-manure application consist of surface grab samples and shallow soil cores to provide background conditions. A grid sampling scheme was used for each field such that soil samples will be collected at each grid node. Approximately 50 of these samples will be analyzed to determine antibiotic concentrations. Water samples were also collected pre- and post- manure application from monitoring wells, tile drains, and streams at the confinement facilities. Water samples will be analyzed to determine the concentrations of chloride, nitrate, phosphate, sulfate and selected cations and tetracycline and macrolide residues.

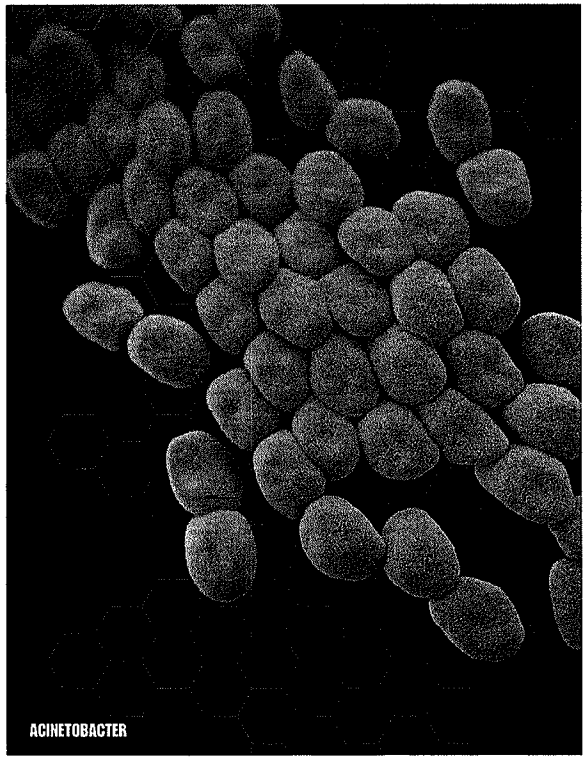
Impacts
Our research is aimed at understanding the fundamental processes that control the origin, fate and transport of antibiotic residues and antibiotic resistance genes from swine waste into surface water, soil after land application of manure, and underlying groundwater. This will impact the siting of Confined Animal Feeding Operations (CAFO's) and the disposal of animal wastes by land application based on their resistance gene diversity and load and their impact on water quality. Issues of animal waste treatment and water quality control must be addressed in ways that minimize the risk of chemical and microbiological contamination in

the environment. The nation's water resources are fundamental to the productivity and health of crop, range and forested lands and our future is dependent on a reliable and sustainable supply of fresh unpolluted water.

Publications

- Mackie, R.I., Koike, S., Krapac, I., Chee-Sanford, J., Maxwell, S. and Aminov, R.I. 2006. Tetracycline residues and tetracycline resistance genes in groundwater impacted by swine production facilities. Animal Biotechnology (In Press).





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FOREWORD

Antimicrobial resistance is one of our most serious health threats. Infections from resistant bacteria are now too common, and some pathogens have even become resistant to multiple types or classes of antibiotics (antimicrobials used to treat bacterial infections). The loss of effective antibiotics will undermine our ability to fight infectious diseases and manage the infectious complications common in vulnerable patients undergoing chemotherapy for cancer, dialysis for renal failure, and surgery, especially organ transplantation, for which the ability to treat secondary infections is crucial.

When first-line and then second-line antibiotic treatment options are limited by resistance or are unavailable, healthcare providers are forced to use antibiotics that may be more toxic to the patient and frequently more expensive and less effective. Even when alternative treatments exist, research has shown that patients with resistant infections are often much more likely to die, and survivors have significantly longer hospital stays, delayed recuperation, and long-term disability. Efforts to prevent such threats build on the foundation of proven public health strategies: immunization, infection control, protecting the food supply, antibiotic stewardship, and reducing person-to-person spread through screening, treatment and education.

Dr. Tom Frieden, MD, MPH
Director, U.S. Centers for Disease Control and Prevention
Meeting the Challenges of Drug-Resistant Diseases in Developing Countries
Committee on Foreign Affairs Subcommittee on Africa, Global Health, Human Rights, and International Organizations
United States House of Representatives
April 23, 2013

ANTIBIOTIC RESISTANCE THREATS IN THE UNITED STATES, 2013

Executive Summary

Antibiotic Resistance Threats in the United States, 2013 is a snapshot of the complex problem of antibiotic resistance today and the potentially catastrophic consequences of inaction. The overriding purpose of this report is to increase awareness of the threat that antibiotic resistance poses and to encourage immediate action to address the threat. This document can serve as a reference for anyone looking for information about antibiotic resistance. It is specifically designed to be accessible to many audiences. For more technical information, references and links are provided.

This report covers bacteria causing severe human infections and the antibiotics used to treat those infections. In addition, *Candida*, a fungus that commonly causes serious illness, especially among hospital patients, is included because it, too, is showing increasing resistance to the drugs used for treatment. When discussing the pathogens included in this report, *Candida* will be included when referencing "bacteria" for simplicity. Also, infections caused by the bacteria *Clostridium difficile (C. difficile)* are also included in this report. Although *C. difficile* infections are not yet significantly resistant to the drugs used to treat them, most are directly related to antibiotic use and thousands of Americans are affected each year.

Drug resistance related to viruses such as HIV and influenza is not included, nor is drug resistance among parasites such as those that cause malaria. These are important problems but are beyond the scope of this report. The report consists of multiple one or two page summaries of cross-cutting and bacteria- specific antibiotic resistance topics. The first section provides context and an overview of antibiotic resistance in the United States. In addition to giving a national assessment of the most dangerous antibiotic resistance threats, it summarizes what is known about the burden of illness, level of concern, and antibiotics left to defend against these infections. This first section also includes some basic background information, such as fact sheets about antibiotic safety and the harmful impact that resistance can have on high-risk groups, including those with chronic illnesses such as cancer.

CDC estimates that in the United States, more than two million people are sickened every year with antibiotic-resistant infections, with at least 23,000 dying as a result. The estimates are based on conservative assumptions and are likely minimum estimates. They are the best approximations that can be derived from currently available data.

Regarding level of concern, CDC has — for the first time — prioritized bacteria in this report into one of three categories: urgent, serious, and concerning.

Urgent Threats

- *Clostridium difficile*
- Carbapenem-resistant Enterobacteriaceae (CRE)
- Drug-resistant *Neisseria gonorrhoeae*

Serious Threats

- Multidrug-resistant *Acinetobacter*
- Drug-resistant *Campylobacter*
- Fluconazole-resistant *Candida* (a fungus)
- Extended spectrum β-lactamase producing Enterobacteriaceae (ESBLs)
- Vancomycin-resistant *Enterococcus* (VRE)
- Multidrug-resistant *Pseudomonas aeruginosa*
- Drug-resistant Non-typhoidal *Salmonella*
- Drug-resistant *Salmonella* Typhi
- Drug-resistant *Shigella*
- Methicillin-resistant *Staphylococcus aureus* (MRSA)
- Drug-resistant *Streptococcus pneumoniae*
- Drug-resistant tuberculosis

Concerning Threats

- Vancomycin-resistant *Staphylococcus aureus* (VRSA)
- Erythromycin-resistant Group A *Streptococcus*
- Clindamycin-resistant Group B *Streptococcus*

The second section describes what can be done to combat this growing threat, including information on current CDC initiatives. Four core actions that fight the spread of antibiotic resistance are presented and explained, including 1) preventing infections from occurring and preventing resistant bacteria from spreading, 2) tracking resistant bacteria, 3) improving the use of antibiotics, and 4) promoting the development of new antibiotics and new diagnostic tests for resistant bacteria.

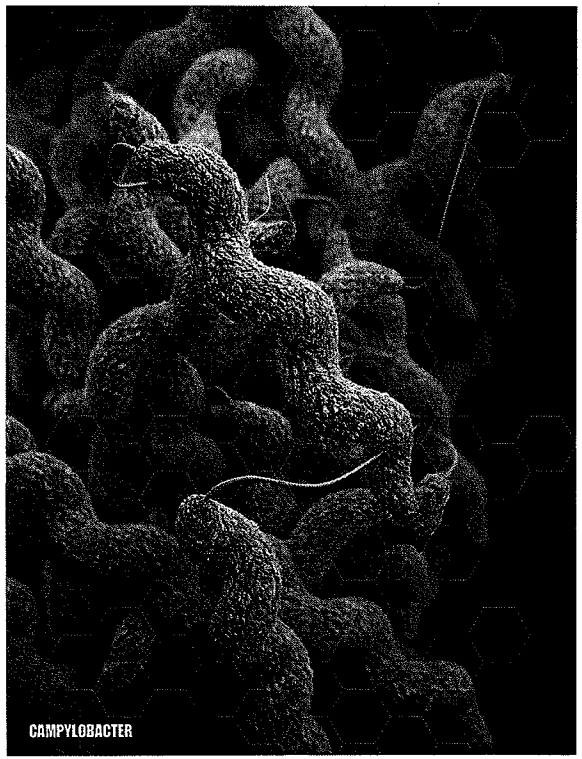
The third section provides summaries of each of the bacteria in this report. These summaries can aid in discussions about each bacteria, how to manage infections, and implications for public health. They also highlight the similarities and differences among the many different types of infections.

This section also includes information about what groups such as states, communities, doctors, nurses, patients, and CDC can do to combat antibiotic resistance. Preventing the spread of antibiotic resistance can only be achieved with widespread engagement, especially among leaders in clinical medicine, healthcare leadership, agriculture, and public health. Although some people are at greater risk than others, no one can completely avoid

the risk of antibiotic-resistant infections. Only through concerted commitment and action will the nation ever be able to succeed in reducing this threat.

A reference section provides technical information, a glossary, and additional resources.

Any comments and suggestions that would improve the usefulness of future publications are appreciated and should be sent to Director, Division of Healthcare Quality Promotion, National Center for Emerging and Zoonotic Infectious Diseases, Centers for Disease Control and Prevention, 1600 Clifton Road, Mailstop A-07, Atlanta, Georgia, 30333. E-mail can also be used: hlpe@cdc.gov.



CAMPYLOBACTER

THE THREAT OF ANTIBIOTIC RESISTANCE

Introduction

Antibiotic resistance is a worldwide problem. New forms of antibiotic resistance can cross international boundaries and spread between continents with ease. Many forms of resistance spread with remarkable speed. World health leaders have described antibiotic-resistant microorganisms as "nightmare bacteria" that "pose a catastrophic threat" to people in every country in the world.

Each year in the United States, at least 2 million people acquire serious infections with bacteria that are resistant to one or more of the antibiotics designed to treat those infections. At least 23,000 people die each year as a direct result of these antibiotic-resistant infections. Many more die from other conditions that were complicated by an antibiotic-resistant infection.

In addition, almost 250,000 people each year require hospital care for *Clostridium difficile (C. difficile)* infections. In most of these infections, the use of antibiotics was a major contributing factor leading to the illness. At least 14,000 people die each year in the United States from *C. difficile* infections. Many of these infections could have been prevented.

Antibiotic-resistant infections add considerable and avoidable costs to the already overburdened U.S. healthcare system. In most cases, antibiotic-resistant infections require prolonged and/or costlier treatments, extend hospital stays, necessitate additional doctor visits and healthcare use, and result in greater disability and death compared with infections that are easily treatable with antibiotics. The total economic cost of antibiotic resistance to the U.S. economy has been difficult to calculate. Estimates vary but have ranged as high as $20 billion in excess direct healthcare costs, with additional costs to society for lost productivity as high as $35 billion a year (2008 dollars).[1]

The use of antibiotics is the single most important factor leading to antibiotic resistance around the world. Antibiotics are among the most commonly prescribed drugs used in human medicine. However, up to 50% of all the antibiotics prescribed for people are not needed or are not optimally effective as prescribed. Antibiotics are also commonly used in food animals to prevent, control, and treat disease, and to promote the growth of food-producing animals. The use of antibiotics for promoting growth is not necessary, and the practice should be phased out. Recent guidance from the U.S. Food and Drug Administration (FDA) describes a pathway toward this goal.[2] It is difficult to directly compare the amount of drugs used in food animals with the amount used in humans, but there is evidence that more antibiotics are used in food production.

1 http://www.tufts.edu/med/apua/consumers/personal_home_5_1451034133.pdf (accessed 8-1-2013), extrapolated from Roberts RR, Hota B, Ahmad I, et al. Hospital and societal costs of antimicrobial-resistant infections in a Chicago teaching hospital: implications for antibiotic stewardship. Clin Infect Dis. 2009 Oct 15;49(8):1175-84

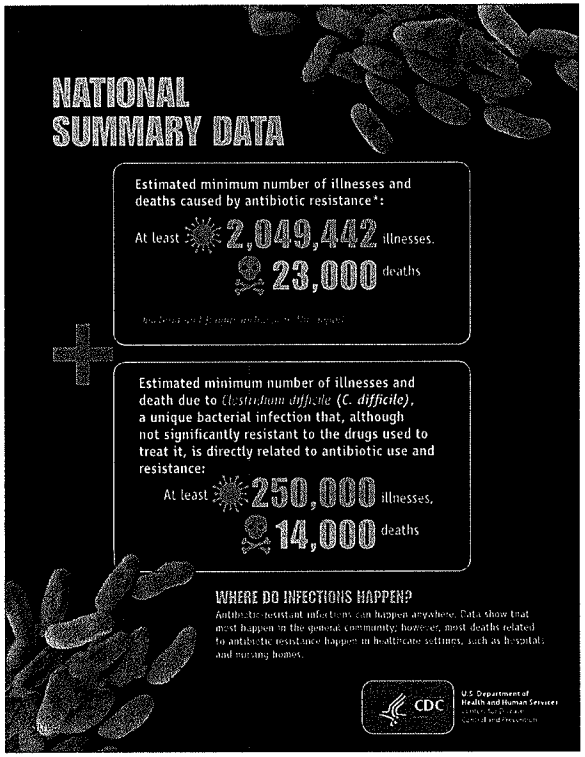
2 http://www.fda.gov/downloads/AnimalVeterinary/GuidanceComplianceEnforcement/GuidanceforIndustry/UCM299624.pdf

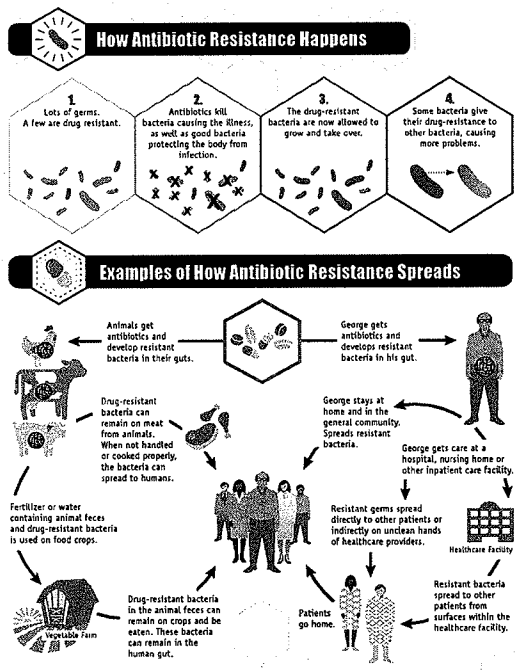
The other major factor in the growth of antibiotic resistance is spread of the resistant strains of bacteria from person to person, or from the non-human sources in the environment, including food.

There are four core actions that will help fight these deadly infections:

- preventing infections and preventing the spread of resistance
- tracking resistant bacteria
- improving the use of today's antibiotics
- promoting the development of new antibiotics and developing new diagnostic tests for resistant bacteria

Bacteria will inevitably find ways of resisting the antibiotics we develop, which is why aggressive action is needed now to keep new resistance from developing and to prevent the resistance that already exists from spreading.





Simply using antibiotics creates resistance. These drugs should only be used to treat infections.

CS239559

Minimum Estimates of Morbidity and Mortality from Antibiotic-Resistant Infections*

Antibiotic-Resistant Microorganism	Infections Included in Case/Death Estimates	Infections Not Included	Estimated Annual Number of Cases	Estimated Annual Number of Deaths
Vancomycin-resistant *Enterococcus* (VRE)	HAIs with onset in hospitalized patients	Infections occurring outside of acute care hospitals (e.g., nursing homes) Infections acquired in acute care hospitals but not diagnosed until after discharge	20,000	1,300
Multidrug-resistant *Acinetobacter* (three or more drug classes)	HAIs with onset in hospitalized patients	Infections occurring outside of acute care hospitals (e.g., nursing homes) Infections acquired in acute care hospitals but not diagnosed until after discharge	6,700	440
Drug-resistant non-typhoidal *Salmonella* (ceftriaxone, ciprofloxacin, or four or more drug classes)	All infections	Not applicable	100,000	40
Drug-resistant *Campylobacter* (ciprofloxacin)	All infections	Not applicable	3,800	<5
Drug-resistant *Neisseria gonorrhoeae* (ceftriaxone or ciprofloxacin)	All infections	Not applicable	27,000	<5
Methicillin-resistant *Staphylococcus aureus* (MRSA)	Invasive infections	Both healthcare and community-associated noninvasive infections such as wound and skin and soft tissue infection	80,000	11,000
Streptococcus pneumoniae (old, clinically relevant drugs)	All infections	Not applicable	1,200,000	7,000
Drug-resistant tuberculosis (any clinically relevant drug)	All infections	Not applicable	1,042	50
Vancomycin-resistant *Staphylococcus aureus* (VRSA)	All infections	Not applicable	<5	<5
Erythromycin-resistant Group A *Streptococcus*	Invasive infections	Noninvasive infections including common upper-respiratory infections like strep throat	1,100	160
Clindamycin-resistant Group B *Streptococcus*	Invasive infections	Noninvasive infections and asymptomatic intrapartum colonization resulting prophylaxis	7,600	440
Summary Totals for Antibiotic-Resistant Infections			2,049,442	23,488
Clostridium difficile Infections	Healthcare-associated infections in acute care hospitals or in patients requiring hospitalization	Infections occurring outside of acute care hospitals (e.g., nursing homes, community) Infections acquired in acute care hospitals but not diagnosed until after discharge	250,000	14,000

*See technical appendix for discussion of estimation methods.
†Resistance or partial resistance

Antibiotic-Resistant Microorganism	Infections Included in Case/Death Estimates	Infections Not Included	Estimated Annual Number of Cases	Estimated Annual Number of Deaths
Carbapenem-resistant Enterobacteriaceae (CRE)	Healthcare-associated infections (HAIs) caused by *Klebsiella* and *E. coli* with onset in hospitalized patients	Infections occurring outside of acute care hospitals (e.g., nursing homes) Infections acquired in acute care hospitals but not diagnosed until after discharge Infections caused by Enterobacteriaceae other than *Klebsiella* and *E.coli* (e.g., *Enterobacter* spp.)	9,300	610
Drug-resistant *Neisseria gonorrhoeae* (any drug)	All infections	Not applicable	246,000	<5
Multidrug-resistant *Acinetobacter* (three or more drug classes)	HAI with onset in hospitalized patients	Infections occurring outside of acute care hospitals (e.g., nursing homes) Infections acquired in acute care hospitals but not diagnosed until after discharge	7,300	500
Drug-resistant *Campylobacter* (azithromycin or ciprofloxacin)	All infections	Not applicable	310,000	28
Drug-resistant *Candida* (fluconazole)	HAIs with onset in hospitalized patients	Infections occurring outside of acute care hospitals (e.g., nursing homes) Infections acquired in acute care hospitals but not diagnosed until after discharge	3,400	220
Extended-spectrum β-lactamase producing Enterobacteriaceae (ESBLs)	HAIs caused by *Klebsiella* and *E. coli* with onset in hospitalized patients	Infections occurring outside of acute care hospitals (e.g., nursing homes) Infections acquired in acute care hospitals but not diagnosed until after discharge Infections caused by Enterobacteriaceae other than *Klebsiella* and *E.coli* (e.g., *Enterobacter* spp.)	26,000	1,700

Limitations of Estimating the Burden of Disease Associated with Antibiotic-Resistant Bacteria

This report uses several methods, described in the technical appendix, to estimate the number of cases of disease caused by antibiotic-resistant bacteria and fungi and the number of deaths resulting from those cases of disease. The data presented in this report are approximations, and totals, as provided in the national summary tables, can provide only a rough estimate of the true burden of illness. Greater precision is not possible at this time for a number of reasons:

- Precise criteria exist for determining the resistance of a particular species of bacteria to a specific antibiotic. However, for many species of bacteria, there are no standard definitions that allow for neatly dividing most species into only two categories—resistant vs. susceptible without regard to a specific antibiotic. This report specifies how resistance is defined for each microorganism.
- There are very specific criteria and algorithms for the attribution of deaths to specific causes that are used for reporting vital statistics data. In general, there are no similar criteria for making clinical determinations of when someone's death is primarily attributable to infection with antibiotic-resistant bacteria, as opposed to other co-existing illnesses that may have contributed to or caused death. Many studies attempting to determine attributable mortality rely on the judgment of chart reviewers, as is the case for many surveillance systems. Thus, the distinction between an antibiotic-resistant infection leading directly to death, an antibiotic-resistant infection contributing to a death, and an antibiotic-resistant infection related to, but not directly contributing to a death are usually determined subjectively, especially in the preponderance of cases where patients are hospitalized and have complicated clinical presentations.

In addition, the estimates provided in this report represent an underestimate of the total burden of bacterial resistant disease.

- The methodology employed in this report likely underestimates, at least for some pathogens, the impact of antibiotic resistance on mortality. As described in the technical appendix, the percentage of resistant isolates for some bacteria was multiplied by the total number of cases or the number of deaths ascribed to that bacterium. A number of studies have shown that the risk of death following infection with a strain of resistant bacteria is greater than that following infection with a susceptible strain of the same bacteria. More accurate data for all bacteria would be necessary to estimate the extent of the differential risk for death associated with a resistant infection vs. the risk of death associated with a susceptible infection. But, lacking that data, the lower, more conservative estimate has been used. That estimate is the approximation of the number of deaths derived by applying the proportion of resistant isolates to the estimated total number of deaths caused by that pathogen.

- For several pathogens, complete data from all types of infections are not available since tracking is limited to the more severe types of infections. For some pathogens, such as methicillin-resistant *Staphylococcus aureus* (MRSA), only cases due to invasive disease are counted. For other pathogens, where resistance is predominately limited to healthcare settings, only disease occurring in acute care hospitals, or requiring hospitalization, are counted.

The actual number of infections and the actual number of deaths, therefore, are certainly higher than the numbers provided in this report.

This report does not provide a specific estimate for the financial cost of antibiotic-resistant infections. Although a variety of studies have attempted to estimate costs in limited settings, such as a single hospital or group of hospitals, the methods used are quite variable. Similarly, careful work has been done to estimate costs for specific pathogens, such as *Streptococcus pneumoniae* and MRSA. However, no consensus methodology currently exists for making such monetary estimates for many of the other pathogens listed in this report. For this reason, this report references non-CDC estimates in the introduction, but does not attempt to estimate the overall financial burden of antibiotic resistance to the United States.

Assessment of Domestic Antibiotic Resistance Threats

CDC conducted an assessment of antibiotic resistance threats, categorizing the threat level of each bacteria as urgent, serious, or concerning. The assessment was done in consultation with non-governmental experts in antibiotic resistance who serve on the Antimicrobial Resistance Working Group of the CDC Office of Infectious Diseases Board of Scientific Counselors (http://www.cdc.gov/old/BSC.html). CDC also received input and recommendations from the National Institutes of Health (NIH) and the U.S. Food and Drug Administration (FDA). Threats were assessed according to seven factors associated with resistant infections:

- clinical impact
- economic impact
- incidence
- 10-year projection of incidence
- transmissibility
- availability of effective antibiotics
- barriers to prevention

The assessment was focused on domestic impact, but the threat of importing international antibiotic-resistant pathogens was taken into account in the 10-year incidence projection. Because antibiotic resistance is a rapidly evolving problem, this assessment will be revised at least every five years. Examples of findings that could result in a change in threat status are:

- Multidrug-resistant and extensively drug-resistant tuberculosis (MDR and XDR TB) infections are an increasing threat outside of the United States. In the United States, infections are uncommon because a robust prevention and control program is in place. If infection rates of MDR and XDR TB increase within the U.S., this antibiotic-resistant threat will change from serious to urgent, because it is transmissible through respiratory secretions, and because treatment options are very limited.
- MRSA infections can be very serious and the number of infections is among the highest of all antibiotic-resistant threats. However, the number of serious infections is decreasing and there are multiple effective antibiotics for treating infections. If MRSA infection rates increase or MRSA strains become more resistant to other antibiotic agents, then MRSA may change from a serious to an urgent threat.
- *Streptococcus pneumoniae* (pneumococcus) can cause serious and sometimes life-threatening infections. Antibiotic resistance significantly affects the ability to manage these infections. A new version of the pneumococcal conjugate vaccine (PCV13), introduced in 2010, protects against infections with the most resistant pneumococcus strains and rates of resistant infections are declining. The extent to which this trend will continue is unknown, but a significant and sustainable drop in resistant infection rates could result in this threat being recategorized as concerning.

In general, threats assigned to the urgent and serious categories require more monitoring and prevention activities, whereas the threats in the concerning category require less. Regardless of category, threat-specific CDC activities are tailored to meet the epidemiology of the infectious agent and to address any gaps in the ability to detect resistance and to protect against infections.

HAZARD LEVEL: URGENT

Clostridium difficile (C. difficile); Carbapenem-resistant Enterobacteriaceae (CRE), Drug-resistant *Neisseria gonorrhoeae* (cephalosporin resistance)

HAZARD LEVEL: SERIOUS

Multidrug-resistant *Acinetobacter*, Drug-resistant *Campylobacter*, Fluconazole-resistant *Candida* (a fungus), Extended spectrum β-lactamase producing Enterobacteriaceae (ESBLs), Vancomycin-resistant *Enterococcus* (VRE), Multidrug-resistant *Pseudomonas aeruginosa*, Drug-resistant Non-typhoidal *Salmonella*, Drug-resistant *Salmonella* Typhi, Drug-resistant *Shigella*, Methicillin-resistant *Staphylococcus aureus* (MRSA), Drug-resistant *Streptococcus pneumoniae*, Drug-resistant tuberculosis (MDR and XDR)

HAZARD LEVEL: CONCERNING

Vancomycin-resistant *Staphylococcus aureus* (VRSA), Erythromycin-resistant *Streptococcus* Group A, Clindamycin-resistant *Streptococcus* Group B

Although *C. difficile* is not currently significantly resistant to antibiotics used to treat it, it was included in the threat assessment because of its unique relationship with resistance genes, antibiotic use, and its high morbidity and mortality.

Running Out of Drugs to Treat Serious Gram-Negative Infections

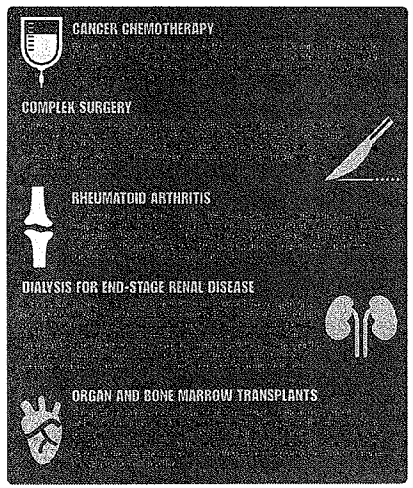
Among all of the bacterial resistance problems, gram-negative pathogens are particularly worrisome, because they are becoming resistant to nearly all drugs that would be considered for treatment. This is true as well, but not to the same extent, for some of the gram-positive infections (e.g., *Staphylococcus* and *Enterococcus*). The most serious gram-negative infections are healthcare-associated, and the most common pathogens are Enterobacteriaceae, *Pseudomonas aeruginosa*, and *Acinetobacter*. Treating infections of either pan-resistant or nearly pan-resistant gram-negative microorganisms is an increasingly common challenge in many hospitals. The table below describes the drug classes used to treat these infections and a description of important drug resistance and other limitations. The classes are in order of most likely to be used to less likely to be used.

Drug Class	Important Characteristics	Resistance and Other Limitations
β-lactams	A large class of broad-spectrum drugs that are the main treatment for gram-negative infections. The subclasses are listed below and are presented in an order from narrow-spectrum (penicillins) to broad-spectrum (carbapenem) β-lactam drugs.	Gram-negative bacteria have developed several pathways to β-lactam resistance. Perhaps the most concerning are β-lactamases, enzymes that destroy the β-lactam antibiotic. Some β-lactamases destroy narrow spectrum drugs (e.g., only active against penicillins) while newer β-lactamases (e.g., carbapenemases found in carbapenem-resistant Enterobacteriaceae or CRE) are active against all β-lactam antibiotics.
β-lactam subclass:		
Penicillin, aminopenicillins, and early generation cephalosporins	Among the first antibiotics developed for treatment of bacterial infections. In the absence of resistance, these drugs are active against a broad range of bacterial pathogens.	Resistance among gram-negative bacteria is widespread. These drugs are rarely recommended as treatment for serious gram-negative infections.
β-lactamase inhibitor combinations	These drugs are still active against gram-negative bacteria that have β-lactamase with limited activity for destroying β-lactam antibiotics.	These drugs are important for treatment of serious gram- negative infections but resistance is increasing. Bacteria that are resistant to extended-spectrum cephalosporins and carbapenems are usually resistant to these drugs as well. New β-lactamase inhibitor combination drugs in development have the potential to overcome some, but not all, of resistance from the most potent β-lactamases such as those found in CRE.
Extended-spectrum Cephalosporins	These drugs have been a cornerstone for treatment of serious gram-negative infections for the past 20 years.	Resistant gram-negative infections first emerged in healthcare settings but now are also spreading in the community. When resistance occurs, a carbapenem is the only remaining β-lactam agent.

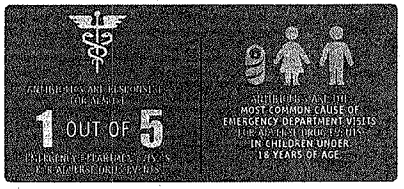
Drug Class	Important Characteristics	Resistance and Other Limitations
Carbapenems	A broad-spectrum β-lactam antibiotic that is considered the last resort for treatment of serious gram-negative infections.	CRE infections are spreading in healthcare facilities throughout the United States and the world. It is reasonable to expect that this resistance will expand to bacteria that circulate in the community, as witnessed by extended-spectrum β-lactamase producing bacteria. Carbapenem resistance can also be found among other gram-negative bacteria including *Pseudomonas* and *Acinetobacter spp.* Once bacteria become resistant to carbapenems, they are usually resistant to all β-lactams.
Fluoroquinolones	These are broad-spectrum antibiotics that are often given orally, making them convenient to use in both inpatients and outpatients.	Resistant bacteria develop quickly with increased use in a patient population. Increased use is also associated with an increase in infections caused by fluoroquinolone-resistant, hyper-virulent strains of *Clostridium difficile*.
Aminoglycosides	These drugs are often used in combination with β-lactam drugs for the treatment of serious gram-negative infections.	Despite growing resistance problems, these drugs continue to be an important therapeutic option. However, clinicians rarely use these drugs alone because of concerns with resistance and side effects.
Tetracyclines & Glycylcines	Tetracyclines are not a first-line treatment option for serious gram negative infections; however, with increasing resistance to other drug classes, tetracyclines are considered as a treatment option. Glycylcines (i.e., tigecycline) are often considered for treatment of multidrug-resistant gram-negative infections.	Tigecycline is a drug that does not distribute evenly in the body, so it is often used in combination with other drugs depending upon the site of infection. Resistance to tigecycline has emerged but it is still relatively uncommon.
Polymyxins	These drugs are an older class that fell out of favor because of toxicity concerns. Now they are often used as a "last resort" agent for treatment of multidrug-resistant gram-negative infections.	Because these are generic drugs, there are limited contemporary data on proper dosing. In addition, resistance is emerging, but there are limited data guiding the accurate detection of resistance in hospital labs. As a result, use of these drugs present significant challenges for clinicians. In the absence of a drug sponsor, FDA and NIH are funding studies to fill these critical information gaps.

People at Especially High Risk

As antibiotic resistance grows, the antibiotics used to treat infections do not work as well or at all. The loss of effective antibiotic treatments will not only cripple the ability to fight routine infectious diseases but will also undermine treatment of infectious complications in patients with other diseases. Many of the advances in medical treatment—joint replacements, organ transplants, cancer therapy, and treatment of chronic diseases such as diabetes, asthma, rheumatoid arthritis—are dependent on the ability to fight infections with antibiotics. If that ability is lost, the ability to safely offer people many life-saving and life-improving modern medical advantages will be lost with it. For example:



Antibiotic Safety



- Antibiotics are powerful drugs that are generally safe and very helpful in fighting disease, but there are times when antibiotics can actually be harmful.
- Antibiotics can have side effects, including allergic reactions and a potentially deadly diarrhea caused by the bacteria *Clostridium difficile (C. difficile)*. Antibiotics can also interfere with the action of other drugs a patient may be taking for another condition. These unintended reactions to antibiotics are called adverse drug events.
- When someone takes an antibiotic that they do not need, they are needlessly exposed to the side effects of the drug and do not get any benefit from it.
- Moreover, taking an antibiotic when it is not needed can lead to the development of antibiotic resistance. When resistance develops, antibiotics may not be able to stop future infections. Every time someone takes an antibiotic they don't need, they increase their risk of developing a resistant infection in the future.

Types of Adverse Drug Events Related to Antibiotics

Allergic Reactions

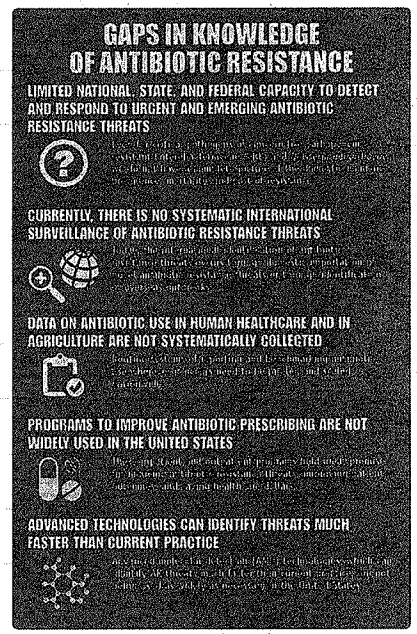
Every year, there are more than 140,000 emergency department visits for reactions to antibiotics. Almost four out of five (79%) emergency department visits for antibiotic-related adverse drug events are due to an allergic reaction. These reactions can range from mild rashes and itching to serious blistering skin reactions swelling of the face and throat, and breathing problems. Minimizing unnecessary antibiotic use is the best way to reduce the risk of adverse drug events from antibiotics. Patients should tell their doctors about any past drug reactions or allergies.

C. difficile

C. difficile causes diarrhea linked to at least 14,000 American deaths each year. When a person takes antibiotics, good bacteria that protect against infection are destroyed for several months. During this time, patients can get sick from *C. difficile* picked up from contaminated surfaces or spread from a healthcare provider's hands. Those most at risk are people, especially older adults, who take antibiotics and also get medical care. Take antibiotics exactly and only as prescribed.

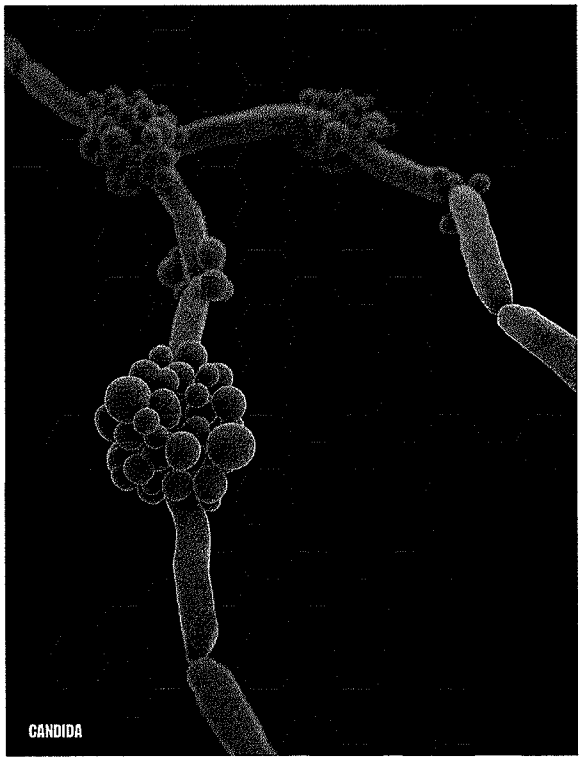
Drug Interactions and Side Effects

Antibiotics can interact with other drugs patients take, making those drugs or the antibiotics less effective. Some drug combinations can worsen the side effects of the antibiotic or other drug. Common side effects of antibiotics include nausea, diarrhea, and stomach pain. Sometimes these symptoms can lead to dehydration and other problems. Patients should ask their doctors about drug interactions and the potential side effects of antibiotics. The doctor should be told immediately if a patient has any side effects from antibiotics.



Developing Resistance

Timeline of Key Antibiotic Resistance Events



FIGHTING BACK AGAINST ANTIBIOTIC RESISTANCE

Four Core Actions to Prevent Antibiotic Resistance

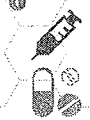
1 PREVENTING INFECTIONS, PREVENTING THE SPREAD OF RESISTANCE

Avoiding infections in the first place reduces the amount of antibiotics that have to be used and reduces the likelihood that resistance will develop during therapy. There are many ways that drug-resistant infections can be prevented: immunization, safe food preparation, handwashing, and using antibiotics as directed and only when necessary. In addition, preventing infections also prevents the spread of resistant bacteria.

2 TRACKING

CDC gathers data on antibiotic-resistant infections, causes of infections and whether there are particular reasons (risk factors) that caused some people to get a resistant infection. With that information, experts can develop specific strategies to prevent those infections and prevent the resistant bacteria from spreading.

3 IMPROVING ANTIBIOTIC PRESCRIBING/STEWARDSHIP



Perhaps the single most important action needed to greatly slow down the development and spread of antibiotic-resistant infections is to change the way antibiotics are used. Up to half of antibiotic use in humans and much of antibiotic use in animals is unnecessary and inappropriate and makes everyone less safe. Stopping even some of the inappropriate and unnecessary use of antibiotics in people and animals would help greatly in slowing down the spread of resistant bacteria. This commitment to always use antibiotics appropriately and safely—only when they are needed to treat disease, and to choose the right antibiotics and to administer them in the right way in every case—is known as antibiotic stewardship.

4 DEVELOPING NEW DRUGS AND DIAGNOSTIC TESTS

Because antibiotic resistance occurs as part of a natural process in which bacteria evolve, it can be slowed but not stopped. Therefore, we will always need new antibiotics to keep up with resistant bacteria as well as new diagnostic tests to track the development of resistance.

1. PREVENTING INFECTIONS, PREVENTING THE SPREAD OF RESISTANCE

Preventing infections from developing reduces the amount of antibiotics used. This reduction in antibiotic use, in turn, slows the pace of antibiotic resistance. Preventing infections also prevents the spread of resistant bacteria. Antibiotic-resistant infections can be prevented in many ways. This section focuses on CDC's works to prevent antibiotic-resistant infections in healthcare settings, in the community, and in food.

CDC's Work to Prevent Infections and Antibiotic Resistance in Healthcare Settings

Antibiotic resistance in healthcare settings is a significant threat to public health. Because almost all Americans will receive care in a medical setting at some point, the problem can affect anyone. In addition, many times, patients in medical settings such as hospitals and long-term care facilities (e.g., skilled nursing facilities and nursing homes) are already vulnerable due to weak immune systems and underlying illness. For these patients, contracting an antibiotic-resistant infection is especially dangerous. By preventing antibiotic resistance in healthcare settings, patients' lives are better protected and their health can be better preserved. In addition, healthcare facilities, systems, insurers and patients can save dollars that otherwise would have been spent on more complex care and medications needed to manage antibiotic-resistant infections.

CDC works to prevent antibiotic resistance in healthcare settings by providing a system to track resistance and prescribing patterns at national, regional, and local levels; providing guidance to healthcare facilities interested in better antibiotic use; and working to prevent all patient infections through infection control guidelines, assistance implementing these guidelines, and laboratory expertise. Here are some examples of how CDC is working to prevent antibiotic resistance in healthcare settings:

Tracking

CDC's National Healthcare Safety Network (NHSN) is used by healthcare facilities to electronically report infections, antibiotic use, and resistance. Data currently submitted by hospitals to NHSN allow facilities, states, and regions the ability to track and benchmark antibiotic resistance in bacteria responsible for many healthcare-associated infections. As more hospitals submit data to the new NHSN Antibiotic Use and Resistance Module, they will be able to track and benchmark antibiotic resistance in all bacteria, as well as track antibiotic usage. This information will allow facilities to target areas of concern, to make needed improvements and to track the success of their efforts. In addition, NHSN allows CDC to perform and report national assessments of antibiotic resistance.

CDC's specialized, national reference laboratory tests bacteria samples from around the country to detect new and emerging resistance patterns that affect patient health. This

reference testing also provides an early warning of new resistance that has the potential to spread across the nation and that requires public health action.

Additionally, CDC recently conducted a survey in collaboration with its Emerging Infections Program to estimate the number of healthcare-associated infections and to better understand antibiotic use among inpatients in U.S. hospitals. The survey found that antibiotic use was frequent, that most antibiotic use was for treating active infections, and that vancomycin was the most commonly used antibiotic overall. Formal results are due to be published in late 2013 and 2014. CDC plans to conduct a repeat survey in 2014 that will include assessments of appropriate antibiotic prescribing.

Improving Antibiotic Prescribing

CDC manages the Get Smart program, a national campaign to improve antibiotic prescribing and use in both outpatient and inpatient settings. The program supports a variety of state-based programs modeled on the national effort. Each November, CDC publicizes its annual Get Smart About Antibiotics Week to raise awareness among patients, healthcare providers, hospital administrators, and policy makers about the threat of antibiotic resistance and the need to decrease inappropriate antibiotic use. CDC provides public health messages and resources for improving antibiotic use in healthcare settings and is now working with a variety of partners to improve the use of antibiotics in healthcare settings. One core activity is the development and implementation of the Antibiotic Stewardship Drivers and Change Package, a tool that provides healthcare facilities with a menu of interventions they can select from to improve antibiotic use. CDC developed and tested this tool with the Institute for Healthcare Improvement. Additional information about Get Smart About Antibiotics Week activities and messages can be found on CDC's website: http://www.cdc.gov/getsmart/. The Drivers and Change Package can be found at http://www.cdc.gov/getsmart/healthcare/improve-efforts/driver-diagram/index.html.

Protecting Patients from Infections

Preventing infections negates the need for antibiotic use in the first place, and scientific evidence shows that reducing antibiotic use in a single facility can reduce resistance in that facility. Taken on a national scale, infection prevention efforts can significantly decrease resistance. To help prevent infections, CDC conducts research to find new ways of preventing infections; provides the nation with infection prevention guidelines and tools to prevent infections; serves as the nation's reference laboratory to identify microorganisms; and offers the nation's largest healthcare-associated infection tracking system, NHSN, allowing facilities and states to identify and address problem areas.

CDC's Work to Prevent Antibiotic Resistance in the Community

Antibiotic-resistant infections outside of the hospital setting were rare until recently. Today, resistant infections that can be transmitted in the community include tuberculosis and respiratory infections caused by *Streptococcus pneumoniae*, skin infections caused by methicillin-resistant *Staphylococcus aureus*, and sexually transmitted infections such as gonorrhea.

CDC works to prevent antibiotic resistance in the community by providing systems to track infections and changes in resistance; improving prescribing at national, regional, and local levels; and limiting or interrupting the spread of infections. These activities are similar to the strategies used in medical settings, but the approach can differ because the population (potentially everyone) is large and the settings are different. Here are some examples of the strategies CDC uses to prevent antibiotic resistance in communities:

Tracking Community Infections and Resistance

These programs are examples of CDC's effort to identify critical infections in the community and monitor resistance trends.

- **Active Bacterial Core surveillance (ABCs):** Tracking infections caused by *Neisseria meningitida, Streptococcus pneumoniae*, Groups A and B *Streptococcus*, and methicillin-resistant *Staphylococcus aureus*
- **Gonococcal Isolate Surveillance Project (GISP):** Collecting isolates from gonorrhea infections to monitor antibiotic resistance
- **National Tuberculosis Surveillance System (NTSS):** National Electronic Disease Surveillance System (NEDSS)-based reporting of tuberculosis cases including resistance data
- **Healthcare-Associated Infections-Community Interface (HAIC):** Tracking infections with *C. difficile* and with multidrug-resistant gram-negative microorganisms.

Improving Antibiotic Prescribing

Prescribing antibiotics when they are not needed or prescribing the wrong antibiotic in outpatient settings such as doctors' offices is common. In some cases, doctors might not order laboratory tests to confirm that bacteria are causing the infection, and therefore the antibiotic might be unnecessarily prescribed. In other cases, patients demand treatment for conditions such as a cold when antibiotics are not needed and will not help. Likewise, healthcare providers can be too willing to satisfy a patient's expectation for an antibiotic prescription. CDC manages the Get Smart program, a national campaign to improve antibiotic prescribing and use in both outpatient and inpatient settings, and supports a variety of state-based programs modeled on the national effort. CDC provides local public health authorities with messages and resources for improving antibiotic use in outpatient settings and is now working with a variety of partners to identify new approaches for improving antibiotic use.

Limiting and Interrupting the Spread of Antibiotic-Resistant Infections in the Community

Preventing the spread of infection in the community is a significant challenge, and many prevention interventions are used, depending on the type of infection and the route of transmission.

Here are some examples of CDC's activities to limit and interrupt the spread of antibiotic-resistant community infections:

- Contact Tracing: A prevention strategy that has proven successful is tracking cases (individuals who are infected) and tracing contacts (people who have had contact with a case that puts them at risk for infection as well). This process is used to ensure that all persons requiring an intervention such as treatment, prophylaxis, or temporary isolation from the general public are identified and managed appropriately. This approach is resource intensive, but it has successfully limited transmission of infections including tuberculosis, gonorrhea, and meningococcus.
- Vaccination: There are few vaccines for antibiotic-resistant bacteria, but the *S. pneumoniae* vaccine has proven that an effective vaccine can reduce antibiotic resistance rates. The vaccine targets certain types of the bacteria, even if it is a resistant type, and reduces the overall number of infections, including those that are caused by resistant strains. The first version of the vaccine was introduced in 2000 and reduced the frequency of antibiotic-resistant infections, but it did not protect against a particular strain of *S. pneumoniae* called serotype 19A. This strain became increasingly resistant to antibiotics and caused more infections because the vaccine did not offer protection. A new version of the vaccine, approved for use in 2010, protects against serotype 19A. As a result, the rate of resistant pneumococcal infections is decreasing.
- Treatment Guidelines: The spread of antibiotic resistance can be prevented if infections are effectively treated before the pathogen is spread to others. For some infections, laboratory tests for guiding treatment are not easily available or the turn-around time is slow or incomplete. This is the case for treating gonorrhea and tuberculosis. For these infections, healthcare providers rely on treatment guidelines for proper management of infections. CDC monitors resistance trends in *Neisseria gonorrhoeae* (the cause of gonorrhea) and *Mycobacterium tuberculosis* (the cause of tuberculosis) and publishes treatment guidelines to limit the progression of these diseases and the spread of bacteria.
- Promotion of Safe Sex: Increases in the spread of drug-resistant *Neisseria gonorrhoeae* poses unique challenges. To prevent transmission of this infection, CDC works to promote safer sexual behaviors such as abstinence, mutual monogamy, and correct and consistent condom use.

Preventing Infections: CDC's Work to Prevent Antibiotic Resistance in Food

Each year, millions of people in the United States become sick from foodborne and other enteric (gastrointestinal) infections. While many of these infections are mild and do not require treatment, antibiotics can be lifesaving in severe infections. Antibiotic resistance compromises our ability to treat these infections and is a serious threat to public health. Preventing resistant enteric infections requires a multifaceted approach and partnerships because bacteria that cause some infections, such as salmonellosis and campylobacteriosis, have animal reservoirs, while other bacteria, such as those that cause shigellosis and typhoid fever, have human reservoirs. To prevent antibiotic-resistant foodborne infections, CDC works closely with state and local health departments; with the U.S. Food and Drug Administration (FDA), which regulates antibiotics, many foods, animal feed, and other products; and with the U.S. Department of Agriculture (USDA), which regulates meat, poultry, and egg products.

Tracking Antibiotic Resistance

In 1996, the National Antimicrobial Resistance Monitoring System (NARMS) was established as a collaboration among CDC, FDA, USDA, and state and local public health departments. This national public health surveillance system tracks antibiotic resistance among *Salmonella, Campylobacter,* and other bacteria transmitted commonly through food. NARMS tests bacteria from humans (CDC), retail meats (FDA), and food-producing animals (USDA) in the United States. The primary objectives of the NARMS program are to:

- Monitor trends in antibiotic resistance among enteric bacteria from humans, retail meats, and food-producing animals.
- Disseminate information on antibiotic resistance to promote interventions that reduce antibiotic resistance among foodborne bacteria.
- Conduct research to better understand the emergence, persistence, and spread of antibiotic resistance.
- Provide data that assist the FDA in making decisions about approving safe and effective antibiotic drugs for animals.

The CDC reference laboratory conducts antibiotic susceptibility testing on isolates from sporadic cases and outbreaks of illness. The lab also confirms and studies bacteria that have new antibiotic resistance patterns. NARMS provides information about patterns of emerging resistance among enteric pathogens to stakeholders, including federal regulatory agencies, policymakers, consumer advocacy groups, industry, and the public, to guide public health prevention and policy efforts that protect people from resistant infections. For more information about NARMS: www.cdc.gov/narms.

Improving Antibiotic Use

Antibiotics are widely used in food-producing animals, and according to data published by FDA, there are more kilograms of antibiotics sold in the United States for food-producing animals than for people. (http://www.fda.gov/downloads/ForIndustry/UserFees/AnimalDrugUserFeeActADUFA/UCM338170.pdf). This use contributes to the emergence of antibiotic-resistant bacteria in food-producing animals. Resistant bacteria in food-producing animals are of particular concern because these animals serve as carriers.

Resistant bacteria can contaminate the foods that come from those animals, and people who consume these foods can develop antibiotic-resistant infections. Antibiotics must be used judiciously in humans and animals because both uses contribute to not only the emergence, but also the persistence and spread of antibiotic-resistant bacteria.

Scientists around the world have provided strong evidence that antibiotic use in food-producing animals can harm public health through the following sequence of events:

- Use of antibiotics in food-producing animals allows antibiotic-resistant bacteria to thrive while susceptible bacteria are suppressed or die.
- Resistant bacteria can be transmitted from food-producing animals to humans through the food supply.
- Resistant bacteria can cause infections in humans.
- Infections caused by resistant bacteria can result in adverse health consequences for humans.

Because of the link between antibiotic use in food-producing animals and the occurrence of antibiotic-resistant infections in humans, antibiotics should be used in food-producing animals only under veterinary oversight and only to manage and treat infectious diseases, not to promote growth. CDC encourages and supports efforts to minimize inappropriate use of antibiotics in humans and animals, including FDA's strategy to promote the judicious use of antibiotics that are important in treating humans (http://www.fda.gov/AnimalVeterinary/SafetyHealth/AntimicrobialResistance/JudiciousUseofAntimicrobials/default.htm). CDC supports FDA's plan to implement draft guidance in 2013 that will operationalize this strategy (http://www.fda.gov/downloads/AnimalVeterinary/GuidanceComplianceEnforcement/GuidanceforIndustry/UCM299624.pdf). CDC has also contributed to a training curriculum for veterinarians on prudent antibiotic use in animals. CDC's efforts to improve antibiotic prescribing in humans are described in other sections of this report.

Preventing Infections

Efforts to prevent foodborne and other enteric infections help to reduce both antibiotic-resistant infections and antibiotic-susceptible infections (those that can be treated effectively with antibiotics). CDC activities that help prevent these infections include:

- Estimating how much foodborne illness occurs.
- Monitoring trends in foodborne infections.
- Investigating outbreaks and sporadic cases of foodborne illness to stop outbreaks and improve prevention.
- Attributing illnesses to specific foods and settings.
- Tracking and responding to changes in resistance.
- Determining the sources of antibiotic-resistant enteric infections.
- Educating consumers and food workers about safe food handling practices.
- Identifying and educating groups at high risk for infection.
- Promoting proper handwashing.

- Strengthening the capacity of state and local health departments to detect, respond to, and report foodborne infections.
- Developing better diagnostic tools to rapidly and accurately find sources of contamination.
- Providing recommendations for travelers on safe food and clean water.

2. TRACKING RESISTANCE PATTERNS

CDC gathers data on antibiotic-resistant infections, causes of infections, and whether there are particular reasons (risk factors) that caused some people to get a resistant infection. With that information, experts develop specific strategies to prevent those infections and prevent the resistant bacteria from spreading.

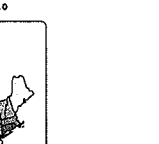
CDC's Antibiotic Resistance and Antibiotic-Resistant Infections Tracking Platform

Tracking Networks	Data Collected	Resistant Bacteria/Fungus[1]
EIP Emerging Infections Program There are three main programs within the EIP: 1. ABCs: Active Bacterial Core surveillance 2. HAIC: Healthcare-Associated Infections-Community Interface 3. FoodNet: Foodborne Diseases Active Surveillance Network	A network of public health, academic, hospital collaborations in 10 states. It provides access to bacterial and fungal samples for testing and detailed clinical case data. The three main programs within EIP collect different types of resistance data: 1. ABCs provides clinical information and resistance data for bacteria that cause infections predominately in the community. 2. The HAIC provides clinical information and resistance data for bacteria and fungi that cause infections at the intersection of healthcare and the general community. 3. FoodNet supplies clinical and epidemiologic data on some human isolates in the National Antimicrobial Resistance Monitoring System (NARMS).	ABCs: *Streptococcus pneumoniae* Groups A and B *Streptococcus* Methicillin-resistant *Staphylococcus aureus* HAIC: *C. difficile* *Candida* (a fungus) Carbapenem-R Enterobacteriaceae MDR *Acinetobacter* FoodNet: (see NARMS list)
NARMS National Antimicrobial Resistance Monitoring System	A national public health surveillance system that tracks changes in the susceptibility of foodborne and other enteric bacteria to antibiotics of human and veterinary medical importance. NARMS is a collaboration among CDC, FDA, USDA, and state and local health departments. CDC tests bacterial isolates from humans, while FDA and USDA test isolates from retail meats and food animals.	*Salmonella* *Campylobacter* *Shigella*

Tracking Networks	Data Collected	Resistant Bacteria/Fungus[1]
NHSN National Healthcare Safety Network	A system that collects and provides data on infections and drug-resistance in healthcare settings. Since NHSN collects data directly from healthcare facilities, it can provide facility-level information on healthcare-associated infections and antibiotic resistance (and in the future, on antibiotic use).	*Staphylococcus aureus* *Enterococcus* Enterobacteriaceae *Acinetobacter* *Pseudomonas aeruginosa* *Candida* (a fungus)
GISP Gonococcal Isolate Surveillance Program	A program to track antibiotic resistance data for gonococcal isolates. Isolates are collected from sexually transmitted disease clinics in approximately 28 cities.	*Neisseria gonorrhoeae*
NTSS National Tuberculosis Surveillance System	National Electronic Disease Surveillance System (NEDSS)-based reporting of tuberculosis cases including resistance data. Public health departments from 50 states and the US territories contribute data.	*Mycobacterium tuberculosis*

[1]ABCs also includes surveillance for *Neisseria meningitidis* and *Haemophilus influenzae*. NARMS also includes surveillance for *E. coli* O157 and *Vibrio* (non-*V. cholerae*)

3. ANTIBIOTIC STEWARDSHIP: IMPROVING PRESCRIBING AND USE

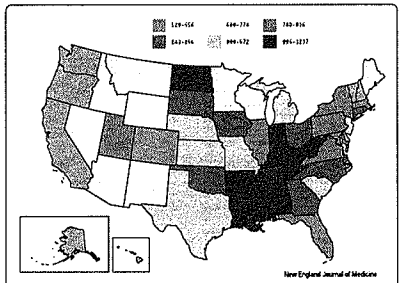


Antibiotics were first used to treat serious infections in the 1940s. Since then, antibiotics have saved millions of lives and transformed modern medicine. During the last 70 years, however, bacteria have shown the ability to become resistant to every antibiotic that has been developed. And the more antibiotics are used, the more quickly bacteria develop resistance *(see the Antibiotic Resistance Timeline in this report)*.

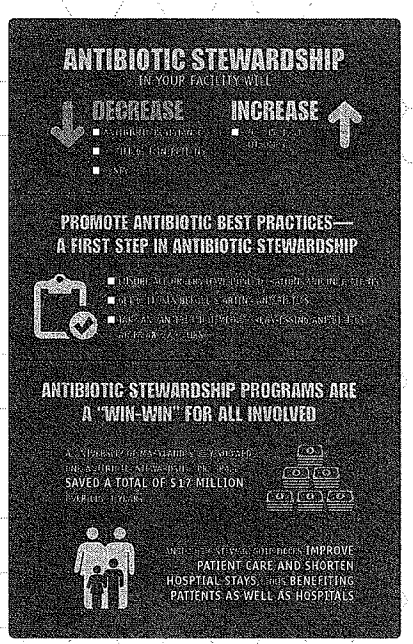
Anytime antibiotics are used, this puts biological pressure on bacteria that promotes the development of resistance. When antibiotics are needed to prevent or treat disease, they should always be used. But research has shown that as much as 50% of the time, antibiotics are prescribed when they are not needed or they are misused (for example, a patient is given the wrong dose). This not only fails to help patients; it might cause harm. Like every other drug, antibiotics have side effects and can also interact or interfere with the effects of other medicines. This inappropriate use of antibiotics unnecessarily promotes antibiotic resistance.

Antibiotics are a limited resource. The more that antibiotics are used today, the less likely they will still be effective in the future. Therefore, doctors and other health professionals around the world are increasingly adopting the principles of responsible antibiotic use, often called antibiotic stewardship. Stewardship is a commitment to always use antibiotics only when they are necessary to treat, and in some cases prevent, disease; to choose the right antibiotics; and to administer them in the right way in every case. Effective stewardship ensures that every patient gets the maximum benefit from the antibiotics, avoids unnecessary harm from allergic reactions and side effects, and helps preserve the life-saving potential of these drugs for the future. Efforts to improve the responsible use of antibiotics have not only demonstrated these benefits but have also been shown to improve outcomes and save healthcare facilities money in pharmacy costs.

Antibiotic Prescriptions per 1000 Persons of All Ages According to State, 2010



The frequency with which doctors prescribe antibiotics varies greatly from state to state. The reasons for this variation are being studied and might suggest areas where improvements in antibiotic prescribing (fewer unnecessary prescriptions) would be most helpful.



4. DEVELOPING NEW ANTIBIOTICS AND DIAGNOSTIC TESTS

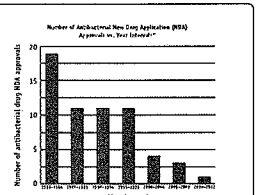
FOUR CORE ACTIONS

DEVELOPING NEW ANTIBIOTICS AND DIAGNOSTIC TESTS

Because antibiotic resistance occurs as part of a natural evolution process, it can be significantly slowed but not stopped. Therefore, new antibiotics will always be needed to keep up with resistant bacteria as well as new diagnostic tests to track the development of resistance.

Tomorrow's Antibiotics: The Drug Pipeline

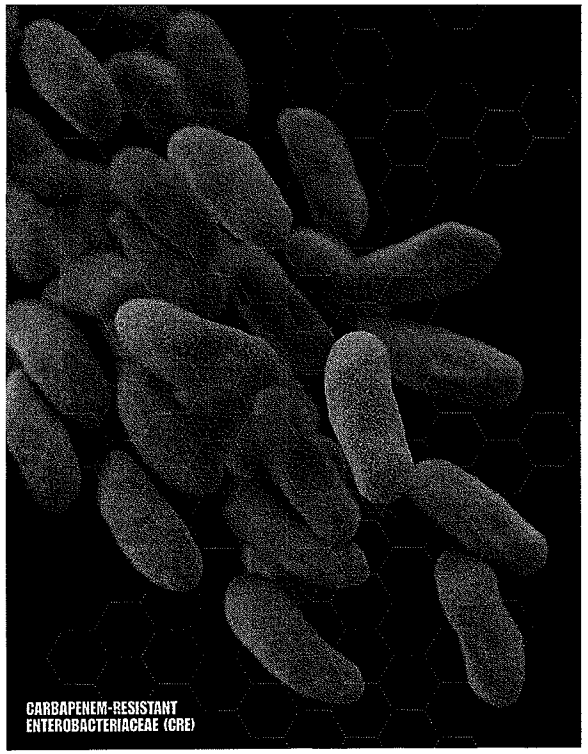
The number of new antibiotics developed and approved has steadily decreased in the past three decades, leaving fewer options to treat resistant bacteria.



Examples of Recently Approved Drugs

Drug Name	Year Approved	Key Targeted Pathogens	Drug's Use and Resistance Trends
Quinupristin/ Dalfopristin	1999	*Staphylococcus* *Streptococcus*	This is a combination of two drugs that can be used to treat gram-positive infections. Because side effects are common, this drug is usually not a first choice for therapy. Resistance in target pathogens has been described, but the percentage in the United States is still low.
Moxifloxacin	1999	Enterobacteriaceae *Staphylococcus* *Streptococcus*	Moxifloxacin, like other fluoroquinolones, demonstrates broad spectrum activity, and it can be used to treat a range of infections. Unfortunately, there is cross-resistance among the fluoroquinolones, and resistance is increasing in all targeted pathogens, especially Enterobacteriaceae.
Linezolid	2000	*Staphylococcus* *Enterococcus*	Linezolid can be used to treat serious gram-positive infections. Resistance has occurred but it is still uncommon.
Ertapenem	2001	Enterobacteriaceae *Staphylococcus* *Streptococcus*	Ertapenem is a carbapenem that can be used to treat a wide range of infections. Dissemination of carbapenem-resistant Enterobacteriaceae (CRE) is impacting the drug's overall effectiveness.
Gemifloxacin	2003	Enterobacteriaceae *Streptococcus*	Gemifloxacin is a fluoroquinolone that can be used to treat mild to moderate community-associated respiratory disease. Like moxifloxacin, there is cross-resistance with other fluoroquinolone drugs so resistance is increasing.
Daptomycin	2003	*Staphylococcus* *Streptococcus* *Enterococcus*	Daptomycin is often used for treatment of serious gram-positive infections. Resistance is emerging in all of the targeted pathogens, but the resistance rates are currently low.
Tigecycline	2005	Enterobacteriaceae *Staphylococcus* *Streptococcus* *Enterococcus*	Tigecycline is often one of the only active agents for carbapenem-resistant gram-negative infections, and resistance is emerging. However, even in the absence of resistance, the effectiveness of this agent for treatment of the most serious infections is a concern.
Doripenem	2007	Enterobacteriaceae *Pseudomonas aeruginosa* *Acinetobacter spp.* *Streptococcus spp.*	Doripenem is a carbapenem drug most commonly used to treat serious gram-negative infections. Dissemination of carbapenem-resistant gram-negative pathogens like CRE is reducing the overall effectiveness of this drug.
Telavancin	2008	*Staphylococcus* *Streptococcus* *Enterococcus*	Telavancin is approved for treatment of gram-positive skin and soft tissue infections. Use is limited because it is administered intravenously and is therefore difficult to use in an outpatient setting. In addition, it should not be used in a woman of childbearing age without a pregnancy test.

Drug Name	Year Approved	Key Targeted Pathogens	Drug's Use and Resistance Trends
Ceftaroline	2010	Enterobacteriaceae *Staphylococcus* *Streptococcus*	Ceftaroline is a cephalosporin drug, but unlike other cephalosporins, this one can be used to treat MRSA infections. Resistance has been identified but is rare. Ceftaroline does not demonstrate any enhanced activity compared to other cephalosporins for Enterobacteriaceae. ESBL-producing isolates and CRE isolates are resistant to this drug as well. ESBL (extended-spectrum β-lactamase) is an enzyme that allows bacteria to become resistant to a wide variety of penicillins and cephalosporins. Bacteria that contain this enzyme are known as ESBLs or ESBL-producing bacteria.



CURRENT ANTIBIOTIC RESISTANCE THREATS IN THE UNITED STATES, BY MICROORGANISM

This section includes summaries for each microorganism, grouped by threat level: URGENT, SERIOUS, and CONCERNING.

THREAT LEVEL
URGENT

MICROORGANISMS WITH A THREAT LEVEL OF URGENT

Clostridium difficile
Carbapenem-resistant **Enterobacteriaceae**
Drug-resistant ***Neisseria gonorrhoeae***

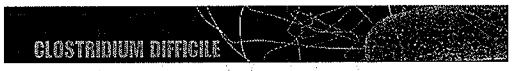
Clostridium difficile (C. difficile) causes life-threatening diarrhea. These infections mostly occur in people who have had both recent medical care and antibiotics. Often, *C. difficile* infections occur in hospitalized or recently hospitalized patients.

RESISTANCE OF CONCERN

- Although resistance to the antibiotics used to treat *C. difficile* infections is not yet a problem, the bacteria spreads rapidly because it is naturally resistant to many drugs used to treat other infections.
- In 2000, a stronger strain of the bacteria emerged. This strain is resistant to fluoroquinolone antibiotics, which are commonly used to treat other infections.
- This strain has spread throughout North America and Europe, infecting and killing more people wherever it spreads.

PUBLIC HEALTH THREAT

- 250,000 infections per year requiring hos
- hospitalized patients.
- 14,000 deaths per year.
- At least $1 billion in excess medical costs
- Deaths related to *C. difficile* increased 40
- because of a stronger bacteria strain that
- Almost half of infections occur in people
- 90% of deaths occur in people 65 and old
- About half of *C. difficile* infections first sh
- recently hospitalized patients, and half fr
- patients or in people recently cared for in



FIGHTING THE SPREAD OF RESISTANCE

WHAT CDC IS DOING

- Tracking and reporting national progress toward preventing *C. difficile* infections.
- Promoting *C. difficile* prevention programs and providing gold-standard patient safety recommendations.
- Providing prevention expertise, as well as outbreak and laboratory assistance, to health departments and healthcare facilities.

WHAT YOU CAN DO

CEOs, Medical Officers, and other Healthcare Facility Leaders Can:

- Support better testing (nucleic acid amplification tests), tracking, and reporting of infections and prevention efforts.
- Ensure policies for rapid detection and isolation of patients with *C. difficile* are in place and followed.
- Assess hospital cleaning to be sure it is performed thoroughly, and augment this using an Environmental Protection Agency-approved, spore-killing disinfectant in rooms where *C. difficile* patients are treated.
- Notify other healthcare facilities about infectious diseases when patients transfer, especially between hospitals and nursing homes.
- Participate in a regional *C. difficile* prevention effort.

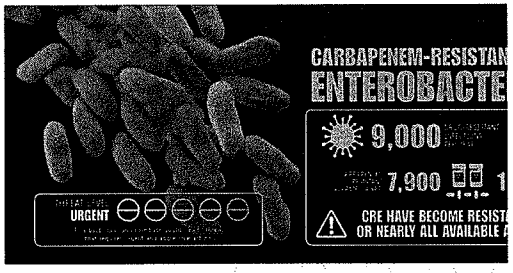
Healthcare Providers Can:

- Prescribe antibiotics carefully (re
- getsmart/specific-groups/hcp/inc
- results are available, check whet
- are correct and necessary.
- Order a *C. difficile* test (preferably
- if the patient has had 3 or more
- Be aware of infection rates in yo
- infection control recommendatio
- using contact precautions (glove
- patients who are suspected to ha
- practices for those with positive

Patients can:

- Take antibiotics only as prescribe
- complete the prescribed course o
- can be lifesaving medicines.
- Tell your doctor if you have been
- within a few months.
- Wash your hands before eating a
- Try to use a separate bathroom if
- bathroom is cleaned well if some

ONLINE RESOURCES
Vital Signs, March 2012: Ne
http://www.cdc.gov/vitalsign
Clostridium difficile Infectio
http://www.cdc.gov/HAI/org



Untreatable and hard-to-treat infections from carbapenem-resistant Enterobacteriaceae (CRE) bacteria are on the rise among patients in medical facilities. CRE have become resistant to all or nearly all the antibiotics we have today. Almost half of hospital patients who get bloodstream infections from CRE bacteria die from the infection.

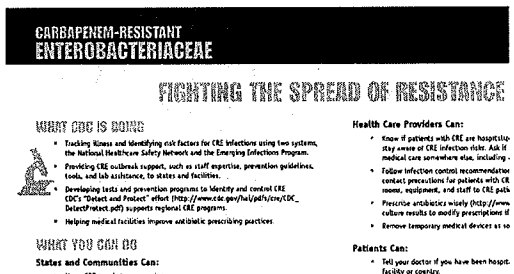
RESISTANCE OF CONCERN

- Some Enterobacteriaceae are resistant to nearly all antibiotics, including carbapenems, which are often considered the antibiotics of last resort.
- More than 9,000 healthcare-associated infections are caused by CRE each year.
- CDC laboratories have confirmed at least one type of CRE in healthcare facilities in 44 states.
- About 4% of U.S. short-stay hospitals had at least one patient with a serious CRE infection during the first half of 2012. About 18% of long-term acute care hospitals had one.

	Percentage of Enterobacteriaceae healthcare-associated infections resistant to carbapenems
Carbapenem-resistant *Klebsiella* spp.	11%
Carbapenem-resistant *E. coli*	2%

PUBLIC HEALTH THREAT

An estimated 140,000 healthcare-associated Enterobact
States each year; about 9,100 of these are caused by CI
infections caused by CRE result in death. Fortunately, b
a minority of all healthcare-associated infections resu
approximately 600 deaths result from infections caused
CRE, carbapenem-resistant *Klebsiella* spp. and carbapen



FIGHTING THE SPREAD OF RESISTANCE

WHAT CDC IS DOING

- Tracking illness and identifying risk factors for CRE infections using two systems, the National Healthcare Safety Network and the Emerging Infections Program.
- Providing CRE outbreak support, such as staff expertise, prevention guidelines, tools, and lab assistance, to states and facilities.
- Developing tests and prevention programs to identify and control CRE.
- CDC's "Detect and Protect" effort (http://www.cdc.gov/hai/pdfs/cre/CDC_
- Detect_Protect.pdf) supports regional CRE programs.
- Helping medical facilities improve antibiotic prescribing practices.

WHAT YOU CAN DO

States and Communities Can:

- Know CRE trends in your region.
- Coordinate regional CRE tracking and control efforts in areas with CRE. Areas not yet or rarely affected by CRE infections can be proactive in CRE prevention efforts.
- Require facilities to alert each other when transferring patients with any infection.
- Consider including CRE infections on your state's Notifiable Diseases list.

Healthcare CEOs, Medical Officers, and Other Healthcare Facility Leaders Can:

- Require and strictly enforce CDC guidance for CRE detection, prevention, tracking, and reporting.
- Make sure your lab can accurately identify CRE and alert clinical and infection prevention staff when these bacteria are present.
- Know CRE trends in your facility and in the facilities around you.
- When transferring a patient, require staff to notify the other facility about infections, including CRE.
- Join or start regional CRE prevention efforts, and promote wise antibiotic use.

Health Care Providers Can:

- Know if patients with CRE are hospitaliz
- stay aware of CRE infection risks. Ask if
- medical care somewhere else, including
- Follow infection control recommendation
- contact precautions for patients with CR
- rooms, equipment, and staff to CRE pati
- Prescribe antibiotics wisely (http://www
- culture results to modify prescriptions if
- Remove temporary medical devices as so

Patients Can:

- Tell your doctor if you have been hospit
- facility or country.
- Take antibiotics only as prescribed.
- Insist that everyone wash their hands be

ONLINE RESOURCES
Vital Signs, March 2013: Middle
2013 CRE Toolkit
http://www.cdc.gov/hai/organi
MMWR, March 2013
http://www.cdc.gov/mmwr/preview/mmwrhtml
Get Smart for Healthcare
http://www.cdc.gov/getsmart/healthcare
Carbapenem-resistant Enterobacteriaceae (C
http://www.cdc.gov/HAI/organisms/cre/index.

Neisseria gonorrhoeae causes gonorrhea, a sexually transmitted disease that can result in discharge and inflammation at the urethra, cervix, pharynx, or rectum.

RESISTANCE OF CONCERN

N. gonorrhoeae is showing resistance to antibiotics usually used to treat it. These drugs include:

- ceftibuxime (an oral cephalosporin)
- ceftriaxone (an injectable cephalosporin)
- azithromycin
- tetracycline

PUBLIC HEALTH THREAT

Gonorrhea is the second most commonly reported notifiable infection in the United States and is easily transmitted. It causes severe reproductive complications and disproportionately affects sexual, racial, and ethnic minorities. Gonorrhea control relies on prompt identification and treatment of infected persons and their sex partners. Because some drugs are less effective in treating gonorrhea, CDC recently updated its treatment guidelines to slow the emergence of drug resistance. CDC now recommends only ceftriaxone plus either azithromycin or doxycycline as first-line treatment for gonorrhea. The emergence of cephalosporin resistance, especially ceftriaxone resistance, would greatly limit treatment options and could cripple gonorrhea control efforts.

In 2011, 321,849 cases of gonorrhea were reported to CDC, but CDC estimates that more than 820,000 cases occur annually in the United States.

	Percentage	Estimated number of cases
Gonorrhea		820,000
Resistance to any antibiotic	39%	246,000
Reduced susceptibility to cefixime	<1%	11,480
Reduced susceptibility to ceftriaxone*	<1%	3,280
Reduced susceptibility to azithromycin	<1%	2,460
Resistance to tetracycline	22%	180,400

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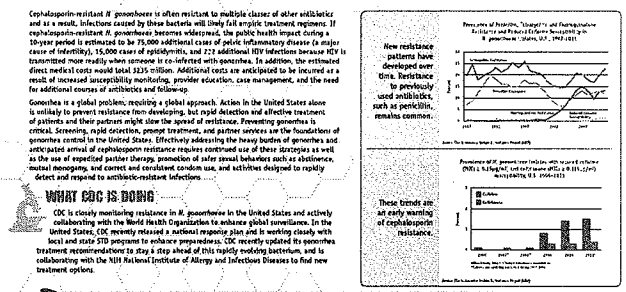
Centers for Disease Control and Prevention

FIGHTING THE SPREAD OF RESISTANCE

Cephalosporin-resistant *N. gonorrhoeae* is often resistant to multiple classes of other antibiotics and as a result, infections caused by these bacteria will likely fail empiric treatment regimens. If cephalosporin-resistant *N. gonorrhoeae* becomes widespread, the public health impact during a 10-year period is estimated to be 75,000 additional cases of pelvic inflammatory disease (a major cause of infertility), 15,000 cases of epididymitis, and 222 additional HIV infections because HIV is transmitted more readily when someone is co-infected with gonorrhea. In addition, the estimated direct medical costs would total $235 million. Additional costs are anticipated to be incurred as a result of increased susceptibility monitoring, provider education, case management, and the need for additional courses of antibiotics and follow-up.

Gonorrhea is a global problem, requiring a global approach. Action in the United States alone is unlikely to prevent resistance from developing, but rapid detection and effective treatment of patients and their partners might slow the spread of resistance. Preventing gonorrhea is critical. Screening, rapid detection, prompt treatment, and partner services are the foundations of gonorrhea control in the United States. Effectively addressing the heavy burden of gonorrhea and anticipated arrival of cephalosporin resistance requires continued use of these strategies as well as the use of expedited partner therapy, promotion of safer sexual behaviors such as abstinence, mutual monogamy, and correct and consistent condom use, and activities designed to rapidly detect and respond to antibiotic-resistant infections.



WHAT CDC IS DOING

CDC is closely monitoring resistance in *N. gonorrhoeae* in the United States and actively collaborating with the World Health Organization to enhance global surveillance. In the United States, CDC recently released a national response plan and is working closely with local and state STD programs to enhance preparedness. CDC recently updated its gonorrhea treatment recommendations to stay a step ahead of this rapidly evolving bacterium, and is collaborating with the NIH National Institute of Allergy and Infectious Diseases to find new treatment options.

ONLINE RESOURCES

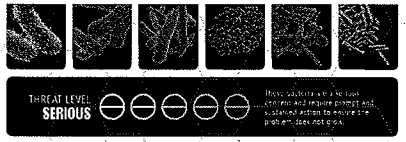
CDC's gonorrhea website
http://www.cdc.gov/std/gonorrhea/default.htm

CDC's Antibiotic-Resistant Gonorrhea website
http://www.cdc.gov/std/Gonorrhea/arg/default.htm

New Treatment Guidelines for Gonorrhea: Antibiotic Change. MedScape CDC Expert Commentary, 2012. http://www.medscape.com/viewarticle/764843

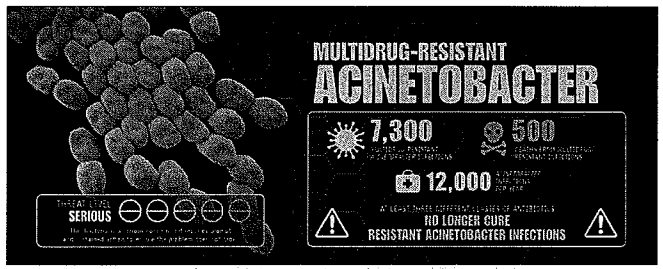
Kirkcaldy RD, Bolan GA, Wasserheit JN. Cephalosporin-Resistant Gonorrhea in North America. JAMA 2013;309(2):185-187. http://jama.jamanetwork.com/article.aspx?articleid=1556135

CDC. Update to CDC's Sexually Transmitted Diseases Treatment Guidelines, 2010: Oral cephalosporins no longer a recommended treatment for gonococcal infections. MMWR 2012;61(31):590-594. http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6131a3.htm?



MICROORGANISMS WITH A THREAT LEVEL OF SERIOUS

Multidrug-resistant *Acinetobacter*
Drug-resistant *Campylobacter*
Fluconazole-resistant *Candida* (a fungus)
Extended spectrum β-lactamase producing **Enterobacteriaceae (ESBLs)**
Vancomycin-resistant *Enterococcus* **(VRE)**
Multidrug-resistant *Pseudomonas aeruginosa*
Drug-resistant **non-typhoidal** *Salmonella*
Drug-resistant *Salmonella* **Typhi**
Drug-resistant *Shigella*
Methicillin-resistant *Staphylococcus aureus* **(MRSA)**
Drug-resistant *Streptococcus pneumoniae*
Drug-resistant **tuberculosis**



Acinetobacter is a type of gram-negative bacteria that is a cause of pneumonia or bloodstream infections among critically ill patients. Many of these bacteria have become very resistant to antibiotics.

RESISTANCE OF CONCERN

Some *Acinetobacter* strains are resistant to nearly all or all antibiotics including carbapenems, often considered antibiotics of last resort.

- About 63% of *Acinetobacter* is considered multidrug-resistant, meaning at least three different classes of antibiotics no longer cure *Acinetobacter* infections.
- Approximately 2% of healthcare-associated infections reported to CDC's National Healthcare Safety Network are caused by *Acinetobacter*, but the proportion is higher among critically ill patients on mechanical ventilators (about 7%).

PUBLIC HEALTH THREAT

An estimated 12,000 healthcare-associated *Acinetobacter* infections occur in the United States each year. Nearly 7,000 (or 63%) of these are multidrug-resistant, and about 500 deaths are attributed to these infections.

	Percentage of all *Acinetobacter* healthcare-associated infections that are multidrug-resistant	Estimated number of infections	Estimated number of deaths attributed
Multidrug-resistant *Acinetobacter*	63%	7,300	500

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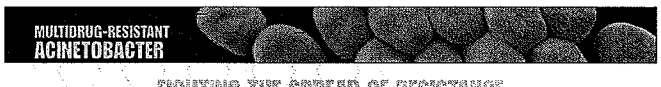


FIGHTING THE SPREAD OF RESISTANCE

WHAT CDC IS DOING

- Tracking illness and identifying risk factors for drug-resistant infections using two systems, the National Healthcare Safety Network and the Emerging Infections Program.
- Providing outbreak support such as staff expertise, prevention guidelines, tools, and lab assistance, to states and facilities.
- Developing tests and prevention recommendations to control drug-resistant infections.
- Helping medical facilities improve antibiotic prescribing practices.

WHAT YOU CAN DO

States and Communities Can:

- Know resistance trends in your region.
- Coordinate local and regional infection tracking and control efforts.
- Require facilities to alert each other when transferring patients with any infection.

Healthcare CEOs, Medical Officers, and other Healthcare Facility Leaders Can:

- Require and strictly enforce CDC guidance for infection detection, prevention, tracking, and reporting.
- Make sure your lab can accurately identify infections and alert clinical and infection prevention staff when these bacteria are present.
- Know infection and resistance trends in your facility and in the facilities around you.
- When transferring a patient, require staff to notify the other facility about all infections.
- Join or start regional infection prevention efforts.
- Promote wise antibiotic use.

Healthcare Providers Can:

- Know the type of drug-resistant infections that are present in your facility and patients.
  - Request immediate alerts when the lab identifies drug-resistant infections in your patients.
  - Alert the other facility when you transfer a patient with a drug-resistant infection.
- Protect patients from drug-resistant infections.
  - Follow relevant guidelines and precautions at every patient encounter.
  - Prescribe antibiotics wisely.
  - Remove temporary medical devices such as catheters and ventilators as soon as no longer needed.

Patients and Their Loved Ones Can:

- Ask everyone including doctors, nurses, other medical staff, and visitors, to wash their hands before touching the patient.
- Take antibiotics exactly as prescribed.

ONLINE RESOURCES

Acinetobacter in Healthcare Settings
http://www.cdc.gov/HAI/organisms/acinetobacter.html

Healthcare-associated Infections, Guidelines and Recommendations
http://www.cdc.gov/HAI/prevent/prevent_pubs.html

DRUG-RESISTANT CAMPYLOBACTER

THREAT LEVEL: SERIOUS

310,000 drug-resistant Campylobacter infections per year

1,300,000 Campylobacter infections per year

13,000 hospitalizations

120 deaths

Campylobacter usually causes diarrhea (often bloody), fever, and abdominal cramps, and sometimes causes serious complications such as temporary paralysis.

RESISTANCE OF CONCERN

Physicians rely on drugs like ciprofloxacin and azithromycin for treating patients with severe disease. Resistant infections sometimes last longer. *Campylobacter* is showing resistance to:

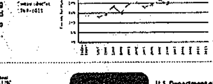
- ciprofloxacin
- azithromycin

PUBLIC HEALTH THREAT

Campylobacter is estimated to cause approximately 1.3 million infections, 13,000 hospitalizations, and 120 deaths each year in the United States. CDC is seeing resistance to ciprofloxacin in almost 25% of *Campylobacter* tested and resistance to azithromycin in about 2%. Costs are expected to be higher for resistant infections because antibiotic-resistant *Campylobacter* infections sometimes last longer.

	Percentage of all Campylobacter*	Estimated number of illnesses per year	Estimated illnesses per 100,000 U.S. population	Estimated number of deaths per year
Resistance to ciprofloxacin	23%	310,000	102.3	28
Resistance to azithromycin	2%	22,000	7.4	<5
Resistance to azithromycin or ciprofloxacin	24%	310,000	107.9	28

Campylobacter drug resistance increased from 13% in 1997 to almost 25% in 2011.



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DRUG-RESISTANT CAMPYLOBACTER

FIGHTING THE SPREAD OF RESISTANCE

Campylobacter spreads from animals to people through contaminated food, particularly raw or undercooked chicken and unpasteurized milk. Infections may also be acquired through contact with animals and by drinking contaminated water. Antibiotic use in food animals can result in resistant *Campylobacter* that can spread to humans. Resistant *Campylobacter* are common in many countries and cause illness in travelers. Key measures to prevent resistant infections include:

- Avoiding inappropriate antibiotic use in food animals.
- Tracking antibiotic use in different types of food animals.
- Stopping spread of *Campylobacter* among animals on farms.
- Improving food production and processing to reduce contamination.
- Educating consumers and food workers about safe food handling practices.

WHAT CDC IS DOING

- Tracking changes in antibiotic resistance through ongoing surveillance.
- Promoting initiatives that measure and improve antibiotic use in food animals.
- Determining foods responsible for outbreaks of *Campylobacter* infections.
- Supporting and improving local, state, and federal public health surveillance.
- Guiding prevention efforts by estimating how much illness occurs and identifying the sources of infection.
- Educating people about how to avoid *Campylobacter* infections.

WHAT YOU CAN DO

- **Clean.** Wash hands, cutting boards, utensils, sinks, and countertops.
- **Separate.** Keep raw meat, poultry, and seafood separate from ready-to-eat foods.
- **Cook.** Use a food thermometer to ensure that foods are cooked to a safe internal temperature.
- **Chill.** Keep your refrigerator below 40°F and refrigerate food that will spoil.
- Avoid drinking raw milk and untreated water.
- Report suspected illness from food to your local health department.
- Don't prepare food for others if you have diarrhea or vomiting.
- Be especially careful preparing food for children, pregnant women, those in poor health, and older adults.
- Consume safe food and water when traveling abroad.

ONLINE RESOURCES

National Antimicrobial Resistance Monitoring System
http://www.cdc.gov/narms

***Campylobacter* Information**
http://www.cdc.gov/nczved/divisions/dfbmd/diseases/campylobacter/

Traveler's Health
http://wwwnc.cdc.gov/travel/yellowbook/2012/chapter-2-the-pre-travel-consultation/travelers-diarrhea.htm

Vital Signs, June 2011: Making Food Safer to Eat
http://www.cdc.gov/VitalSigns/FoodSafety/

CS239559-B

FLUCONAZOLE-RESISTANT CANDIDA

THREAT LEVEL: SERIOUS

3,400 fluconazole-resistant Candida infections

220 deaths

46,000 Candida infections per year

Candidiasis is a fungal infection caused by yeasts of the genus *Candida*. There are more than 20 species of *Candida* yeasts that can cause infection in humans, the most common of which is *Candida albicans*. *Candida* yeasts normally live on the skin and mucous membranes without causing infection. However, overgrowth of these microorganisms can cause symptoms to develop. Symptoms of candidiasis vary depending on the area of the body that is infected.

Candida is the fourth most common cause of healthcare-associated bloodstream infections in the United States. In some hospitals it is the most common cause. These infections tend to occur in the sickest of patients.

RESISTANCE OF CONCERN

- Some *Candida* strains are increasingly resistant to first-line and second-line antifungal treatment agents. Recent data demonstrate a marked shift among infections towards *Candida* species with increased resistance to antifungal drugs including azoles and echinocandins.
- CDC conducts multicenter surveillance for antifungal resistance in the United States, candidal infections, their economic impact, and possible areas where prevention and control strategies can be focused.

PUBLIC HEALTH THREAT

An estimated 46,000 healthcare-associated *Candida* infections occur among hospitalized patients in the United States each year. Roughly 30% of patients with bloodstream infections (candidemia) with drug-resistant *Candida* die during their hospitalization. CDC estimates that each case of *Candida* infection results in 3–13 days of additional hospitalization, and a total of $6,000–$29,000 in direct healthcare costs. Based on these estimates, we calculate resistant *Candida* infections may add millions of dollars in excess costs to U.S. healthcare expenditures each year.

	Percentage of Candida bloodstream isolates testing resistant	Estimated number of infections per year	Estimated number of deaths
Fluconazole-resistant Candida species	7%	3,400	220

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FLUCONAZOLE-RESISTANT CANDIDA

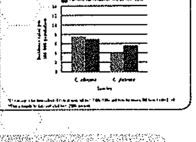
FIGHTING THE SPREAD OF RESISTANCE

Prevention strategies for candidemia are not well defined. Most infections are thought to be caused by *Candida* that the patient carries on his or her own body. Therapy to prevent infections (antifungal prophylaxis) may be appropriate for some groups at high risk of developing *Candida* bloodstream infection, such as low-birth-weight infants. CDC recommendations for catheter care and handwashing can be helpful in reducing transmission in healthcare institutions.

WHAT CDC IS DOING

Prevention of significant morbidity and mortality from candidemia remains a challenge. Although antifungal prophylaxis has been shown to be effective in selected patient populations, there is still debate on the application of risk prevention tools and other prevention strategies. There is a continued need for surveillance of candidemia to develop and evaluate prevention strategies and to monitor for changes in incidence and resistance.

There is increasing incidence of *Candida* infections due to azole- and echinocandin-resistant strains.



ONLINE RESOURCES

CDC's candidiasis website
http://www.cdc.gov/fungal/candidiasis/

CS239559-B

EXTENDED SPECTRUM β-LACTAMASE (ESBL) PRODUCING ENTEROBACTERIACEAE

THREAT LEVEL: SERIOUS

26,000 drug-resistant infections

1,700 deaths

140,000 Enterobacteriaceae infections per year

$40,000 in excess medical costs per each infection

Extended-spectrum β-lactamase is an enzyme that allows bacteria to become resistant to a wide variety of penicillins and cephalosporins. Bacteria that contain this enzyme are known as ESBLs or ESBL-producing bacteria. ESBL-producing Enterobacteriaceae are resistant to strong antibiotics including extended spectrum cephalosporins.

RESISTANCE OF CONCERN

Some Enterobacteriaceae are resistant to nearly all:

- penicillins
- cephalosporins

In these cases, the remaining treatment option is an antibiotic from the carbapenem family. These are drugs of last resort, and use of them is also contributing to resistance (see CRE fact sheet).

- Nearly 26,000 (or 19%) healthcare-associated Enterobacteriaceae infections are caused by ESBL-producing Enterobacteriaceae.
- Patients with bloodstream infections caused by ESBL-producing Enterobacteriaceae are about 57% more likely to die than those with bloodstream infections caused by a non ESBL-producing strain.

PUBLIC HEALTH THREAT

An estimated 140,000 healthcare-associated Enterobacteriaceae infections occur in the United States each year. CDC estimates that bloodstream infections caused by ESBL-containing Enterobacteriaceae result in upwards of $40,000 in excess hospital charges per occurrence. Approximately 26,000 infections and 1,700 deaths are attributable to ESBLs.

	Percentage of Enterobacteriaceae healthcare-associated infections resistant to extended spectrum cephalosporins	Estimated number of infections	Estimated number of deaths attributed
ESBL-producing Klebsiella spp.	23%	17,000	1,100
ESBL-producing E. coli	14%	9,000	600
Total		26,000	1,700

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EXTENDED SPECTRUM β-LACTAMASE (ESBL) PRODUCING ENTEROBACTERIACEAE

FIGHTING THE SPREAD OF RESISTANCE

WHAT CDC IS DOING

- Tracking illness and identifying risk factors for drug-resistant infections using two systems, the National Healthcare Safety Network and the Emerging Infections Program.
- Providing outbreak support, such as staff expertise, prevention guidelines, tools, and lab assistance, to states and facilities.
- Developing tests and prevention recommendations to control drug-resistant infections.
- Helping medical facilities improve antibiotic prescribing practices.

WHAT YOU CAN DO

States and Communities Can:

- Know resistance trends in your region.
- Coordinate local and regional infection tracking and control efforts.
- Require facilities to alert each other when transferring patients with any infection.

Health Care CEOs, Medical Officers, and Other Healthcare Facility Leaders Can:

- Require and strictly enforce CDC guidance for infection detection, prevention, tracking, and reporting.
- Make sure your lab can accurately identify infections and alert clinical and infection prevention staff when these bacteria are present.
- Know infection and resistance trends in your facility and in the facilities around you.
- When transferring a patient, require staff to notify the other facility about all infections.
- Join or start regional infection prevention efforts.
- Promote wise antibiotic use.

Healthcare Providers Can:

- Know when and what types of drug-resistant infections are present in your facility and patients.
- Request immediate alerts when the lab identifies drug-resistant infections in your patients.
- Alert the other facility when you transfer a patient with a drug-resistant infection.
- Protect patients from drug-resistant infections.
- Follow relevant guidelines and precautions at every patient encounter.
- Prescribe antibiotics wisely.
- Remove temporary medical devices such as catheters and ventilators as soon as no longer needed.

Patients and Their Loved Ones Can:

- Ask everyone including doctors, nurses, other medical staff, and visitors, to wash their hands before touching the patient.
- Take antibiotics only and exactly as prescribed.

ONLINE RESOURCES

CDC's Healthcare-associated Infections (HAI) website
www.cdc.gov/hai

Healthcare-associated Infections (HAIs), Guidelines and Recommendations
www.cdc.gov/hicpac/pubs.html

CS239559-B

Enterococci cause a range of illnesses, mostly among patients receiving healthcare, but include bloodstream infections, surgical site infections, and urinary tract infections.

RESISTANCE OF CONCERN

- *Enterococcus* often cause infections among very sick patients in hospitals and other healthcare settings.
- Some *Enterococcus* strains are resistant to vancomycin, an antibiotic of last resort, leaving few or no treatment options.
- About 20,000 (or 30%) of *Enterococcus* healthcare-associated infections are vancomycin resistant.

PUBLIC HEALTH THREAT

An estimated 66,000 healthcare-associated *Enterococcus* infections occur in the United States each year. The proportion of infections that occur with a vancomycin resistant strain differs by the species of *Enterococcus*; overall 20,000 vancomycin-resistant infections occurred among hospitalized patients each year, with approximately 1,300 deaths attributed to these infections.

	Percent of all *Enterococcus* healthcare-associated infections resistant to vancomycin	Estimated number of infections	Estimated number of deaths attributed
Vancomycin-resistant *Enterococcus faecium*	77%	10,000	450
Vancomycin-resistant *Enterococcus faecalis*	9%	1,100	200
Vancomycin-resistant *Enterococcus* (species not determined)	40%	5,400	650
Totals		20,000	1,300

CDC
U.S. Department of Health and Human Services
Centers for Disease Control and Prevention

FIGHTING THE SPREAD OF RESISTANCE

WHAT CDC IS DOING

- Tracking illness and identifying risk factors for drug-resistant infections using two systems, the National Healthcare Safety Network and the Emerging Infections Program.
- Providing outbreak support such as staff expertise, prevention guidelines, tools, and lab assistance, to states and facilities.
- Developing tests and prevention recommendations to control drug-resistant infections.
- Helping medical facilities improve antibiotic prescribing practices.

WHAT YOU CAN DO

States and Communities can:

- Know resistance trends in your region.
- Coordinate local and regional infection tracking and control efforts.
- Require facilities to alert each other when transferring patients with any infection.

Healthcare CEOs, Medical Officers, and other Healthcare Facility Leaders can:

- Require and strictly enforce CDC guidance for infection detection, prevention, tracking, and reporting.
- Make sure your lab can accurately identify infections and alert clinical and infection prevention staff when these germs are present.
- Know infection and resistance trends in your facility and in the facilities around you.
- When transferring a patient, require staff to notify the other facility about all infections.
- Join or start regional infection prevention efforts.
- Promote wise antibiotic use.

Doctors and Nurses can:

- Know when and what types of drug-resistant infections are present in your facility and patients. Request immediate alerts when the lab identifies drug-resistant infections in your patients.
- Alert the other facility when you transfer a patient with a drug-resistant infection.
- Protect patients from drug-resistant infections.
- Follow relevant guidelines and precautions at every patient encounter.
- Prescribe antibiotics wisely.
- Remove temporary medical devices such as catheters and ventilators as soon as no longer needed.

Patients and their loved ones can:

- Ask everyone including doctors, nurses, other medical staff, and visitors, to wash their hands before touching the patient.
- Take antibiotics only and exactly as prescribed.

ONLINE RESOURCES

Vancomycin-resistant Enterococci (VRE) in Healthcare Settings
http://www.cdc.gov/HAI/organisms/vre/vre.html

Healthcare-associated Infections (HAIs) Guidelines and Recommendations
www.cdc.gov/hicpac/pubs.html

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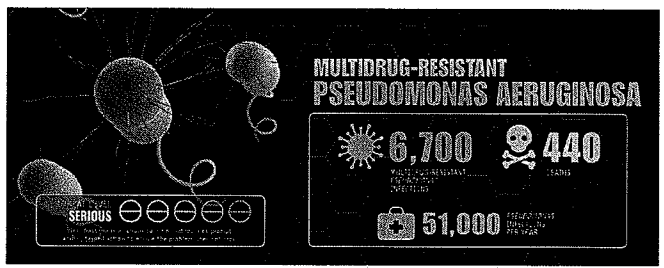

Pseudomonas aeruginosa is a common cause of healthcare-associated infections including pneumonia, bloodstream infections, urinary tract infections, and surgical site infections.

RESISTANCE OF CONCERN

- Some strains of *Pseudomonas aeruginosa* have been found to be resistant to nearly all or all antibiotics including aminoglycosides, cephalosporins, fluoroquinolones, and carbapenems.
- Approximately 8% of all healthcare-associated infections reported to CDC's National Healthcare Safety Network are caused by *Pseudomonas aeruginosa*.
- About 13% of severe healthcare-associated infections caused by *Pseudomonas aeruginosa* are multidrug resistant, meaning several classes of antibiotics no longer cure these infections.

PUBLIC HEALTH THREAT

An estimated 51,000 healthcare-associated *Pseudomonas aeruginosa* infections occur in the United States each year. More than 6,000 (or 13%) of these are multidrug-resistant, with roughly 400 deaths per year attributed to these infections.

	Percentage of all *Pseudomonas aeruginosa* healthcare-associated infections that are multidrug-resistant	Estimated number of infections	Estimated number of deaths attributed
Multi-drug resistant *Pseudomonas aeruginosa*	13%	6,700	440

CDC
U.S. Department of Health and Human Services
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FIGHTING THE SPREAD OF RESISTANCE

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WHAT YOU CAN DO

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Health Care CEOs, Medical Officers, and Other Healthcare Facility Leaders Can:

- Require and strictly enforce CDC guidance for infection detection, prevention, tracking, and reporting.
- Make sure your lab can accurately identify infections and alert clinical and infection prevention staff when these bacteria are present.
- Know infection and resistance trends in your facility and in the facilities around you.
- When transferring a patient, require staff to notify the other facility about all infections.
- Join or start regional infection prevention efforts.
- Promote wise antibiotic use.

Healthcare Providers Can:

- Know when and what types of drug-resistant infections that are present in your facility and patients.
- Request immediate alerts when the lab identifies drug-resistant infections in your patients.
- Alert the other facility when you transfer a patient with a drug-resistant infection.
- Protect patients from drug-resistant infections.
- Follow relevant guidelines and precautions at every patient encounter.
- Prescribe antibiotics wisely.
- Remove temporary medical devices such as catheters and ventilators as soon as no longer needed.

Patients and Their Loved Ones Can:

- Ask everyone including doctors, nurses, other medical staff, and visitors, to wash their hands before touching the patient.
- Take antibiotics only and exactly as prescribed.

ONLINE RESOURCES

Healthcare-associated Infections (HAI)
www.cdc.gov/hai

Healthcare-associated Infections (HAIs), Guidelines and Recommendations
www.cdc.gov/hicpac/pubs.html

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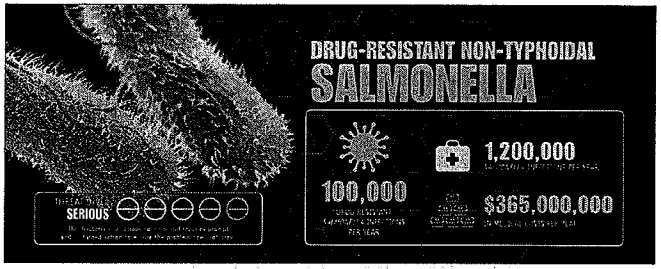


Non-typhoidal *Salmonella* (serotypes other than Typhi, Paratyphi A, Paratyphi B, and Paratyphi C) usually causes diarrhea (sometimes bloody), fever, and abdominal cramps. Some infections spread to the blood and can have life-threatening complications.

RESISTANCE OF CONCERN

Physicians rely on drugs, such as ceftriaxone and ciprofloxacin, for treating patients with complicated *Salmonella* infections. Resistant infections are more severe and have higher hospitalization rates. Non-typhoidal *Salmonella* is showing resistance to:

- ceftriaxone
- ciprofloxacin
- multiple classes of drugs

	Percentage of all non-typhoidal *Salmonella**	Estimated number of illnesses per year	Estimated illnesses per 100,000 U.S. population	Estimated number of deaths per year
Ceftriaxone resistance	7%	14,000	17.5	17
Ciprofloxacin resistance or partial resistance	5%	11,000	13.8	12
Resistance to 5 or more antibiotic classes	6%	14,000	21.3	24
Any resistance pattern shown	9%	100,000	76.1	59

* Year range: 2004–07

PUBLIC HEALTH THREAT

Non-typhoidal *Salmonella* causes approximately 1.2 million illnesses, 23,000 hospitalizations, and 450 deaths each year in the United States. Direct medical costs are estimated to be $365 million annually. CDC is seeing resistance to ceftriaxone in about 1% of non-typhoidal *Salmonella* tested, and some level of resistance to ciprofloxacin in about 3%. About 5% of non-typhoidal *Salmonella* tested by CDC are resistant to five or more types of drugs. Costs are expected to be higher for resistant than for susceptible infections because resistant infections are more severe, these patients are more likely to be hospitalized, and treatment is less effective.

CDC
U.S. Department of Health and Human Services
Centers for Disease Control and Prevention

FIGHTING THE SPREAD OF RESISTANCE

Salmonella spreads from animals to people mostly through food. Antibiotic use in food animals can result in resistant *Salmonella*, and people get sick when they eat foods contaminated with *Salmonella*. Key measures to prevent resistant infections include:

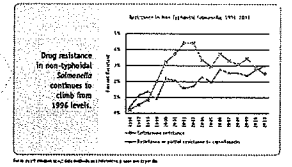
- Avoiding inappropriate antibiotic use in food animals.
- Tracking antibiotic use in different types of food animals.
- Stopping spread of *Salmonella* among animals on farms.
- Improving food production and processing to reduce contamination.
- Educating consumers and food workers about safe food handling practices.

WHAT CDC IS DOING

- Tracking changes in antibiotic resistance through ongoing surveillance.
- Promoting initiatives that measure and improve antibiotic use in food animals.
- Determining foods responsible for outbreaks of *Salmonella* infections.
- Supporting and improving local, state, and federal public health surveillance.
- Guiding prevention efforts by estimating how much illness occurs and identifying the sources of infection.
- Educating people about how to avoid *Salmonella* infections.

WHAT YOU CAN DO

- **Clean.** Wash hands, cutting boards, utensils, and countertops.
- **Separate.** Keep raw meat, poultry, and seafood separate from ready-to-eat foods.
- **Cook.** Use a food thermometer to ensure that foods are cooked to a safe internal temperature.
- **Chill.** Keep your refrigerator below 40°F and refrigerate food that will spoil.
- Avoid drinking raw milk.
- Report suspected illness from food to your local health department.
- Don't prepare food for others if you have diarrhea or vomiting.
- Be especially careful preparing food for children, pregnant women, those in poor health, and older adults.



ONLINE RESOURCES

National Antimicrobial Resistance Monitoring System
http://www.cdc.gov/narms

Salmonella
http://www.cdc.gov/salmonella/index.html

Vital Signs, June 2011: Making Food Safer to Eat
http://www.cdc.gov/VitalSigns/FoodSafety/?pkw=vs_fs009

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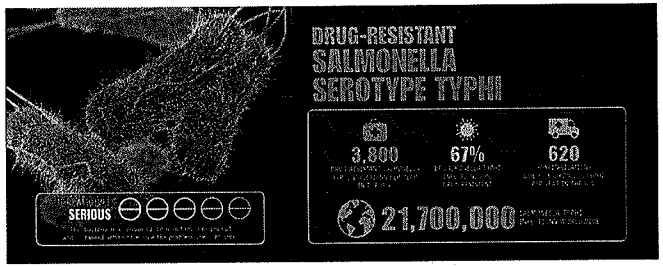


DRUG-RESISTANT SALMONELLA SEROTYPE TYPHI

3,800

67%

620

SERIOUS

21,700,000

Salmonella serotype Typhi causes typhoid fever, a potentially life-threatening disease. People with typhoid fever usually have a high fever, abdominal pain, and headache. Typhoid fever can lead to bowel perforation, shock, and death.

RESISTANCE OF CONCERN

Physicians rely on drugs such as ceftriaxone, azithromycin, and ciprofloxacin for treating patients with typhoid fever. *Salmonella* serotype Typhi is showing resistance to:

- ceftriaxone
- azithromycin
- ciprofloxacin (resistance is so common that it cannot be routinely used)

PUBLIC HEALTH THREAT

Salmonella Typhi causes approximately 21.7 million illnesses worldwide. In the United States, it causes approximately 5,700 illnesses and 620 hospitalizations each year. Most illnesses occur in people who travel to some parts of the developing world where the disease is common. Travel-associated infections are more likely to be antibiotic resistant. CDC is seeing some level of resistance to ciprofloxacin in two-thirds of *Salmonella* Typhi tested. CDC has not yet seen resistance to ceftriaxone or azithromycin in the United States, but this has been seen in other parts of the world. Resistant infections are likely to cost more than susceptible infections because illness may last longer. Deaths in the United States are rare now, but before there were antibiotics, 10% to 20% of patients died

	Percentage of all *Salmonella* Typhi*	Estimated number of illnesses per year	Estimated illnesses per 100,000 U.S. population	Estimated number of deaths per year
Resistance or partial resistance to ciprofloxacin	63%	3,500	1.1	<5

U.S. Department of Health and Human Services
Centers for Disease Control and Prevention

DRUG-RESISTANT SALMONELLA SEROTYPE TYPHI

FIGHTING THE SPREAD OF RESISTANCE

Salmonella serotype Typhi spreads from one person to another through food or water contaminated with feces. Typhoid fever is common in developing countries lacking safe water and adequate sanitation. Most U.S. cases are associated with travel to these countries. Sometimes the source is a carrier who is no longer ill, but is still infected. Key measures to prevent the spread of resistant infections include:

- Vaccinating people traveling to countries where typhoid fever is common.
- Consuming safe food and water when traveling in these countries.
- Improving access to clean water and sanitation for people living in these countries.
- Reporting changes in resistance to people who diagnose and treat patients with typhoid fever.
- Investigating cases of typhoid fever to identify and treat carriers.

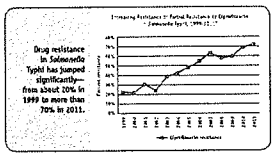
WHAT CDC IS DOING

- Providing recommendations for travelers on vaccination, safe food, and clean water.
- Tracking and reporting changes in antibiotic resistance through ongoing surveillance.
- Determining settings and high-risk groups for resistant infections in the U.S. and other countries.
- Educating healthcare providers about specific resistance problems and the need to vaccinate travelers.
- Promoting safer water and sanitation in countries where typhoid fever is common.
- Building public health capacity in other countries to diagnose, track, and control typhoid fever.

WHAT YOU CAN DO

If you're traveling to a country where typhoid fever is common:

- Get vaccinated against typhoid fever before you depart.
- Choose foods and drinks carefully while traveling even if you are vaccinated. That means: boil it, cook it, peel it, or forget it.
  - Boil or treat water yourself.
  - Eat foods that are hot and steaming.
  - Avoid raw fruits and vegetables unless you peel them yourself.
  - Avoid cold food and beverages; from street vendors.
- If you get sick with high fever and a headache during or after travel, seek medical care at once and tell the healthcare provider where you have traveled.



ONLINE RESOURCES

National Antimicrobial Resistance Monitoring System
http://www.cdc.gov/narms

Typhoid Fever
http://www.cdc.gov/nczved/dfbmd/disease/typhoid_fever/

Traveler's Health "Traveler's Diarrhea"
http://wwwnc.cdc.gov/travel/yellowbook/2012/chapter-2-the-pre-travel-consultation/travelers-diarrhea.htm

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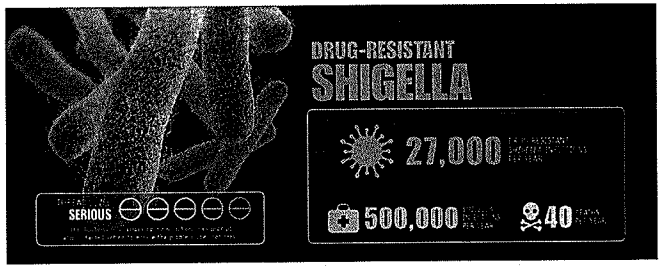

DRUG-RESISTANT SHIGELLA

27,000

500,000

40

SERIOUS

Shigella usually causes diarrhea (sometimes bloody), fever, and abdominal pain. Sometimes it causes serious complications such as reactive arthritis. High-risk groups include young children, people with inadequate handwashing and hygiene habits, and men who have sex with men.

RESISTANCE OF CONCERN

Resistance to traditional first-line drugs such as ampicillin and trimethoprim-sulfamethoxazole has become so high that physicians must now rely on alternative drugs like ciprofloxacin and azithromycin to treat infections. Resistant infections can last longer than infections with susceptible bacteria (bacteria that can be treated effectively with antibiotics). *Shigella* is showing resistance to:

- ciprofloxacin
- azithromycin

	Percentage of all *Shigella**	Estimated number of illnesses per year	Estimated illnesses per 100,000 U.S. population	Estimated number of deaths per year
Ciprofloxacin resistance	2%	12,000	4.0	<5
Azithromycin resistance	2%	15,000	4.5	<5
Azithromycin or ciprofloxacin resistance	6%	27,000	9.0	<5

PUBLIC HEALTH THREAT

Shigella causes approximately 500,000 diarrheal illnesses, 5,500 hospitalizations, and 40 deaths each year in the United States. CDC is seeing resistance to ciprofloxacin in 1.4% of the *Shigella* cases tested and resistance to azithromycin in approximately 3%. Because initial treatment can fail, costs are expected to be higher for resistant infections.

U.S. Department of Health and Human Services
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DRUG-RESISTANT SHIGELLA

FIGHTING THE SPREAD OF RESISTANCE

Shigella spreads from one person to another in feces through direct contact, or through contaminated surfaces, food, or water. Antibiotic use in humans can result in resistant *Shigella* and hasten further spread. Key measures to prevent resistant infections include:

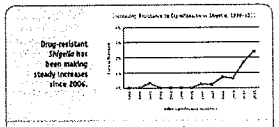
- Promoting thorough and frequent hand washing with soap, especially in child care centers, elementary schools, restaurants, and homes with small children.
- Using antibiotics to treat more severe *Shigella* infections and managing milder infections with fluids and rest.
- Reporting changes in resistance to healthcare providers.
- Detecting and controlling outbreaks of *Shigella* infections.
- Educating consumers and food workers about safe food handling practices.

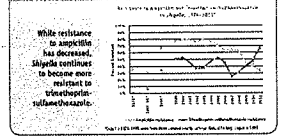
WHAT CDC IS DOING

- Tracking changes in antibiotic resistance through ongoing surveillance.
- Determining settings and high-risk groups for outbreaks of resistant infections.
- Educating healthcare providers about specific resistance problems.
- Promoting prudent antibiotic use and handwashing.

WHAT YOU CAN DO

- Don't prepare food for others if you have diarrhea or vomiting.
- Keep children who have diarrhea and who are in diapers out of child care settings and swimming pools.
- Avoid sexual behavior that is likely to transmit infection when you have diarrhea.
- Consume safe food and water when traveling abroad.





ONLINE RESOURCES

National Antimicrobial Resistance Monitoring System
http://www.cdc.gov/narms

Shigellosis
http://www.cdc.gov/nczved/divisions/dfbmd/diseases/shigellosis/

Traveler's Health "Traveler's Diarrhea"
http://wwwnc.cdc.gov/travel/yellowbook/2012/chapter-2-the-pre-travel-consultation/travelers-diarrhea.htm

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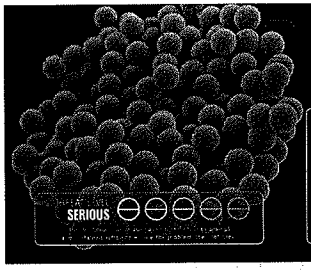


METHICILLIN-RESISTANT STAPHYLOCOCCUS AUREUS (MRSA)

80,461

11,285

SERIOUS

HEALTHCARE-ASSOCIATED INFECTIONS

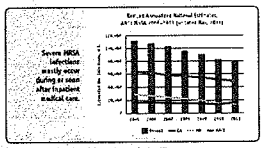
Methicillin-resistant *Staphylococcus aureus* (MRSA) causes a range of illnesses, from skin and wound infections to pneumonia and bloodstream infections that can cause sepsis and death. Staph bacteria, including MRSA, are one of the most common causes of healthcare-associated infections.

RESISTANCE OF CONCERN

Resistance to methicillin and related antibiotics (e.g., nafcillin, oxacillin) and resistance to cephalosporins are of concern.

PUBLIC HEALTH THREAT

CDC estimates 80,461 invasive MRSA infections and 11,285 related deaths occurred in 2011. An unknown but much higher number of less severe infections occurred in both the community and in healthcare settings.



U.S. Department of Health and Human Services
Centers for Disease Control and Prevention

METHICILLIN-RESISTANT STAPHYLOCOCCUS AUREUS (MRSA)

FIGHTING THE SPREAD OF RESISTANCE

Although still a common and severe threat to patients, invasive MRSA infections in healthcare settings appear to be declining. Between 2005 and 2011 overall rates of invasive MRSA dropped 31%; the largest declines (54%) were observed among infections occurring during hospitalization. Success began with preventing central-line associated bloodstream infections with MRSA, where rates fell nearly 50% from 1997 to 2007.

During the past decade, rates of MRSA infections have increased rapidly among the general population (people who have not recently received care in a healthcare setting). There is some evidence that these increases are slowing, but they are not following the same downward trends as healthcare-associated MRSA.

WHAT CDC IS DOING

- Tracking illness and identifying risk factors for drug-resistant infections using two systems, the National Healthcare Safety Network and the Emerging Infections Program.
- Providing states and facilities with outbreak support such as staff expertise, prevention guidelines, tools, and lab assistance.
- Developing tests and prevention recommendations to control drug-resistant infections.
- Helping healthcare facilities improve antibiotic prescribing practices.

WHAT YOU CAN DO

States and Communities Can:

- Know resistance trends in your region.
- Coordinate local and regional infection tracking and control efforts.
- Require facilities to alert each other when transferring patients with any infection.

Healthcare CEOs, Medical Officers, and Other Healthcare Facility Leaders Can:

- Require and strictly enforce CDC guidance for infection detection, prevention, tracking, and reporting.
- Make sure your lab can accurately identify infections and alert clinical and infection prevention staff when these bacteria are present.
- Know infection and resistance trends in your facility and in the facilities around you.
- When transferring a patient, require staff to notify the other facility about all infections.
- Join or start regional infection prevention efforts.
- Promote wise antibiotic use.

Healthcare Providers Can:

- Know when and types of drug-resistant infections are present in your facility and patients.
- Request immediate alerts when the lab identifies drug-resistant infections in your patients.
- Alert the other facility when you transfer a patient with a drug-resistant infection.
- Protect patients from drug-resistant infections.
- Follow relevant guidelines and precautions at every patient encounter.
- Prescribe antibiotics wisely.
- Remove temporary medical devices such as catheters and ventilators as soon as no longer needed.

Patients and Their Loved Ones Can:

- Ask everyone, including doctors, nurses, other medical staff, and visitors, to wash their hands before touching the patient.
- Take antibiotics only and exactly as prescribed.

ONLINE RESOURCES

Basics on CDC's MRSA website
www.cdc.gov/hai/mrsa

Prevention Guidelines for MRSA
www.cdc.gov/hicpac/pubs.html

Medscape/CDC Expert Commentaries about MRSA
http://www.medscape.com/partners/cdc/public/cdc-commentary

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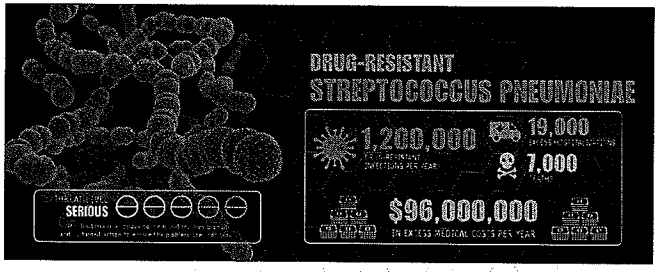


Streptococcus pneumoniae (*S. pneumoniae*, or pneumococcus) is the leading cause of bacterial pneumonia and meningitis in the United States. It also is a major cause of bloodstream infections and ear and sinus infections.

RESISTANCE OF CONCERN

S. pneumoniae has developed resistance to drugs in the penicillin and erythromycin groups. Examples of these drugs include amoxicillin and azithromycin (Zithromax, Z-Pak). *S. pneumoniae* has also developed resistance to less commonly used drugs.

PUBLIC HEALTH THREAT

Pneumococcal disease, whether or not resistant to antibiotics, is a major public health problem. Pneumococcal disease causes 4 million disease episodes and 22,000 deaths annually. Pneumococcal ear infections (otitis media) are the most common type of pneumococcal disease among children, causing 1.5 million infections that often result in antibiotic use. Pneumococcal pneumonia is another important form of pneumococcal disease. Each year, nearly 160,000 children younger than 5 years old see a doctor or are admitted to the hospital with pneumococcal pneumonia. Among adults, over 600,000 seek care for or are hospitalized with pneumococcal pneumonia. Pneumococcal pneumonia accounts for 72% of all direct medical costs for treatment of pneumococcal disease.

In 30% of severe *S. pneumoniae* cases, the bacteria are fully resistant to one or more clinically relevant antibiotics. Resistant infections complicate treatment and can result in almost 1,200,000 illnesses and 7,000 deaths per year. Cases of resistant pneumococcal pneumonia result in about 32,000 additional doctor visits and about 19,000 additional hospitalizations each year. The excess costs associated with these cases are approximately $96 million.

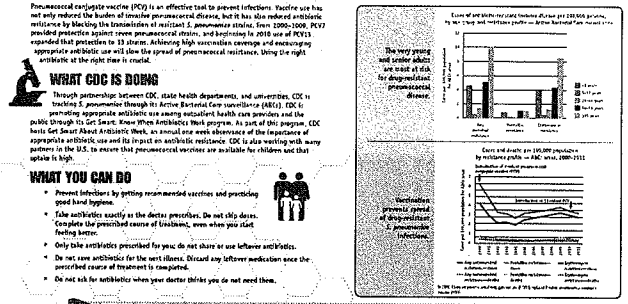
Invasive pneumococcal disease means that bacteria invade parts of the body that are normally sterile, and when this happens, disease is usually severe, causing hospitalization or even death. The majority of cases and deaths occur among adults 50 years or older, with the highest rates among those 65 years or older. Almost everyone who gets invasive pneumococcal disease needs treatment in the hospital.

U.S. Department of Health and Human Services
Centers for Disease Control and Prevention

DRUG-RESISTANT
STREPTOCOCCUS PNEUMONIAE

FIGHTING THE SPREAD OF RESISTANCE

Pneumococcal conjugate vaccine (PCV) is an effective tool to prevent infections. Vaccine use has not only reduced the burden of invasive pneumococcal disease, but it has also reduced antibiotic resistance by blocking the transmission of resistant *S. pneumoniae* strains. From 2000–2009, PCV7 provided protection against seven pneumococcal strains, and beginning in 2010 use of PCV13 expanded that protection to 13 strains. Achieving high vaccination coverage and encouraging appropriate antibiotic use will slow the spread of pneumococcal resistance. Using the right antibiotic at the right time is crucial.



WHAT CDC IS DOING

Through partnerships between CDC, state health departments, and universities, CDC is tracking *S. pneumoniae* through its Active Bacterial Core surveillance (ABCs). CDC is promoting appropriate antibiotic use among outpatient health care providers and the public through its Get Smart: Know When Antibiotics Work program. As part of this program, CDC hosts Get Smart About Antibiotics Week, an annual one week observance of the importance of appropriate antibiotic use and its impact on antibiotic resistance. CDC is also working with many partners in the U.S. to ensure that pneumococcal vaccines are available for children and that uptake is high.

WHAT YOU CAN DO

- Prevent infections by getting recommended vaccines and practicing good hand hygiene.
- Take antibiotics exactly as the doctor prescribes. Do not skip doses. Complete the prescribed course of treatment, even when you start feeling better.
- Only take antibiotics prescribed for you; do not share or use leftover antibiotics.
- Do not save antibiotics for the next illness. Discard any leftover medication once the prescribed course of treatment is completed.
- Do not ask for antibiotics when your doctor thinks you do not need them.

ONLINE RESOURCES

Pneumococcal Disease
www.cdc.gov/pneumococcal

Pneumococcal Vaccine Recommendations
http://www.cdc.gov/vaccines/vpd-vac/pneumo/in-short-adult-him.htm

Get Smart: Know When Antibiotics Work Program
http://www.cdc.gov/getsmart/

Active Bacterial Core surveillance (ABCs)
http://www.cdc.gov/abcs/index.html

Drug-Resistant Streptococcus pneumoniae (DRSP) Surveillance Toolkit
http://www.cdc.gov/abcs/reports-findings/surv-manual.html

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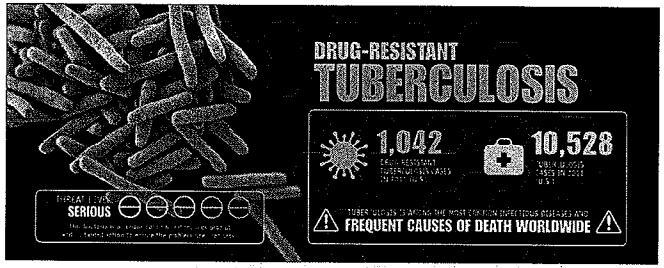


Tuberculosis (TB) is among the most common infectious diseases and a frequent cause of death worldwide. TB is caused by the bacteria *Mycobacterium tuberculosis* (*M. tuberculosis*) and is spread most commonly through the air. *M. tuberculosis* can affect any part of the body, but disease is found most often in the lungs. In most cases, TB is treatable and curable with the available first-line TB drugs; however, in some cases, *M. tuberculosis* can be resistant to one or more of the drugs used to treat it. Drug-resistant TB is more challenging to treat — it can be complex and requires more time and more expensive drugs that often have more side effects. Extensively Drug-Resistant TB (XDR TB) is resistant to most TB drugs; therefore, patients are left with treatment options that are much less effective. The major factors driving TB drug resistance are incomplete or wrong treatment, short drug supply, and lack of new drugs. In the United States most drug-resistant TB is found among persons born outside of the country.

RESISTANCE OF CONCERN

- Resistance to antibiotics used for standard therapy
- Resistance to isoniazid (INH)
- Some TB is multidrug-resistant (MDR), showing resistance to at least INH and rifampicin (RMP), two essential first-line drugs
- Some TB is XDR TB, defined as MDR TB plus resistance to any fluoroquinolone and to any of the three second-line injectable drugs (i.e., amikacin, kanamycin, capreomycin)

	Number of cases	Cases per 100,000 U.S. population	Percent of all TB cases in U.S.
Any first-line resistance	1,042	0.33	10%
INH resistance	760	0.24	7%
MDR TB	122	0.04	1%
XDR TB	6	0.0019	<1%
Deaths caused by antibiotic-resistant TB	50		

PUBLIC HEALTH THREAT

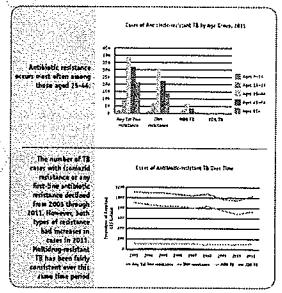
Of a total of 10,528 cases of TB in the United States reported in 2011, antibiotic resistance was identified in 1,042, or 9.90%, of all TB cases.

U.S. Department of Health and Human Services
Centers for Disease Control and Prevention

DRUG-RESISTANT
TUBERCULOSIS

FIGHTING THE SPREAD OF RESISTANCE

Health care providers can help prevent drug-resistant TB by quickly suspecting and diagnosing cases, following recommended treatment guidelines, monitoring patients' response to treatment, and ensuring therapy is completed. Additional drug-resistant TB prevention measures include implementing effective infection control procedures that help limit exposure to known drug-resistant TB patients in settings such as hospitals, prisons, or homeless shelters.



WHAT CDC IS DOING

CDC conducts ongoing surveillance for drug-resistant TB in all 50 states and the District of Columbia using the National Tuberculosis Surveillance System (NTSS). The TB Genotyping Information Management System (TBGIMS), a Web-based system designed to improve access and dissemination of genotyping information nationwide, complements the ongoing surveillance for drug-resistant TB by linking genotyping results to surveillance data. In 2009, CDC implemented the Molecular Detection of Drug Resistance Service (MDDR), a national clinical referral service which provides rapid confirmation of MDR and XDR TB. Molecular drug-resistant testing enhances but does not replace culture or conventional drug-susceptibility testing.

Other CDC activities directed at preventing spread of drug-resistant TB include funding of five TB Regional Training and Medical Consultation Centers (RTMCCs) from 2013–2017. The RTMCCs are regionally assigned to cover all 50 states and the U.S. territories. One of the primary purposes of each RTMCC is to provide medical consultation to TB programs and medical providers, particularly for complex, drug-resistant cases. Additionally, the RTMCCs offer trainings that provide information on diagnosing and treating drug-resistant TB.

Additionally, CDC international activities include studies to improve first and second line antibiotic use in patients with drug-resistant TB.

ONLINE RESOURCES

http://www.cdc.gov/tb/
http://www.cdc.gov/tb/topic/drtb/default.htm
http://www.cdc.gov/tb/publication/factsheets/drtb/mdrtb.htm
http://www.cdc.gov/tb/topic/drtb/mdrtb.htm
http://www.cdc.gov/tb/statistics/reports/2011/default.htm
http://www.cdc.gov/tb/topic/Laboratory/mddr.htm
http://www.aphl.org/aphlprograms/infectious/tuberculosis/Pages/default.aspx
http://www.thecompliancecenter.com/
http://www.who.int/tb/publications/mdr_surveillance/en/index.html

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THREAT LEVEL
CONCERNING
Those patterns use monitoring, and careful interpreting, and prevention action are needed

MICROORGANISMS WITH A THREAT LEVEL OF CONCERNING

Vancomycin-resistant ***Staphylococcus aureus*** **(VRSA)**
Erythromycin-resistant Group A ***Streptococcus***
Clindamycin-resistant Group B ***Streptococcus***

Staphylococcus aureus is a common type of bacteria that is found on the skin. During medical procedures when patients require catheters or ventilators or undergo surgical procedures, *Staphylococcus aureus* can enter the body and cause infections. When *Staphylococcus aureus* becomes resistant to vancomycin, there are few treatment options available because vancomycin-resistant *S. aureus* bacteria identified to date were also resistant to methicillin and other classes of antibiotics.

RESISTANCE OF CONCERN

In rare cases, CDC has identified *Staphylococcus aureus* that is resistant to vancomycin, the antibiotic most frequently used to treat serious *S. aureus* infections.

PUBLIC HEALTH THREAT

A total of 13 cases of vancomycin-resistant *Staphylococcus aureus* (VRSA) have been identified in the United States since 2002.

VRSA infection continues to be a rare occurrence. A few existing factors seem to predispose case patients to VRSA infection, including:

- Prior MRSA and enterococcal infections or colonization
- Underlying conditions (such as chronic skin ulcers and diabetes)
- Previous treatment with vancomycin

	Number of cases	Cases per 100,000 U.S. population	Percentage of all Group A *Streptococcus* cases in U.S.	Number of deaths	Deaths per 100,000 U.S. population
Vancomycin-resistant *Staphylococcus aureus*	13	N/A	N/A	0	N/A

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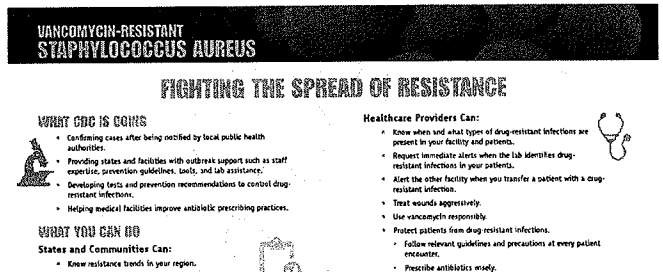

FIGHTING THE SPREAD OF RESISTANCE

WHAT CDC IS DOING

- Confirming cases after being notified by local public health authorities.
- Providing states and facilities with outbreak support such as staff expertise, prevention guidelines, tools, and lab assistance.
- Developing tests and prevention recommendations to control drug-resistant infections.
- Helping medical facilities improve antibiotic prescribing practices.

WHAT YOU CAN DO

States and Communities Can:

- Know resistance trends in your region.
- Coordinate local and regional infection tracking and control efforts.
- Require facilities to alert each other when transferring patients with any infection.

Healthcare CEOs, Medical Officers, and Other Healthcare Facility Leaders Can:

- Require and strictly enforce CDC guidance for infection detection, prevention, tracking, and reporting.
- Make sure your lab can accurately identify infections, and alert clinical and infection prevention staff when these bacteria are present.
- Know infection and resistance trends in your facility and in the facilities around you.
- When transferring a patient, require staff to notify the other facility about all infections.
- Join or start regional infection prevention efforts.
- Promote wise antibiotic use.

Healthcare Providers Can:

- Know when and what types of drug-resistant infections are present in your facility and patients.
- Request immediate alerts when the lab identifies drug-resistant infections in your patients.
- Alert the other facility when you transfer a patient with a drug-resistant infection.
- Treat wounds aggressively.
- Use vancomycin responsibly.
- Protect patients from drug-resistant infections.
  - Follow relevant guidelines and precautions at every patient encounter.
  - Prescribe antibiotics wisely.
  - Remove temporary medical devices such as catheters and ventilators as soon as no longer needed.

Patients and Their Loved Ones Can:

- Ask everyone, including doctors, nurses, other medical staff, and visitors, to wash their hands before touching the patient.
- Take antibiotics only and exactly as prescribed.

ONLINE RESOURCES

Vancomycin-Intermediate/Resistant Staphylococcus (VISA/VRSA) in Healthcare Settings
http://www.cdc.gov/HAI/organisms/visa_vrsa/visa_vrsa.html

Healthcare-associated Infections (HAIs), Guidelines and Recommendations
www.cdc.gov/hicpac/pubs.html

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Group A *Streptococcus* (GAS) causes many illnesses, including pharyngitis (strep throat), streptococcal toxic shock syndrome, necrotizing fasciitis ("flesh-eating" disease), scarlet fever, rheumatic fever, and skin infections such as impetigo.

RESISTANCE OF CONCERN

GAS has developed resistance to clindamycin and a category of drugs called macrolides. Macrolides include erythromycin, azithromycin and clarithromycin. GAS has also developed resistance to a less commonly used drug—tetracycline. Of these, resistance to erythromycin and the other macrolide antibiotics is of the most immediate concern.

PUBLIC HEALTH THREAT

Each year in the United States, erythromycin-resistant, invasive GAS causes 1,300 illnesses and 160 deaths.

GAS is a leading cause of upper respiratory tract infections such as strep throat. There are 1–2.6 million cases of strep throat in the U.S. each year. These bacteria are also the leading cause of necrotizing fasciitis, an invasive disease that can be fatal in 25%–35% of cases. Invasive disease means that bacteria invade parts of the body that are normally sterile. When this happens, disease is usually very severe, causing hospitalization or even death. There is highest risk for invasive disease are the elderly, those with skin lesions, young children, people in group living situations such as nursing homes, and those with underlying medical conditions, such as diabetes.

Penicillin is the recommended first-line treatment for GAS infections. Amoxicillin is a type of penicillin that is often used to treat strep throat. Currently, GAS is not resistant to treatment with penicillin. If resistance to penicillin emerges, it would severely compromise treatment of invasive GAS infections. For people who are allergic to penicillin, two of the alternative antibiotics, azithromycin and clarithromycin, can be used to treat strep throat. In fact, azithromycin is prescribed more commonly than penicillin. Of GAS bacterial samples tested at CDC from 2010 and 2011, 10% were erythromycin-resistant (and therefore resistant to other macrolides such as azithromycin and clarithromycin), while 1.4% were clindamycin-resistant. Increasing resistance to erythromycin will complicate treatment of strep throat, particularly for those who cannot tolerate penicillin.

A more current concern is the increase in bacteria that show the genetic potential for becoming resistant to clindamycin. Clindamycin has a unique role in treatment of severe GAS infections. For severe, life-threatening infections, like necrotizing fasciitis and toxic shock syndrome, a combination of penicillin and clindamycin is recommended for treatment.

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FIGHTING THE SPREAD OF RESISTANCE

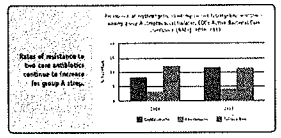
Encouraging appropriate antibiotic use, including using the right antibiotic at the right time, and for the right amount of time, is crucial to preventing the spread of drug-resistant GAS. Doctors should adhere to the recommended antibiotics for treating GAS infections, including using penicillin or amoxicillin whenever possible.

WHAT CDC IS DOING

CDC has collaborated with the Infectious Diseases Society of America to update guidance on diagnosing strep throat and selecting antibiotics to treat it. These guidelines reinforce appropriate use of antibiotics for this common illness. CDC is also promoting appropriate antibiotic use among outpatient healthcare providers and the public through its Get Smart: Know When Antibiotics Work program. As part of this program, CDC hosts Get Smart About Antibiotics Week, an annual one-week observance of the importance of appropriate antibiotic use and its impact on antibiotic resistance. Through partnerships between CDC, state health departments, and universities, CDC is tracking GAS through Active Bacterial Core surveillance (ABCs).

WHAT YOU CAN DO

- Prevent infections by practicing good hand hygiene.
- Take antibiotics exactly as the doctor prescribes. Do not skip doses. Complete the prescribed course of treatment, even when you start feeling better.
- Only take antibiotics prescribed for you. Do not share or use leftover antibiotics.
- Do not save antibiotics for the next illness. Discard any leftover medication once the prescribed course of treatment is completed.
- Do not ask for antibiotics when your doctor thinks you do not need them.



ONLINE RESOURCES

Active Bacterial Core surveillance (ABCs)
http://www.cdc.gov/abcs/index.html

Get Smart: Know When Antibiotics Work Program
http://www.cdc.gov/getsmart/

Group A Strep
http://www.cdc.gov/ncidod/dbmd/diseaseinfo/groupastreptococcal_g.htm

Necrotizing Fasciitis
http://www.cdc.gov/features/necrotizingfasciitis/

Strep Throat
http://www.cdc.gov/features/streptothroat/

Scarlet Fever
http://www.cdc.gov/features/scarletfever/

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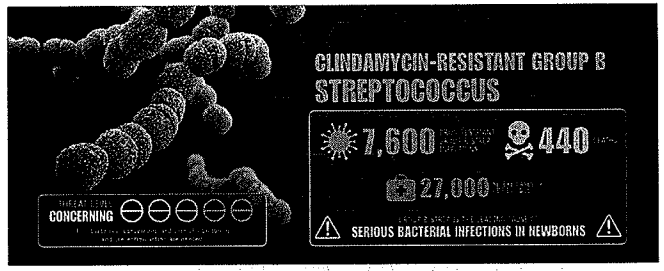


Group B *Streptococcus* (GBS) is a type of bacteria that can cause severe illnesses in people of all ages, ranging from bloodstream infections (sepsis) and pneumonia to meningitis and skin infections.

RESISTANCE OF CONCERN

GBS has developed resistance to clindamycin and erythromycin. GBS that are resistant to erythromycin will also be resistant to azithromycin. Recently, the very first cases with resistance to vancomycin have been detected among adults. These cases are extremely rare and also very concerning since vancomycin is the most commonly used drug for treatment of potentially resistant gram-positive infections in adults. Strains with decreasing responsiveness to treatment with penicillin drugs have been described but remain very rare. Resistance to clindamycin is of the most immediate clinical concern, although the other forms of resistance are worrisome.

PUBLIC HEALTH THREAT

Each year in the United States, clindamycin-resistant Group B Strep causes an estimated 7,600 illnesses and 440 deaths.

In the United States, GBS is the leading cause of serious bacterial infections in newborns, including bloodstream infections, meningitis, and pneumonia. When these GBS infections occur in the first 7 days of life, they are known as early-onset disease. To prevent early-onset disease in newborns, antibiotics are given during labor and delivery to mothers who test positive for GBS (tested at 35–37 weeks of pregnancy with a vaginal/rectal swab) and to those who have other risk factors for passing GBS to their newborns.

GBS also is one of the most common causes of meningitis and other severe infections in infants from 7 days to 3 months old (late-onset disease). GBS is also an increasing cause of bloodstream infections, pneumonia, skin and soft tissue infections, and bone and joint infections in adults, especially among pregnant women, the elderly, and people with certain medical conditions such as diabetes.

CDC estimates from preliminary data that 27,000 cases of severe GBS disease, such as blood infections or meningitis, occurred in 2011, causing 1,575 deaths. Forty-nine percent of GBS isolates (samples) tested were erythromycin-resistant, and 26% were clindamycin-resistant. Although the incidence of early-onset disease has been decreasing, the proportion of GBS infections resistant to erythromycin and clindamycin has increased steadily since 2000.

Resistance to the penicillin drug class could threaten the success of strategies to prevent early-onset disease and lead to treatment failure, since penicillin drugs are the top choice for treating GBS. Additionally, the increasing resistance to recommended second-line drugs, clindamycin and erythromycin, limits prevention and treatment for patients with GBS who are allergic to penicillin.

U.S. Department of Health and Human Services
Centers for Disease Control and Prevention

FIGHTING THE SPREAD OF RESISTANCE

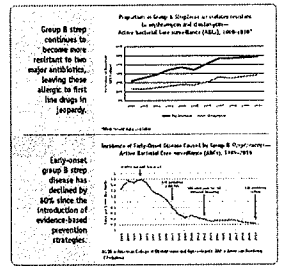
Doctors should test all pregnant women for GBS at 35–37 weeks of pregnancy and adhere to the recommended antibiotics during labor and delivery for prevention of early-onset disease. Broad efforts to prevent appropriate use of antibiotics in outpatient and inpatient settings will also help minimize the spread of resistance among GBS bacteria.

WHAT CDC IS DOING

CDC, in collaboration with professional associations, has developed evidence-based Guidelines for the Prevention of Perinatal Group B Streptococcal Disease. These guidelines discuss diagnosis and management, and recommendations are provided regarding antibiotic choices and dosing. They also support GBS screening for all pregnant women at 35–37 weeks of pregnancy and use of antibiotics during labor and delivery to prevent newborn infection. Through partnerships between CDC, state health departments, and universities, CDC is tracking GBS through its Active Bacterial Core surveillance (ABCs). This program monitors antibiotic resistance and has contributed to the detection of the very first cases in the U.S. of vancomycin-resistant GBS, as well as tracking of susceptibility trends of other antibiotics important for treatment of GBS. CDC is promoting appropriate antibiotic use among outpatient health care providers and the public through its Get Smart: Know When Antibiotics Work program.

WHAT YOU CAN DO

- Pregnant women should talk to their doctor or nurse about their GBS status and let them know if any medication allergies during a checkup.
- When women get to the hospital or birthing center for delivery, they should remind their doctor or nurse if they have GBS and if they are allergic to any medications.
- Practice appropriate antibiotic use whenever you see a doctor or are prescribed an antibiotic for any condition:
  - Take antibiotics exactly as the doctor prescribes. Do not skip doses. Complete the prescribed course of treatment, even when you start feeling better.
  - Only take antibiotics prescribed for you. Do not share or use leftover antibiotics.
  - Do not save antibiotics for the next illness. Discard any leftover medication once the prescribed course of treatment is completed.
  - Do not ask for antibiotics when your doctor thinks you do not need them.



ONLINE RESOURCES

Group B Strep (GBS)
http://www.cdc.gov/groupbstrep/about/index.html

Active Bacterial Core surveillance (ABCs)
http://www.cdc.gov/abcs/index.html

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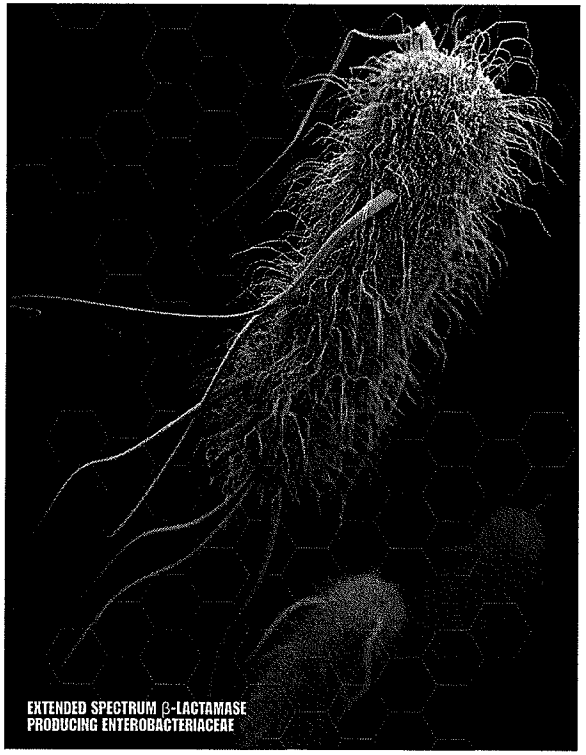

EXTENDED SPECTRUM β-LACTAMASE PRODUCING ENTEROBACTERIACERE

TECHNICAL APPENDIX

Technical Appendix

Clostridium difficile

Methods

National estimates of the number of *Clostridium difficile (C. difficile)* infections (CDI) requiring hospitalization or in already hospitalized patients were obtained from the data submitted through the Emerging Infections Program's *C. difficile* surveillance in 2011, of 34 counties in 10 U.S. states (http://www.cdc.gov/hai/eip/cdiff_techInfo.html). During 2011, a total of 15,452 CDI cases were identified across the participating sites. Data on hospitalization following CDI or at the time of infection were obtained for all cases from 8 of 10 U.S. states and from a random sample of 33% from cases from the other 2 states. The sampled cases were used to estimate total number of hospitalizations in the 2 states where sampling was performed. The national estimates were made using 2011 population estimates from U.S. Census Bureau adjusting for age, gender and race distribution of the American population.[1] Approximately 18% of cases were reported without a race value. Multiple imputation was used to estimate the missing race based on the data that are available and the results were summarized. The *C. difficile* attributable mortality was estimated from death certificate data.[2] Trends on deaths related to *C. difficile* were obtained from the CDC's National Center for Health Statistics.[3] Estimates were rounded to two significant digits.

References

1 Lessa FC, Mu, Y, Cohen J, Dumyati G, Farley MM, Winston L, Kast K, Holzbauer S, Meek J, Beldavs S, McDonald LC, Fridkin SK. Presented at the IDWeek 2012, Annual Meeting of the Infectious Disease Society of America, Society for Healthcare Epidemiology, Pediatric Infectious Disease Society, and HIV Medical Association; San Diego, October 2012.

2 Hall AJ, Curns AT, McDonald LC, Parashar UD, Lopman BA. The Roles of *Clostridium difficile* and Norovirus Among Gastroenteritis-Associated Deaths in the United States, 1999-2007. Clin Infect Dis. 2012 Jul;55(2):216–23.

3 Kochanek KD, Xu J, Murphy SL, Miniño AM, Kung HC. Deaths: Preliminary Data for 2009. National Vital Statistics Report.

Technical Appendix

Carbapenem-Resistant Enterobacteriaceae

Multidrug-Resistant *Acinetobacter*

Fluconazole-Resistant *Candida*

Extended Spectrum β-lactamase producing Enterobacteriaceae (ESBLs)

Vancomycin-Resistant *Enterococcus* (VRE)

Multidrug-Resistant *Pseudomonas aeruginosa*

Methods

National estimates of the number of healthcare-associated infections (HAIs) with Enterobacteriaceae, *Pseudomonas aeruginosa*, *Candida*, *Acinetobacter*, or Enterococci were obtained from a 2011 survey of 11,282 patients in 183 hospitals in 10 different states, among whom 452 were identified with at least one HAI for a total of 504 HAIs (some patients had >1 HAI).

Many assumptions were made in deriving national estimates, using these 452 patients, and adjusting for age and length of stay using the 2010 Nationwide Inpatient Sample (NIS), Healthcare Cost and Utilization Project (HCUP), Agency for Healthcare Research and Quality. For 2011, an estimated 647,985 patients had at least one HAI, resulting in an estimated 721,854 HAIs.[1] 481 pathogens were reported among the 504 HAIs detected; 50 *K. pneumonia* or *K. oxytoca* (9.9%), 47 *E. coli* (9.3%), 46 *Enterococci spp.* (9.1%), 36 *P. aeruginosa* (7.1%), 34 *Candida spp.* (6.7%), 8 *Acinetobacter spp.* (1.6%). For each pathogen, the pathogen-specific annual estimate was obtained by multiplying this proportion (of all HAIs) by the national HAI estimate (721,854). Next, the estimated no. of resistant infections was obtained by multiplying the respective pathogen-specific national estimate by the proportion of pathogens reported as non-susceptible to the antimicrobial of interest from other CDC data systems. For Enterobacteriaceae, *Pseudomonas aeruginosa*, *Acinetobacter*, and Enterococci this was CDC's National Healthcare Safety Network and includes the mean percent non-susceptible across the device and procedure-associated HAIs reported during 2009–2010[2]; see individual fact sheets in this report for percent resistance for each pathogen.

For *Candida* by the proportion of *Candida* species testing non-susceptible to fluconazole that were submitted to CDC for confirmatory testing as part of the Emerging Infections Program Surveillance of *Candida* bloodstream infections during 2008-2011.[3] In this program a total of 2,675 *Candida* species isolates associated with bloodstream infections were submitted as part of the EIP population-based surveillance in 2 US cities, azole resistance was identified in 165 cases, or 7%.

The number of deaths attributable to the antimicrobial-resistant healthcare-associated infection was determined by multiplying the estimated number of resistant infections by 6.5%, an overall estimate of attributable mortality from antibiotic-resistant hospital-onset infections previously determined.[4] This estimate accounts for the overall distribution of the different types of infections commonly caused by antibiotic-resistant pathogens in hospitalized patients and is generally much lower than the crude mortality observed in many of these patients owing to their severe underlying disease status. Definitions of multidrug resistance used in this analysis are published elsewhere.[2] The proportion of U.S. hospitals reporting carbapenem-resistant Enterobacteriaceae was derived as reported elsewhere.[5] Estimates were rounded to two significant digits.

References

1 Magill SS, Edwards JR, Bamberg W, Beldavs Z, Dumyati G, Kainer M, Lynfield R, Maloney M, McAllister-Hollod L, Nadle J, Ray SR, Thompson DL, Wilson LE, Fridkin SK. Presented at the IDWeek 2012, Annual Meeting of the Infectious Disease Society of America, Society for Healthcare Epidemiology, Pediatric Infectious Disease Society, and HIV Medical Association; San Diego, October 2012.

2 Sievert DM, Ricks P, Edwards JR, Schneider A, Patel J, Srinivasan A, Kallen A, Limbago B, Fridkin S; National Healthcare Safety Network (NHSN) Team and Participating NHSN Facilities. Antimicrobial-resistant pathogens associated with healthcare-associated infections: summary of data reported to the National Healthcare Safety Network at the Centers for Disease Control and Prevention, 2009–2010. Infect Control Hosp Epidemiol. 2013 Jan;34(1):1–14

3 Cleveland AA, Farley MM, Harrison LH, Stein B, Hollick R, Lockhart SR, Magill SS, Derado G, Park BJ, Chiller TM. Changes in incidence and antifungal drug resistance in candidemia: results from population-based laboratory surveillance in Atlanta and Baltimore, 2008–2011. Clin Infect Dis. 2012 Nov 15;55(10):1352–61.

4 Roberts RR, Hota B, Ahmad I, Scott RD 2nd, Foster SD, Abbasi F, Schabowski S, Kampe LM, Ciavarella GG, Supino M, Naples J, Cordell R, Levy SB, Weinstein RA. Hospital and societal costs of antimicrobial-resistant infections in a Chicago teaching hospital: implications for antibiotic stewardship. Clin Infect Dis. 2009 Oct 15;49(8):1175–84

5 Centers for Disease Control and Prevention (CDC). Vital Signs: Carbapenem-resistant Enterobacteriaceae. MMWR Morb Mortal Wkly Rep. 2013 Mar 8;62(9):165–70.

Technical Appendix

Neisseria gonorrhoeae

Methods

Estimates of the number of gonococcal infections with any resistance pattern, reduced susceptibility to cephalosporins or azithromycin, or resistance to tetracycline are reported. They are derived by multiplying an estimate of the annual number of gonococcal infections in the United States[1] by the prevalence of reduced susceptibility or resistance among urethral *Neisseria gonorrhoeae* isolates collected and tested by the Gonococcal Isolate Surveillance Project (GISP) during 2011.[2]

Many assumptions were made in deriving the estimates. Data from the National Health and Nutrition Examination Survey (NHANES) provided accurate gonorrhea prevalence estimates, although NHANES only measures urogenital infections and does not include oropharyngeal or rectal infections. The average duration of infection, used to calculate incidence, was based on expert opinion, due to an absence of published data. Also, estimates of resistance in GISP are nationally representative. However, compared to the regional distribution of reported gonococcal infections, GISP relatively over-samples patients from the West Coast, where resistance has traditionally first emerged in the United States. The Clinical Laboratory Standards Institute categorizes susceptibility to cefixime and ceftriaxone as minimum inhibitory concentrations (MICs) ≤0.25 µg/ml.[3] For this analysis, isolates with cefixime MICs ≥0.25 µg/ml were considered to have reduced cefixime susceptibility, and isolates with ceftriaxone MICs ≥0.125 µg/ml were considered to have reduced ceftriaxone susceptibility. An azithromycin MIC ≥2.0 µg/ml was considered to have reduced azithromycin susceptibility, and a tetracycline MIC ≥2.0 µg/ml was considered resistant. Resistance to any antimicrobial includes resistance to penicillin (MIC ≥ 2 µg/ml), tetracycline, ciprofloxacin (MIC ≥ 1µg/ml), or spectinomycin (MIC ≥ 128 µg/ml), or reduced susceptibility to the cephalosporins or azithromycin.

GISP, established in 1986, is a sentinel surveillance system with partners that include CDC, sexually transmitted disease clinics at 25–30 sentinel sites, and 5 regional laboratories in the United States.[4] Gonococcal isolates are collected from up to the first 25 men diagnosed with gonococcal urethritis at each sentinel site each month. Antimicrobial susceptibility testing is performed using agar dilution for a panel of antimicrobials that includes penicillin, tetracycline, ciprofloxacin, spectinomycin, cefixime, ceftriaxone, and azithromycin.

References

1 Satterwhite CL et al. Sexually transmitted infections among US women and men: prevalence and incidence estimates, 2008. Sex Transm Dis 2013;40(3):187–93.

2 CDC. Sexually transmitted diseases surveillance 2011. Atlanta: U.S. Department of Health and Human Services; 2012.

3 Clinical and Laboratory Standards Institute. Performance Standards for Antimicrobial Susceptibility Testing; Twenty-Third Informational Supplement. CLSI document M100-S23. Wayne, PA: Clinical and Laboratory Standards Institute; 2013; 33(1):100–102.

4 CDC GISP website: http://www.cdc.gov/std/GISP.

Technical Appendix

Drug-Resistant *Campylobacter*

Methods

Estimates of the number of illnesses and deaths from infections with *Campylobacter* resistant to ciprofloxacin or azithromycin are reported. They were derived by multiplying an estimate of the annual number of *Campylobacter* illnesses or deaths in the United States[1] by the average prevalence of resistance among *Campylobacter* tested by the National Antimicrobial Resistance Monitoring System (NARMS) during the years 2009–2011. Resistance breakpoints from the NARMS 2011 Human Isolates Report were used.[2]

Many assumptions were made in deriving the estimates. The estimated number of illnesses from resistant *Campylobacter* was divided by the U.S. population and multiplied by 100,000 to calculate the estimated number of illnesses from resistant infections per 100,000 people. The U.S. population in 2006 (approximately 299 million people) was used for the calculations because the estimated number of *Campylobacter* illnesses in the United States was based on this population.[1] The sentinel county survey data displayed in Figure 1 was previously reported.[3]

References

1 Scallan E, Hoekstra RM, Angulo FJ, et al. Foodborne illness acquired in the United States—major pathogens. Emerg Infect Dis 2011;17:7–15.

2 CDC. National Antimicrobial Resistance Monitoring System for Enteric Bacteria (NARMS): Human Isolates Final Report, 2011. Atlanta, Georgia: U.S. Department of Health and Human Services, CDC, 2013.

3 Gupta A, Nelson JM, Barrett TJ, et al. Antimicrobial Resistance among *Campylobacter* Strains, United States, 1997–2001. Emerg Infect Dis 2004;10:1102–9.

Technical Appendix

Drug-Resistant Non-Typhoidal *Salmonella*

Methods

Estimates of the number of illnesses and deaths from infections with non-typhoidal *Salmonella* resistant to ceftriaxone, resistant or partially resistant to ciprofloxacin, or resistant to five or more antibiotic classes are reported. They were derived by multiplying an estimate of the annual number of non-typhoidal *Salmonella* illnesses or deaths in the United States[1] by the average prevalence of resistance among non-typhoidal *Salmonella* isolates tested by the National Antimicrobial Resistance Monitoring System (NARMS) during the years 2009–2011. Resistance breakpoints from the NARMS 2011 Human Isolates Report were used.[2] For ciprofloxacin, isolates with intermediate susceptibility results (minimum inhibitory concentration of 0.12–0.5 µg/ml) were considered partially resistant.

Many assumptions were made in deriving the estimates. The estimated number of illnesses from resistant *Salmonella* was divided by the U.S. population and multiplied by 100,000 to calculate the estimated number of illnesses from resistant *Salmonella* per 100,000 population. The U.S. population in 2006 (approximately 299 million people) was used for the calculations because the estimated number of non-typhoidal *Salmonella* illnesses in the United States was based on this population.[1] The methods used to estimate the direct medical costs for *Salmonella* infections were previously reported.[3]

References

1 Scallan E, Hoekstra RM, Angulo FJ, et al. Foodborne illness acquired in the United States—major pathogens. Emerg Infect Dis. 2011;17:7–15.

2 CDC. National Antimicrobial Resistance Monitoring System for Enteric Bacteria (NARMS): Human Isolates Final Report, 2011. Atlanta, Georgia: U.S. Department of Health and Human Services, CDC, 2013.

3 CDC. Vital Signs: Incidence and Trends of Infection with Pathogens Transmitted Commonly Through Food—Foodborne Diseases Active Surveillance Network, 10 U.S. Sites, 1996–2010. MMWR 2011;60:749–55.

Technical Appendix

Drug-Resistant *Salmonella* Serotype Typhi

Methods

An estimate of the number of illnesses and deaths from *Salmonella* serotype Typhi resistant or partially resistant to ciprofloxacin was derived by multiplying an estimate of the annual number of illnesses or deaths from typhoid fever in the United States[1] by the average prevalence of ciprofloxacin resistance or partial resistance among *Salmonella* Typhi isolates tested by the National Antimicrobial Resistance Monitoring System (NARMS) during 2009–2011. Resistance breakpoints from the NARMS 2011 Human Isolates Report were used.[2] For ciprofloxacin, isolates with intermediate susceptibility results (minimum inhibitory concentration of 0.12–0.5 µg/ml) were considered partially resistant.

Many assumptions were made in deriving the estimates. The estimated number of illnesses from ciprofloxacin resistant or partially resistant *Salmonella* Typhi was divided by the U.S. population and multiplied by 100,000 to calculate the estimated number of illnesses from resistant or partially resistant infections per 100,000 people. The U.S. population in 2006 (approximately 299 million people) was used for the calculations because the estimated number of typhoid fever illnesses in the United States was based on this population. Worldwide case estimates[3] and pre-antibiotic era mortality[4] are from published sources.

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Technical Appendix

Drug-Resistant *Shigella*

Methods

Estimates of the number of illnesses and deaths from infections with *Shigella* resistant to azithromycin or ciprofloxacin are reported. They were derived by multiplying an estimate of the annual number of *Shigella* illnesses or deaths in the United States[1] by the prevalence of resistance among *Shigella* tested by the National Antimicrobial Resistance Monitoring System (NARMS) in 2011, the year azithromycin testing began. Resistance breakpoints from the NARMS 2011 Human Isolates Report were used.[2] As clinical azithromycin breakpoints have not been established for *Shigella*, the values used here were based on epidemiological cut-off values used in the NARMS report. Isolates with azithromycin minimal inhibitory concentrations of ≥32 µg/ml were considered resistant.

Many assumptions were made in deriving these estimates. The estimated number of illnesses from resistant *Shigella* was divided by the U.S. population and multiplied by 100,000 to calculate the estimated number of illnesses from resistant infections per 100,000 people. The U.S. population in 2006 (approximately 299 million people) was used for the calculations because the estimated number of *Shigella* illnesses in the United States was based on this population.[1] The sentinel county survey data displayed were previously reported.[3,4]

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Technical Appendix

Methicillin-Resistant *Staphylococcus aureus* (MRSA)

Methods

National estimates of the number of invasive MRSA healthcare-associated infections (HAIs) were derived from the Emerging Infection Program/Active Bacterial Core Surveillance[1] for invasive MRSA using data reported for infections occurring during 2011 (http://www.cdc.gov/abcs/reports-findings/surv-reports.html). During 2011, 4,872 reports of invasive MRSA (isolates of MRSA cultured from a normally sterile site and identified by a participating clinical laboratory) were received from the 9 participating program sites (population of 19,393,677). Reports include both healthcare-associated infections and community-associated infections, but are limited to invasive infections (approximately 85% are bloodstream infections).

Estimates were made using National Center for Health Statistics bridged-race vintage 2011 post-censal file and U.S. renal data systems, adjusting for race, age, gender, and receipt of dialysis. Mortality includes all-cause mortality during hospitalization, and estimates were adjusted in similar fashion as infection estimates. Approximately 18% of cases were reported without a race value, multiple imputation was used to estimate the missing race based on the data that are available and the results were summarized. Regarding device and procedure-associated infections with MRSA, the proportion of facilities reporting at least one *S. aureus* HAI reported as MRSA for each HAI type was obtained from CDC's National Healthcare Safety Network Antimicrobial Resistance Report 2009–2010.[2] Estimates were rounded to two significant digits.

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Technical Appendix

Vancomycin-Resistant *Staphylococcus aureus*

Methods

Vancomycin resistant *S. aureus* (VRSA) have been a nationally notifiable condition since 2004.[1] The national estimate of the number of VRSA cases is derived from individual case reports and confirmation at the Centers for Disease Control and Prevention (CDC). All reported VRSA are submitted to CDC for confirmatory antimicrobial susceptibility with reference broth microdilution.[2] Vancomycin resistance in *S. aureus* is defined as an MIC ≥ 16 ug/ml. All isolates meeting this criterion are further characterized with PCR to detect known resistance mechanisms. All 13 U.S. VRSA identified to date have carried the *vanA* resistance determinant.[3]

References

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Technical Appendix

Drug-Resistant *Streptococcus pneumoniae*

Methods

Trends in the incidence of antibiotic-resistant invasive pneumococcal disease per 100,000 persons are from Active Bacterial Core surveillance (ABCs), which is part of CDC's Emerging Infections Program (EIP) network.[1] ABCs conducts surveillance for invasive bacterial infections, including *Streptococcus pneumoniae*, at 10 sites located throughout the United States representing a population of approximately 30 million persons. Isolates are collected on ≥90% of all cases (approximately 3200 isolates per year) and sent to reference laboratories for susceptibility testing to eighteen different antibiotics using Clinical and Laboratory Standards Institute (CLSI) methods. Estimates of invasive pneumococcal disease are also from ABCs.[2]

Estimates of the burden of antibiotic resistant pneumococcal disease are derived from three sources. First, numbers of cases were estimated by applying the rate for full resistance to clinically relevant drugs (i.e. penicillin, ceftriaxone, cefotaxime, erythromycin, levofloxacin, tetracycline, trimethoprim/sulfamethoxazole) in 2011 (30%) to estimates of cases of all *S. pneumoniae* infections (4 million) as estimated by Huang and colleagues.[3] Numbers of deaths were estimated by applying the rate of full resistance to a clinically relevant drug (33%) to the total number of deaths from pneumococcal disease.[3] Excess pneumococcal pneumonia visits, hospitalizations, and costs were estimated using the previous overall burden estimates[3] but consideration of the burden of disease that would have occurred in the absence of resistance to penicillin, erythromycin, and levofloxacin.[4]

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Technical Appendix

Erythromycin-Resistant Group A *Streptococcus*

Methods

Estimates of the proportion of GAS isolates resistant to erythromycin, clindamycin and tetracycline are from isolates collected through Active Bacterial Core surveillance (ABCs), which is part of CDC's Emerging Infections Program (EIP) network.[1] ABCs conducts surveillance for invasive bacterial infections, including GAS, at 10 sites located throughout the United States representing a population of approximately 32 million people. Isolates are collected on ~80% of all cases (approximately ~1000 isolates per year) and sent to reference laboratories for susceptibility testing to twelve different antibiotics using Clinical and Laboratory Standards Institute (CLSI) methods.

Cases and deaths were estimated by applying 2011 resistant rate to erythromycin (10%, see Strep Group A *Streptococcus* pathogen page) to total cases (13300) and total deaths (1,550) reported in the 2011 report of the Active Bacteria Core surveillance (ABCs).[2]

References

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Technical Appendix

Clindamycin-Resistant Group B *Streptococcus*

Methods

Estimates of the proportion of GBS isolates resistant to erythromycin and clindamycin are from isolates collected through Active Bacterial Core surveillance (ABCs), which is part of CDC's Emerging Infections Program (EIP) network.[1] ABCs conducts surveillance for invasive bacterial infections, including GBS, at 10 sites located throughout the United States representing a population of approximately 32 million persons. Isolates are collected currently from 7 of these states, from ~85% of the cases in these states (approximately ~1500 isolates per year) and sent to reference laboratories for susceptibility testing to twelve different antibiotics using Clinical and Laboratory Standards Institute (CLSI) methods. Estimates of severe disease are also from ABCs.[2]

Cases and deaths were estimated by applying the 2010 overall resistant rate to clindamycin (28%) from the ABCs antimicrobial susceptibilities report[3] to total cases (27,000) and total deaths (1,575) reported in the 2011 ABCs GBS surveillance report.[2]

References

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GLOSSARY

Active Bacterial Core surveillance (ABCs): A core component of CDC's Emerging Infections Programs network (EIP), a collaboration between CDC, state health departments, and universities. ABCs is an active laboratory- and population-based surveillance system that tracks invasive bacterial pathogens of public health importance. It currently operates among 10 EIP sites across the United States, representing a population of approximately 41 million persons. At this time, ABCs conducts surveillance for six pathogens: group A and group B *Streptococcus* (GAS, GBS), *Haemophilus influenzae, Neisseria meningitidis, Streptococcus pneumoniae*, and methicillin-resistant *Staphylococcus aureus* (MRSA).

Adverse drug event: When therapeutic drugs (example, antibiotics) have harmful effects; when someone has been harmed by a medication.

Aminoglycoside: A type of antibiotic that destroys the functioning of gram-negative bacteria. Increased resistance to aminoglycosides has made them less useful.

Antibiotic: Type of medicine made from mold or bacteria that kills or slows the growth of other bacteria. Examples include penicillin and streptomycin.

Antibiotic class: A grouping of antibiotics that are similar in how they work and how they are made.

Antibiotic growth promotion: Giving farm animals antibiotics to increase their size in order to produce and sell more meat.

Antibiotic resistance: The result of bacteria changing in ways that reduce or eliminate the effectiveness of antibiotics. Antibiotic resistance is one type of antimicrobial resistance.

Antibiotic stewardship: Coordinated efforts and programs to improve the use of antimicrobials. For example, facilities with antibiotic stewardship programs have made a commitment to always use antibiotics appropriately and safely—only when they are needed to prevent or treat disease, and to choose the right antibiotics and to administer them in the right way in every case.

Antimicrobial: A general term for the drugs, chemicals, or other substances that either kill or slow the growth of microorganisms. Among the antimicrobial agents in use today are antibacterial drugs (which kill bacteria), antiviral agents (which kill viruses), antifungal agents (which kill fungi), and antiparasitic drugs (which kill parasites).

Antimicrobial resistance: The result of microorganisms changing in ways that reduce or eliminate the effectiveness of drugs, chemicals, or other agents used to cure or prevent infections. In this report, the focus is on antibiotic resistance, which is one type of antimicrobial resistance.

Azithromycin: A macrolide antibiotic used to treat infections caused by gram-positive bacteria and infections such as respiratory tract and soft-tissue infections.

Azoles: A large class of drugs developed to treat fungal infections.

Bacteria: Single-celled organisms that live in and around us. Bacteria can be helpful, but in certain conditions can cause illnesses such as strep throat, ear infections, and bacterial pneumonia.

Bacteriology: The study of bacteria.

Beta (β)-lactamase enzyme: A chemical produced by certain bacteria that can destroy some kinds of antibiotics.

Broad-spectrum antibiotic: An antibiotic that is effective against a wide range of bacteria.

Carbapenem: A type of antibiotic that is resistant to the destructive beta-lactamase enzyme of many bacteria. Carbapenems are used as a last line of defense for many bacteria, but increased resistance to carbapenems has made them less useful.

Cefixime: A cephalosporin antibiotic that is resistant to the destructive beta-lactamase enzyme of many bacteria.

Ceftriaxone: A cephalosporin antibiotic that is resistant to the destructive beta-lactamase enzyme of many bacteria.

Cephalosporin: Cephalosporins are a class of antibiotics containing a large number of drugs. Some more recently developed cephalosporins are resistant to the destructive beta-lactamase enzyme produced by many bacteria.

Ciprofloxacin: A broad-spectrum fluoroquinolone antibiotic that is important in treating serious bacterial infections, especially when resistance to older antibiotic classes is suspected.

Clindamycin: An antibiotic used to treat certain types of bacterial infections, including infections of the lungs, skin, blood, female reproductive organs, and internal organs.

Conjugate vaccine: A vaccine in which an antigen is attached to a carrier protein from the same microorganism. This approach enhances the immunological response to the vaccine and thereby enhances the overall effectiveness of the vaccine.

Echinocandins: A class of drugs developed to treat fungal infections.

EIP: The Emerging Infections Program network is a national resource for surveillance, prevention, and control of emerging infectious diseases. It was established in 1995. The EIP is a network of 10 state health departments and their collaborators in local health departments, academic institutions, other federal agencies, and public health and clinical laboratories; infection preventionists; and healthcare providers.

Endogenous flora: Bacteria that naturally reside in or on the body.

Epidemiology: The study of diseases to find out who is affected, how disease is spread, trends in illnesses and deaths, what behaviors or other risk factors might put a person at risk, and other information that can be used to develop prevention strategies. Epidemiologists use surveys and surveillance systems to track illnesses, and they often investigate disease outbreaks.

Erythromycin: An antibiotic used to treat certain infections caused by bacteria, such as bronchitis, diphtheria, Legionnaires' disease, pertussis (whooping cough), pneumonia, rheumatic fever, sexually transmitted diseases, and infections of the ear, intestine, lung, urinary tract, and skin. It is also used before some surgery or dental work to prevent infection.

Extended-spectrum antibiotic: An antibiotic that has been chemically modified to attack additional types of bacteria, usually those that are gram-negative.

Extensively drug-resistant (XDR): Resistance to nearly all drugs that would be considered for treatment. Exact definitions for XDR differ for each type of bacteria.

Fluconazole: An antifungal drug in the azole class.

Fluoroquinolones: Broad-spectrum antibiotics that play an important role in treatment of serious bacterial infections, especially hospital-acquired infections and others in which resistance to older antibacterial classes is suspected. Increasing resistant to fluoroquinolones is making them less effective.

Fungus: A single-celled or multicellular organism. Fungi can be opportunistic pathogens (such as aspergillosis, candidiasis, and cryptococcosis) that cause infections in people with compromised immune systems, such as cancer patients, transplant recipients, and people with HIV/AIDS. Fungi can also be or pathogens (such as the endemic mycoses, histoplasmosis and coccidioidomycosis, and superficial mycoses) that cause infections in healthy people. Fungi are used to develop antibiotics, antitoxins, and other drugs used to treat various diseases.

GISP: The Gonococcal Isolate Surveillance Project was established in 1986 to monitor U.S. trends in antimicrobial susceptibilities of strains of *Neisseria gonorrhoeae*, the type of bacteria that causes gonorrhea. The goal of GISP is to establish a rational basis for the selection of drugs used to treat gonorrhea. GISP is a collaborative project between selected sexually transmitted disease clinics, five regional laboratories, and CDC.

HAIs: Healthcare-associated infections are those that occur in hospitals, outpatient clinics, nursing homes, and other facilities where people receive care.

Hand hygiene: The practice of cleaning hands. This practice protects against infection and illness.

Hypervirulent: Increased ability to cause severe disease, relapse rates, and death.

Invasive disease: A disease that can spread within the body to healthy tissue.

Isolate/bacterial isolate: A pure culture or sample of bacteria used to study their properties.

Isoniazid (INH): A first-line drug used to treat tuberculosis. Strains of tuberculosis resistant to INH and rifampin are considered to be multidrug resistant.

Macrolide: A type of antibiotic used to treat infections caused by gram-positive bacteria and infections such as respiratory tract and soft-tissue infections. Macrolides are often used

in people allergic to penicillin, but resistance to macrolides is increasing and has made them less useful.

Methicillin: An antibiotic derived from penicillin. It was previously used to treat bacteria such as *Staphylococcus aureus*.

Microbiology: The study of microorganisms.

Microorganism: Organisms so small that a microscope is required to see them. This term includes bacteria, fungi, parasites, and viruses.

Morbidity: The number of people who are infected with a specified illness in a given time period.

Mortality: The number of people who die in a given time from a specified illness.

MRSA: Methicillin-resistant *Staphylococcus aureus* is used to describe any strain of *S. aureus* that is resistant to all types of penicillin (not just methicillin) as well as cephalosporin.

Multidrug-resistant (MDR): Microorganisms that are resistant to multiple classes of antimicrobials. The exact number of drugs that a microorganism is resistant to varies depending on the infection or pathogen.

NARMS: The National Antimicrobial Resistance Monitoring System monitors antimicrobial resistance in foodborne and other enteric bacteria, including *Salmonella, Campylobacter, Shigella, Escherichia coli* O157, and *Vibrio* (non-*V. cholerae*). NARMS is a collaboration among CDC, the U.S. Food and Drug Administration (FDA), the U.S. Department of Agriculture (USDA), and state and local health departments.

Narrow-spectrum antibiotic: An antibiotic that is active against a limited range of bacteria.

NHSN: CDC's National Healthcare Safety Network is the nation's most widely used healthcare-associated infection tracking system. NHSN provides facilities, states, regions, and the nation with data needed to identify problem areas, measure progress of prevention efforts, and ultimately eliminate healthcare-associated infections. In addition, NHSN allows healthcare facilities to track blood safety errors and important healthcare process measures such as healthcare personnel influenza vaccine status and infection control adherence rates.

Outbreak: When a group of people develop the same illness around the same time, and the number of people affected is higher than normal. Outbreak investigations are conducted to identify what exposure the affected people had in common.

Pan drug-resistance (PDR): Resistance to all drugs that would be considered for treatment. Exact definitions for PDR differ for each bacteria.

Penicillins: A class of antibiotics including amoxicillin, methicillin, piperacillin and other drugs based on the first true antibiotic discovered in 1928 by Dr. Alexander Fleming. Increased resistance has made many types of penicillins less useful.

Pneumonia: An inflammatory condition of the lungs affecting primarily the microscopic air

sacs known as alveoli. It is usually caused by infection with viruses or bacteria, and typical symptoms include a cough, chest pain, fever, and difficulty breathing.

Reservoir: A person, animal, insect, plant, or other host that is carrying a pathogen (for example, bacteria or fungi) that causes infectious diseases. Some pathogens have animal reservoirs (to survive, they need animal hosts). Others pathogens have human reservoirs (to survive, they need human hosts).

Resistant bacteria: Microorganisms that have changed in ways that reduce or eliminate the effectiveness of drugs, chemicals, or other agents to cure or prevent infections.

Rifampin: A first-line drug used to treat tuberculosis. Strains of tuberculosis resistant to isoniazid (INH) and rifampin (RMP) are considered to be multidrug resistant.

Strain/bacterial strain: A strain is a genetic variant or subtype of a microorganism (for example, a flu strain is a subtype of the flu virus). Some strains of bacteria are resistant to antibiotics, and others are not. When bacteria become resistant to antibiotics, they can share their resistance with other bacteria to create new resistant bacterial strains.

Superinfection: An infection following a previous infection, especially when caused by microorganisms that are resistant or have become resistant to the antibiotics used earlier.

Surveillance: The ongoing systematic collection and analysis of data. Surveillance systems that monitor infectious diseases provide data that can be used to develop actions to prevent infectious diseases.

Susceptible bacteria: When antibiotics are effective at killing or stopping the growth of a certain bacteria, the bacteria is known as susceptible to antibiotics. Susceptible infections are infections that can be treated effectively with antibiotics.

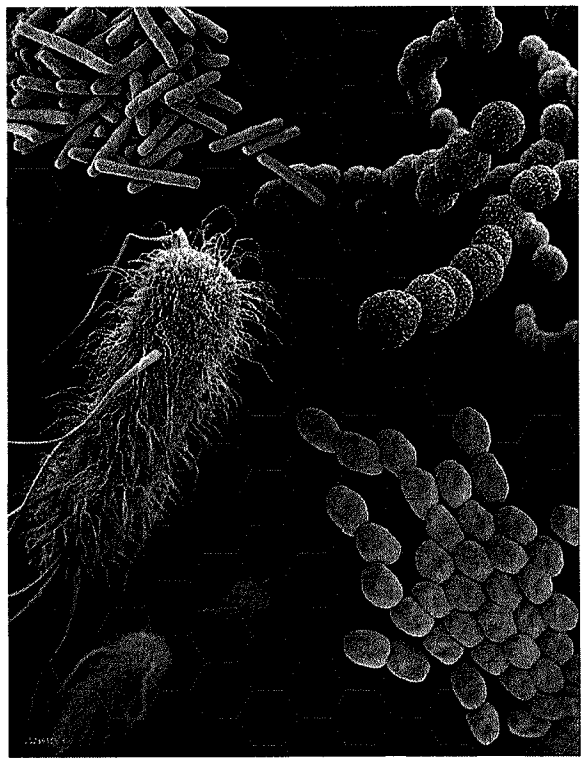
Systemic agents: Drugs that travel through the bloodstream and reach cells throughout the body.

Tetracyclines: A class of broad-spectrum antibiotics including tetracycline, doxycycline, minocycline, and other drugs. Increased resistance has made many types of tetracyclines less useful.

Vaccine: A product that produces immunity in a person's body and therefore protects them from an infectious disease. Vaccines are administered through shots, by mouth, and by aerosol mist.

Vancomycin: A drug that is frequently used to treat methicillin-resistant *Staphylococcus aureus* infections and that is also effective against other bacteria.

Virus: A strand of DNA or RNA in a protein coat that must get inside a living cell to grow and reproduce. Viruses cause many types of illness. For example, varicella virus causes chickenpox, and the human immunodeficiency virus (HIV) causes acquired immune deficiency syndrome (AIDS).



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Workplace

Original article

Persistence of livestock-associated antibiotic-resistant *Staphylococcus aureus* among industrial hog operation workers in North Carolina over 14 days

OPEN ACCESS

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Abstract

Objectives This study aimed to evaluate the persistence of nasal carriage of *Staphylococcus aureus*, methicillin-resistant *S. aureus* and multidrug-resistant *S. aureus* over 14 days of follow-up among industrial hog operation workers in North Carolina.

Methods Workers anticipating at least 24 h away from work were enrolled June–August 2012. Participants self-collected a nasal swab and completed a study journal on the evening of day 1, and each morning and evening on days 2–7 and 14 of the study. *S. aureus* isolated from nasal swabs were assessed for antibiotic susceptibility, *spa* type and absence of the *scn* gene. Livestock association was defined by absence of *scn*

Results Twenty-two workers provided 327 samples. *S. aureus* carriage end points did not change with time away from work (mean 49 h; range >0–96 h). Ten workers were persistent and six were intermittent carriers of livestock-associated *S. aureus*. Six workers were persistent and three intermittent carriers of livestock-associated multidrug-resistant *S. aureus*. One worker persistently carried livestock-associated methicillin-resistant *S. aureus*. Six workers were non-carriers of livestock-associated *S. aureus*. Eighty-two per cent of livestock-associated *S. aureus* demonstrated resistance to tetracycline. A majority of livestock-associated *S. aureus* isolates (n=169) were CC398 (68%) while 31% were CC9. No CC398 and one CC9 isolate was detected among *scn*-positive isolates.

Conclusions Nasal carriage of livestock-associated *S. aureus*, multidrug-resistant *S. aureus* and methicillin-resistant *S. aureus* can persist among industrial hog operation workers over a 14-day period, which included up to 96 h away from work.

We recommend

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Home > News > News Releases > 2014 > Hog Workers Carry Drug-Resistant Bacteria Even After They Leave the Farm

September 9, 2014

Hog Workers Carry Drug-Resistant Bacteria Even After They Leave the Farm

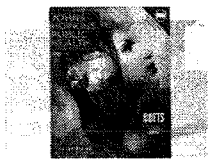
Livestock-associated Staphylococcus aureus persists in the noses of workers; persistence may have implications for spread beyond the farm

A new study suggests that nearly half of workers who care for animals in large industrial hog farming operations may be carrying home livestock-associated bacteria in their noses, and that this potentially harmful bacteria remains with them up to four days after exposure.

Researchers had believed that livestock-associated bacteria would clear from the noses of hog workers quickly – within 24 hours. But this small study of hog workers in North Carolina, reported online Sept. 8 in the journal *Occupational and Environmental Medicine*, suggests it can stick around longer. Much of the *Staphylococcus aureus* bacteria they carried were antibiotic resistant, likely due to the use of drugs both to treat sick hogs and to promote hog growth to ready them for market sooner. The longer the bacteria stick around in workers' noses, the researchers say, the greater the opportunity for them to potentially spread to hog workers' families, their communities and even into hospitals, where the bacteria have been associated with an increased risk of staph infections.

"Before this study, we didn't know much about the persistence of livestock-associated strains among workers in the United States whose primary full-time jobs involve working inside large industrial hog-confinement facilities," says study author Christopher D. Heaney, PhD, MS, an assistant professor in the departments of Environmental Health Sciences and Epidemiology at the Johns Hopkins Bloomberg School of Public Health. "Now we need to better understand not only how persistence of this drug-resistant bacteria may impact the health of the workers themselves, but whether there are broader public health implications."

In Europe, the children of livestock workers have been treated for infections caused by a new livestock-associated strain of MRSA (methicillin-resistant *Staphylococcus aureus*) that doesn't match the more widely found community- or hospital-associated strains. This suggests the children may have been exposed to MRSA strains through their family members who worked on livestock farms. Evidence of persistent carriage of this new livestock-associated strain and its drug resistance has led to restrictions on the non-therapeutic use of antibiotics in livestock overseas.



Statistics on the number of hog workers are tough to come by, but census data from 2007 suggest that there are roughly 292,000 livestock workers in the United States. In North Carolina, where the study was conducted, there are roughly 6,400 workers employed at 938 hog operations that reported hired labor.

The study, done in conjunction with researchers from the University of North Carolina Gillings School of Global Public Health and the Statens Serum Institute and community organizers from the Rural Empowerment Association for Community Help (REACH), involved 22 hog workers in North Carolina. Between June and August 2012, researchers recruited industrial hog workers to be studied for two weeks. In the first week, the goal was for workers to have at least a 24-hour stretch off from work. During that week, each participant collected nasal swabs in the morning before going to work and again in the evening, whether they worked that day or not. On the 14th day, they took two more nasal swabs. The longest time spent away from the farm was four days, with an average of two days among workers. Researchers later analyzed 327 separate nose swabs to see what kind of Staph bacteria they found, whether the strains were traditionally found in livestock or humans and whether the bacteria were drug resistant.

Eighty-six percent of the hog workers – 19 of them – carried at least one type of *Staphylococcus aureus* at some point during the study period, while 16 of them (73 percent) carried the livestock-associated strain at some point. In contrast, only about one-third of the general population carry a strain of *Staphylococcus aureus* associated with humans.

But 10 of the 22 workers (46 percent) were what the researchers call persistent carriers of livestock-associated Staph, meaning they had these strains in their noses all or all but one of the times they provided samples, even after leaving work at the animal confinements. Six of them persistently carried the multi-drug resistant kind of *S. aureus*, while one persistently carried MRSA.

Researchers found that even after up to four days away from the hog operation, the bacteria were still present in workers' noses.

Garden-variety staph are common bacteria that can live in our bodies without consequence. When they do cause infection, most aren't life threatening and appear as mild infections on the skin, like sores or boils. But staph can also cause more serious skin infections or infect surgical wounds, the bloodstream, the lungs or the urinary tract. Strains of staph like MRSA, which are resistant to some antibiotics, can be the most damaging because they can be very hard to treat.

MRSA is particularly dangerous in hospitals where the bacteria are hard to get rid of and the people there are the most vulnerable.

Heaney and the team are doing more research to see whether hog workers with persistent drug-resistant bacteria are spreading it to their family members and communities.

"We're trying to figure out if this is mainly a workplace hazard associated with hog farming or is it a threat to public health at large," he says. "To do that we need to learn more not just about how long workers carry bacteria in their noses, but how it relates to the risk of infection and other health outcomes in workers, their families, and communities."

Funding for this study was provided by the North Carolina Occupational Safety and Health Education and Research Center; the Centers for Disease Control and Prevention's National Institute for Occupational Health and Safety; the Johns Hopkins Center for a Livable Future and a grant from the National Science Foundation.

"Persistence of livestock-associated antibiotic-resistant *Staphylococcus aureus* among industrial hog operation workers in North Carolina over 14 days" was written by Maya Nadimpalli, Jessica L. Rinsky, Steve Wing, Devon Hall, Jill Stewart, Jesper Larsen, Keeve E. Nachman, Dave C. Love, Elizabeth Pierce, Nora Pisanic, Jean Strelitz, Laurel Harduar-Morano, and Christopher D. Heaney.

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The IOWA SOURCE
IOWA'S ENLIGHTENING MAGAZINE

Hog Confinement Health Risks

Fumes from Hog Confinements Impact Human & Environmental Health

BY CHRISTINE SCHRUM

Here in Iowa, we're used to a little bit of piggy stink. In recent years, though, as our state's belly swells with industrialized hog farms, more and more residents are finding the overwhelming odors associated with Confined Animal Feeding Operations (CAFOs) unbearable. Moreover, a host of recent research is showing that toxic air emissions from these operations can adversely affect human health.

In 1970, the average Iowa hog farm housed fewer than 200 hogs, whereas in 2000, it spiked up to 1,500, tightly packed. Today, CAFOs operating at maximum capacity can hold up to 10,000 hogs or more. That's a lot of swine—anda lot of manure to deal with.

Iowa's livestock churn out an estimated 50 million tons of excrement each year. In industrial-sized hog farms, the manure accumulates as a liquid in pits beneath the confinement building, or in sewage lagoons outside. Naturally, these putrid pools give off an enormous stench.

Health-Hazardous Emissions

But it's not just a matter of malodor. According to a 2002 jointstudy by Iowa State University and the University of Iowa, the manure pits become anaerobic and putrid, polluting the air with particulate matter and many gases—including ammonia and hydrogen sulfide—that can lead to a wide range of health complaints. Exposure to hydrogen sulfide is known to cause nausea, headaches, diarrhea, and even life-threatening pulmonary edema.

Researchers from the 2002 study concluded that "CAFO air emissionmay constitute a public health hazard and that precautions should be taken to minimize both specific chemical exposures (hydrogen sulfide and ammonia) and mixed exposures (including odor) arising from CAFOs."

There appears to be ample evidence to support this notion. A 2000 North Carolina study (Wing and Wolf) found that people living in proximity toa 6,000-head hog CAFO reported increased rates of headaches, runny nose, sore throat, excessive coughing, diarrhea, and burning eyes compared to rural residents living far from livestock operations.

A 1995 North Carolina study (Schiffman and colleagues) found that residents who lived in the vicinity of intensive swine operations reported increased negative mood states, including tension, depression, anger, fatigue, confusion, and reduced vigor.

While a 1997 Iowa study (Thu and colleagues) found no increased incidences of depression and anxiety among residents living within two miles of a 4,000-sow CAFO, researchers found that both farm workers and community residents reported higher rates of chest tightness, wheezing, runny nose, scratchy throat, burning eyes, headaches, and plugged ears.

The 2002 UI/ISU study noted that CAFO workers run an extremely high risk of developing respiratory diseases including asthma, acute bronchitis, sinusitis, and rhinitis. Researchers concluded, "The scientific literature is quite clear that workers in swine or poultry CAFOs are at risk to acute and chronic respiratory diseases from concentrated emissions inside CAFOs."

On the whole, CAFO workers are known to be a hearty bunch. But as the authors of the 2002 UI/ISU study pointed out, "Those in the general community, including the children, the elderly, those with chronic impairments such as pre-existing asthma or chronic obstructive pulmonary disease, are expected to be much more susceptible to CAFO exposures."
So what's being done about all this? Where does Iowa currently stand in terms of healthy air quality standards? Unfortunately, on somewhat stinky, and potentially unhealthy, ground.

The Need for Enforceable Air Quality Standards

In 2003, prompted by pressure from concerned citizens and organizations like Iowa Citizens for Community Improvement (Iowa CCI), the DNR acted to approve air quality standards for CAFO ammonia and hydrogen sulfide emissions, based on the 2002 ISU/UI study authors' recommendations (no more than 15 parts per billion of hydrogen sulfide, 150 parts per billion of ammonia, and a 7:1 dilution rate for odor). The standards were set in place, but within days, the 2003 Iowa Legislature promptly put a halt to them.

"The legislators were responding to the powerful special interest lobbying of factory farms and not their constituents," said Carissa Lenfort of Iowa CCI.

In response to the dust kicked up by agribusiness proponents, the 2004 Iowa Legislature passed HF 2523, a bill that would have essentially allowed CAFOs to pollute air with impunity. Fortunately, Governor Vilsack vetoed the bill. Later in the year, the Environmental Protection Commission (EPC), the Iowa DNR's citizen oversight board, enacted a watered down setof air quality standards that called for no more than 30 parts per billion of hydrogen sulfide.

"It's a step forward," says Lenfort, "but the standards definitely need to be strengthened in order to actually protect public health." As yet, there are no regulations for ammonia or odor. "We're continuing to say that standards need to be set for those as well," says Lenfort.

Establishing adequate air quality standards has thus far been an uphill battle, but if Iowa's residents pull together, the climb is easier. It was only after Iowa CCI members submitted a 6,000-plus signature petition to the EPC calling for air quality standards (in 2001) that the board first began to consider establishing standards at all. Iowa CCI's efforts eventually led to the joint report by ISU/UI in 2002, which, in turn, led to the establishment of today's standards.

The home page of Iowa CCI's webpage reads: "A wise man once wrote that the only solution to any problem is to 'get to work on it.' " Residents who want to be part of the solution to the problem of CAFO air emissions should contact their state representative and senator and let them know they support the 2002 study's recommendations. They can also visit the Iowa CCI website and click on the "What Can I Do?" link for other action steps.

Taking Control Locally

Another way to move the issue forward is to promote "local control," which would ensure that each county has ultimate control over when, how, and if proposed CAFOs should be established and maintained in the area.

"Counties have the ability to site schools and other economic developments," says Lenfort, "They should be allowed to site CAFOs. The local people know the land better than anyone. They know their county."

Somewhat to this end, in 2004 the state of Iowa established the "Master Matrix," a 44-question scoring system that purports to help counties maintain local control over CAFOs of 2,500 hogs or more.

Although the Matrix requires CAFO operators to meet standards in three categories (water, air, and community impacts), the system is often criticized for being somewhat lax. To date, the Matrix has yet to deny a single CAFO permit.

"It's kind of a token thing in my mind," says Iowa dairy farmer Francis Thicke, who is a member of the EPC and has written extensively on sustainable farming practices. "It's a compromise. Several years ago when there was a push for local control, the farm lobbyists pushed back. It doesn't equal local control, by any means," he said.

So what can residents do to help establish local control?

"Contact your legislative reps, help get the message out there," says Lenfort. "Join Iowa CCI and ask for local control. It's going to take a lot of work, because we realize that factory farms have a lot of power and resources, and when you're taking on powerful opponents, the fight's always stronger."

Interestingly, Iowa's residents already seem largely in favor of local control. An informal 2001 survey by the Des Moines Register found that 71 percent of Iowans want local control, 9 percent are undecided, and a mere 20 percent are in favor of CAFOs. According to recent reports, there have been as many CAFO permit applications within the past six months of 2005 as there were in all of 2004. So if community members want to have moresay about CAFO siting, they'd be wise to speak up soon.

The New Old Solution

Then again, perhaps there's an even simpler solution to the problem of noxious fumes emitted from CAFOs. In a recent Sierra Club article entitled "Naturally, Hogs Don't Stink!" Thicke writes, "Industrial hog-lot manure accumulates in a liquid form, so it becomes anaerobic and putrid. When hogs are on pasture, their manure is dispersed on the soil and is aerobically decomposed, so putrid compounds do not form."

When farmers raise hogs outdoors, rather than in cooped confinement lots, pigs don't smell nearly so raunchy. Writes Thicke, "A friend of mine who raises hogs on pasture likes to boast that he can check his hogs on the way into town and nobody can smell that he has."

It seems that with natural hog-farming, everybody wins. Pigs have healthier, antibiotic-free diets; farm pastures receive natural fertilization; manure lagoons don't pollute the land, air, creeks, and lakes; and rural homeowners near hog farms don't have to watch in dismay as their property value is devastated. But what about the farmers—won't traditional, outdoor hog-farming cut back on profits?

Not across the board. Recent estimates by the Sierra Club state that for every new CAFO established, ten family farms are eliminated or forced to enter into corporate contracts. Today's CAFO operators are, in Thicke's words, essentially the "serfs of corporate agribusiness." At present, four corporations control 59 percent of the hog market. The pigs and feed are provided by these large corporations, but the farmers are responsible for all the liabilities.

As factory farms grow in numbers, family farms diminish across the state. In the end, it seems CAFO proponents may end up being the ones "living high on the hog," while those of us breathing the toxic fumes are finding new meaning in the expression.

Change—a Whiff Away

Many organizations are striving to ensure today's hog farms are safe for humans, animals, and the environment, but we still have a ways to go. With education, awareness, and action, the CAFO trend could drastically change.

As Francis Thicke sees it, "Iowa is divided into three groups on the CAFO issue. The first group is extremely small. It's those people with vested interests, who profit from CAFOs. The second group is a little larger. They're the locals who're against CAFOs because they've had personal experience with discomfort caused by them. The third groupis the huge majority. They know little about the pitfalls of CAFOs, but they're just a whiff away from being against them. It's just a matter of awareness—of enough people waking up and smelling the hydrogen sulfide."

***Sidebar*: Feces Fiascos & Antibiotic Resistance**

Certainly there are other health risks associated with CAFOs. In 1995, an eight-acre hog waste lagoon in North Carolina burst, releasing 25 million gallons of hog refuse into Onslow County. The spill killed as many as 10 million fish and closed 364,000 acres of coastal wetlands to shellfishing. Smaller spills are common, and often closer to home than Iowans imagine. In 1996, for example, 40 spills in Iowa, Minnesota, and Missouri killed close to 700,000 fish. In 1997, Indiana feedlots caused a total of 2,391 manure spills. A 100,000-gallon spill in 1998 killed close to 700,000 fish in Minnesota's Beaver Creek.

And then there's the issue of antibiotic resistance. Large-scale animal farms often feed animals antibiotics (U.S. farmers dole out atotal of 24.6 million pounds each year) to promote growth and treat diseases caused by overcrowded conditions. These antibiotics are making their way into the environment and the food chain, contributing to the rise of antibiotic-resistant bacteria and making it more difficult to treat human diseases.

There's hope on both counts. North Carolina imposed an eagerly welcomed moratorium on new hog CAFOs in 1997, after the record-setting spill in Onslow County. The moratorium has been extended a number of times and is currently in place until 2007. As for the issue of antibiotic resistance, the American Medical Association recently went on record opposing the non-therapeutic uses of antibiotics in agriculture. Experience—themother of wisdom. Let's hope Iowa wisens up.

To read Christine Schrum's article on the effect of CAFOs on rural communities, see CAFOs Kill Communities.

For excellent resources, see Jefferson County Farmers and Neighbors.

Comments (13)

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written by Don Carlson, August 05, 2014

I have a hog confinement less then 1200 feet from my house and three others within 3 miles. I can't leave my windows down on nice days for fear the wind will shift and the house will smell. Shad Smith owns the property it sits on in Fremont County Iowa, Scott Township Southwest Iowa. I bought my property from him in 1999. When this confinement was being built 2 plus years ago Mr.

Smith reassured me that I would not even know they were there, he is so wrong about that, I smell them just about every day. I am starting to feel some health issues big time, having a hard time with my breathing and am tired much of the time, I feel there is not much one can do other then relocate to another State. If there is help out there I would appreciate some contact information.
Votes: +1

...
written by Jonathan, February 16, 2012

This is a very good, though scary, article. I worry about my exposure to other respiratory ailments, including asbestos exposure. I read here that there is still asbestos in some schools, and it worried me a lot.
Votes: +1 vote up vote down report abuse

...
written by Sara, March 16, 2011

HI all- I am a law student currently working on several projects related to factory farming and the health effects of CAFOs on residents. I'm not sure if anyone is still checking the comments section here, but if you live near a CAFO and have a story to tell, I would love to talk to you! Please email me at: sdemers@email.arizona.edu

Also, to the article author: I would love to get in touch with you as well to find out more info about the sources you used, specifically the research studies on health effects.

Thanks!
Votes: +0 vote up vote down report abuse

...
written by ex- confinement worker, December 23, 2010

I will just say that I worked at a hog confinement for just over three years and have permanent damage done to my lungs and health in general. I cant say what corporation i worked for, but I will say it was located in S.E. Iowa. The company actually terminated me after they deemed my health was unfit for me to return to work.

If you ever worked inside one of these confinements, anyone of you, I guarantee you would agree this is not the way animals were intended to be raised even for food. The health risks involved with the employees that work in these places is unreal. I was an average younger person in pretty good health before I started, and now I'm without a job and sick every damn day of my life because of that of that place. The companies dont care about the animals all they do is use the animals reproductive systems over and over again until they are done with them and then send them out the door to pork vendors for sausage or whatever they can do with them. They care that little about the animals. Truly I tell you they care far less about their employees than they do even the animals. Very Very sad!!
Votes: +10 vote up vote down report abuse

..., *Lowly rated comment* [Show]

...
written by Marcella, November 06, 2010

having incurred 30,000 dollars worth of medical bills because my neighbor SPRAYS LIQUID HOG MANURE rather than knifing it into the soil....I can tell you that insurance won't cover all the bills hog waste will create because of illnesses one must suffer from hog manure.

DEAD BONE disease results from bacteria eating away at your JAW BONES. Requires expensive BONE GRAFTs, not FUN!

My neighbor literally SPRAYed me with hog manure....as he used 1970's tank to dump manure next to his hog barn, rather than drive down the road to some 2000 other acres ...thinks it is funny that "city girl who retired to local village can't stand hog smell"....BUT I AM FIFTH GENERATION FARMER, WHO GREW UP RAISING HOGS THE RIGHT WAY! NOT IN A CAGE, NOT OVER THEIR MANURE FOR THEIR ENTIRE LIVES, EATING ANTIBIOTICS TO STAY ALIVE.

Corporate serfs are Ignorant Americans....but Corporations OWN Governor Daniels in Indiana, who is off to China this week to SELL MORE PORK RAISED THE EXACT WAY THE COMMUNISTS WANT US TO RAISE HOGS! INDIANA is Third World Sewage Disposal location for hog manure!
Votes: +8 vote up vote down report abuse

...
written by Retiree in Iowa, September 29, 2010

We have a house in Iowa that we are planning on moving into when we retire. We moved from Iowa 22 years ago because of the farming crisis but are coming back in a few short years. Now we find that a hog confinement is going up 1/2 mile from us! When we purchased the property, we felt safe that no confinments would be built in that area. So much for dreams! Ours is now ruined due to this confinement! We are all for agriculture but this isn't a family farm but rather a large company making money while ruining our property value. Maybe we should reconsider moving back to Iowa at all!
Votes: +7 vote up vote down report abuse

..., *Lowly rated comment* [Show]

...
written by downwind, September 27, 2009

Go to the capitol with ideas? We have the best government that money (Farm Bureau) can buy. Hog farmers don't need numbers, they just own the representatives in Des Moines so they stink up the neighborhood, pollute the water underground from your lagoons and pits and generally rule the neighborhood and destroy property values. Oh, and "Have a nice day!" (And did you know they have legislation that gives them tax breaks on their new buildings and big pickup trucks. It's nice to know my taxes are taking up the slack for the taxes they don't pay. THANKS FARM BUREAU!

By the way, did you know the "Right to Farm" legislation was declared unconstitutional in 2004?
Votes: +3 vote up vote down report abuse

...
written by wouldntyou like to know, April 07, 2009

So I live on a small family farm and we raised hogs for 50yrs. Realistically the hog confinement corporations put us out of business. Its depressing to see young people wanting to raise hogs in a more traditional small farm atmosphere, but simply cant since financially the government status wont allow it. Unfortunately hog confinements are disease stricken, unnatural, abusive environments. Now harry larry its been proven that hog confinements cause respiratory problems, but yes only to those who work inside them. Now look at the bigger picture, obviously that horrid smell is coming from the acid waste pits, besides smellling bad, without proper control the waste is polluting the land. Conservation suffers, our water ways are ruined with fish dying and drinking water ruined. Now girls, if the smell is the only thing your worried about then you need a reality check. Instead of putting up worthless arguments with ignorant harry larry, and stating shallow uneducated and unintelligent blogs on here, go to your count extension and conservation and start working on a reasonable arguement to pass onto the capital.
Votes: +5 vote up vote down report abuse

..., *Lowly rated comment* [Show]

...
written by laura, November 10, 2008

Katie- I would further like to speak with you about your little sister's friend's brother. Could you please e-mail me or give me some contact information for yourself? laura-klairmont@uiowa.edu is my email address
Votes: -3 vote up vote down report abuse

..., *Lowly rated comment* [Show]

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The IOWA SOURCE
IOWA'S ENLIGHTENING MAGAZINE

Hog Confinements Kill Communities

How Industrial-sized Hog Lots are Destroying Rural Iowa

BY CHRISTINE SCHRUM

Peggy Birchmier lives in a lovely, pastoral home near Milton—surrounded by five industrial-sized factory farms. Ask her to describe the stench when farmers spread six months' worth of hog slurry on the 156-acre field right outside her yard, and she'll just about retch.

"It's like rotten eggs . . . you can't describe it. It's really intense," she says, holding her stomach. Peggy lived eight contented years in her countryside home in Davis County before the factory farms settled in around her. Now the fumes have forced Peggy, her husband, and their asthmatic son to live in the basement.

Last month, *The Iowa Source* published an article on the human health risks posed by toxic air emissions from CAFOs, concentrated animal feeding operations (CAFOs, August 2005). This month we're taking a closer look at how hog CAFOs are tearing apart Iowa's rural communities.

The Sulfur, My Friend, is Blowin' in the Wind...

Obviously, the most common complaint about industrial-sized hog lots is their horrific stench. Operations that manage tightly packed hogs by the thousands store animal waste in massive underground pits and outdoor lagoons. After fermenting for six months to a year in these holding centers, the putrefied manure is spread en masse upon pastures—either on-site or on the crops of interested farmers.

The ready-made manure, which is known to give off toxic ammonia and hydrogen sulfide emissions, is a commodity rife with controversy. "It's coming out that this manure really isn't a natural manure anymore, it's a toxic compound," says 2000 Master Farmer Ron Kielkopf, citing recent Iowa State research. "With it, crops don't handle stress very well. All manure and fertilizer have to be broken down by other bacteria that's in the soil before the plants can use them. And these bacteria really sometimes don't know what to do with that manure—especially when they put on as much as they do."

CAFO owners can't technically sell the manure to neighboring farmers, since it would be extremely difficult to measure and regulate the nutrients—nitrogen, phosphorous, etc.—that it contains. So instead, many opt to "give" farmers the toxic manure "for free," but charge an application fee and make a little extra cash. At times, the phosphorous content of the slurry is so high, crops are better off without it. And then there's the smell.

"It's like someone sets up a million dollar home in your neighborhood and then vents his sewage slime in your living room," says Kielkopf, who is an at-large member of Iowa Citizens for Community Improvement (Iowa CCI). "It's so rude, having someone else smell something you're making money off of."

Says Birchmier, "The cure-all there was supposed to be that the manure would be knifed into the soil, and they'd plant trees, which would cover up the smell. Well . . . ." Unfortunately, CAFO farmers don't always make good on promises to reduce odor emissions.

Eighty-two-year-old Olive Jones has lived with her husband in their Davis County home for most of her life. Since a 16,000-head hog confinement was erected a few miles from their home approximately six years ago, the putrid fumes have kept them up at night.

"When they run that irrigation system up there," says Olive, "we really get it bad because they spray it out in the air. It bothers my husband because he has a lung problem. He'll start coughing before I can even smell it. To live out in the country and have to live with that smell! I have sinus trouble all the time."

But the smell doesn't really trouble her lungs, Olive says. It just makes her mad.

Employment and Economy: Promises, Promises

CAFO owners looking to establish facilities in rural areas often promise local residents an employment boom and a more prosperous economy. Unfortunately, it doesn't always pan out that way.

"Nobody works in there very long," says Birchmier, of people employed by the factory farms near her. "No matter where they're from, they're almost always transient." CAFO workers typically endure low salaries, long hours, and extremely high health risks. A whopping 58 percent of all swine confinement workers manifest chronic bronchitis, according to the American Lung Association, and nearly 70 percent experience some form of respiratory irritation. Each year, several workers—and occasionally children—actually die from falling in manure pits.

Birchmier finds the working conditions appalling. "I think the worst thing is that the people that are running the business aren't the ones that are playing with the manure. They get the Mennonites and the Amish, a lot of immigrant workers. Anybody who can't work anywhere else."

Not surprisingly, more often that not, CAFO owners—who reap the lion's share of the income generated by their facilities—don't live anywhere near their host communities.

"If the owner of a Davis County confinement lives in Mount Pleasant, and his father, who owns the land, lives in Illinois—if they makea million dollars, how much good is that going to do the local economy?" says family farmer Garry Klicker, of Davis County, vice chairman of Iowa Citizens for Community Improvement (Iowa CCI).

Two studies from 1983 and 2001 found that when farm size and absenteeownership increase, social conditions in the local community tend to deteriorate.Said 1983 study author Dean MacCannel, "We have found depressedmedian family incomes, high levels of poverty, low education levels, socialand economic inequality between ethnic groups, etc., associated with landand capital concentration in agriculture. Communities that are surroundedby farms that are larger than can be operated by a family unit have .. . a few wealthy elites, a majority of poor laborers, and virtually nomiddle class."

So if CAFOs create low-paying, high-turnover jobs that create high gain for absentee owners, thereby funneling money directly out of the region, where's the community payoff? Certainly not in tax breaks.

Taxing on Communities

CAFOs can be incredibly taxing for rural communities—quite literally. Industrial farms generate a fair amount of extra truck traffic, and as a result, bridges and roads require more upkeep to handle the weight of semis brimming with oversized swine and their feed.

The annual estimated cost of local road maintenance around a 20,000-headhog confinement is said to be $6,447 a mile due to heavy-duty truck traffic. One Iowa community recently estimated its costs for gravel road upkeep increased by approximately 40 percent due to excess truck traffic from hog CAFOs.

Ironically, while citizen taxpayers are shouldering the costs of CAFO-causedroad damage, the CAFO owners themselves are being granted tax abatements for implementing "pollution control" measures at their facilities—such as the reeking manure pits and lagoons, which are scientifically proven environmental hazards that cause air, land, and water toxicity.

"In reality, that's government money coming into their pockets that shouldn't be there," says an angered Klicker, recalling that some CAFOs receive as much as $80,000 per site worth of federal tax dollars to establish manure containments for their factory farms. "They can get all kinds of money. If you're putting up, say, four or six buildings for $1 million, $2 million, $3 million, why do you need government assistance? Is that where taxpayer money should go? Subsidies were originally designed to help the small farmer. In reality now, they are just using taxpayer money to pay big corporations to sell out small farms."

Valuable, Valueless Land: Clearing Out Communities

There is some dispute as to whether CAFOs depreciate or appreciate the value of land nearby them. One obvious side of the argument is that noxious fumes from factory farms create an ambiance that few homeowners want to settle down in, and few businesses want to set up shop in.

"Who would ever build a home in this part of the country?" asks Kielkopf. "That's what's happening everywhere in rural Iowa now. All of a sudden, everyone's waking up and saying, 'We better not build a home outside of urban areas.' "

"When you get in neighborhoods like this, people can't rent their homes anymore," says Klicker. "My farm's for sale. If I could leave, I'd leave. But it hasn't sold."

In a 1999 University of Missouri study of 99 rural land real estate transactions of more than one acre, researchers found that CAFOs lowered land values within a three-mile radius of approximately $2.68 million, or $112 peracre (Hamed, 1999).

On the other side of the coin, land near CAFOs becomes more valuable to some—namely, factory farmers who are looking to expand. Says Birchmier, "My property values actually went up because they [CAFO owners] were paying so much to build."

Either way, the end result is a clearing out of a community of residents. "People have to move out," says Klicker. "No one buys the home, so they knock it down; CAFO owners buy it and expand. It absolutely clears out the middle class."

Widening Social Gaps

Naturally, a diminishing middle class in rural Iowa causes existing social gaps to widen further. Families whose financial constraints prevent them from quitting CAFO janitorial positions (i.e., hosing out slurry) tend to face a certain amount of inadvertent social ostricization.

"You don't want to sit in a restaurant near somebody who's been working in a confinement," says Klicker, "Trust me, you don't. They have special soaps that they use, but if they work there day after day after day, it gets in their skin. You cannot wash it away."

Indeed, the indoor manure pit fumes are so strong that the sensitive snouts of baby pigs cannot tolerate them. Piglets must be housed in separate facilities that are washed out daily—with their liquefied sewage stored in outdoor lagoons—otherwise, the odor would kill them.

Says Birchmier, who owns and operates a local truck stop, "The CAFO workers come into the store and they can clear it out in a heartbeat. But they have no idea how odorous they are. It's the same with the dead-pig drivers," she says, referring to those who make their living disposing of the thousands of baby and full-grown CAFO hogs that die of various causes before slaughter.

In addition, it's not unheard of for some CAFO laborers to toil such long days that they have little time for socializing and community involvement.

A Question of Ethics

"At what point does the will of the people enter into the equation?" Garry Klicker wants to know. "Because the majority of people, nobody actually, wants CAFOs. Nobody who lives near 'em now, and nobody who thinks they're going to live near 'em in the future want the things built. So why should a very small minority of people be able to make money off the misery of the majority?"

"Today's consumer really wants to purchase meat that's been raised in a responsible way," according to Kielkopf. "But the retailers are all in bed with the factory farmers. The small guy, he can't get shelf space in Hy-Vee."

To make matters worse, it's becoming increasingly difficult for small farmers to form contracts with meat packers, who can make larger profits when they do business with CAFO operators. Finding themselves with little say in the matter, independent farmers are careful not to "make a stink," as Kielkopf says, because "they could get blacklisted and then nobody would buy their hogs."

If They Build it, More CAFOs Will Come

Unfortunately, at present, Iowa law does little to protect independent farmers and their neighbors from the perils of CAFOs. But if Iowa's rural citizens join together, they can follow the lead of communities in states like Pennsylvania and North Carolina—and even right here in Iowa—who are banning together to "say no" to factory farms. (For more information, see factoryfarm.org/).

In the words of Pennsylvania's Community Environmental Legal Defense Fund spokesman, Thomas Linzey, Esq., "Communities that say no to corporate farming are bravely rejecting an agricultural model that grinds up rural communities, quality of life, and family farmers. In the process, they're rejecting the notion that agribusiness corporations—and their trade associations like the Farm Bureau—run their community, and not them."

According to recent reports from the DNR, permit applications for building hog CAFOs in Iowa are up this year (2005). "We've received 160 application sin the first half of 2005, more than the 122 we received in the entire 2004 calendar year," said Wayne Farrand, supervisor of the DNR wastewater permits section.

Thousands of rural Iowans are concerned. They should be. To them, Birchmier offers these words to the wise. "Try to stop them before they're built. Because once one's there, the rest will come."

Sidebar: CAFO Water Pollution

Aside from the obvious air pollution, CAFOs pose a threat to our state's water supply. Underground concrete manure pits don't always offer stalwart groundwater protection. Joints can leak and cracks can form in concrete. If a pit building's concrete is laid in sand or gravel, leaking manure can easily migrate to water tables. Outdoor lagoons pose similar leakage problems. Shockingly, in Iowa, a 7-acre lagoon may *legally* leak as much as 16 million gallons of liquefied manure annually.

At present, 70 percent of Iowa's streams are polluted, largely due to agricultural runoff. CAFOs certainly do little to remedy the problem. A recent survey of Iowa's 5,600 manure pits found that 18 percent were built over alluvial aquifers, which are widely used drinking water sources that are highly vulnerable to contamination.

Research has shown that hog excrement contains many more pathogens than human waste, in addition to antibiotics, nutrients (nitrate and phosphorous), sediments, organic matter, heavy metals, hormones, antibiotics, and ammonia—all of which can pollute the water that Iowans swim and fish in. The Environmental Protection Agency (EPA) estimates that hog, chicken, and cattle waste has polluted 35,000 miles of rivers in 22 states and contaminated groundwater in 17 states.

According to the Union of Concerned Scientists, 70 percent of all antibiotics produced in the U.S. (25 million pounds) are fed to chickens, turkeys, pigs, and cattle in CAFOs. According to the EPA, as much as 80 percent of antibiotics administered orally to livestock pass through the animals unchanged into manure pits and lagoons, after which they are spread on croplands where they may run-off into waterways.

For Christine Schrum's article on the health hazards of CAFOs, see Hog Confinement Health Risks.

For excellent resources, visit the Jefferson County Farmers and Neighbors website.

Comments (3)

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...
written by greg, August 18, 2009

I would have to agree with Lynn. Me and my family live 2 miles from a large hog operation in north missouri. I personaly think it is the worst thing , that has happened to our comunity, So i can tell you first hand how bad it is. I would like to move but no one will buy our home on account of the smell and concern for there health.
Votes: +6 vote up vote down report abuse

...
written by Lynn, March 14, 2008

Have you been to Bloomfield, Iowa? Now there's a town that's been ruined by hog confinements. No one wants to live where the air smells so bad, and no one can sell their homes. Obviously, Julie doesn't live within smelling range - if she did, she wouldn't be so enthusiastic about them. I wish the legislators who allow such air and land pollution to take place would be required to live next to a CAFO. That would change their minds
Votes: +11 vote up vote down report abuse

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Public Health and Livestock Confinements: Identifying Threats to Human Health

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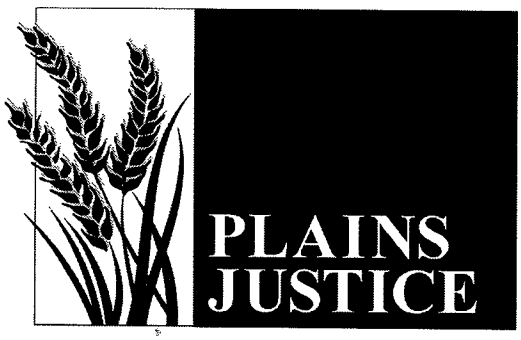


Public Health and Livestock Confinements: Identifying Threats to Human Health

EXECUTIVE SUMMARY

This report highlights recent scientific research on potential public health risks associated with confined animal feeding operations or CAFOs. In particular the report focuses on impacts to air quality, water quality, and pathogens such as viruses and bacteria. The purpose is to provide reliable information, based on a broad review of scientific research currently available, for regulators, individuals, and organizations.

Air quality can be damaged by CAFO emissions including ammonia and hydrogen sulfide, as well as airborne particles. These and other CAFO air pollutants can contribute to respiratory problems such as asthma and difficulty breathing. Ammonia and hydrogen sulfide exposure are associated with strong odors and can result in serious health impacts for CAFO workers. In addition to respiratory effects, particulate matter can increase the risk of heart problems.

Impairments to water quality from manure pollution are also a public health concern. The presence of CAFO-sourced bacteria in recreational waters increases the public health risk associated with water recreation. High levels of ammonia and the resulting hypoxia can impair other recreational activities such as fishing. Bacteria or chemical contamination of ground and surface waters can negatively affect drinking water supplies for those living near or downstream from CAFOs when manure spills occur.

The role of CAFOs in increasing antibiotic resistance among bacteria and the emergence of new strains of viruses is the subject of growing scientific inquiry. Although other factors are also likely involved, the link between CAFOs and pathogens has triggered a number of recent studies. This research indicates that the use of nontherapeutic antibiotics to promote growth or prevent disease is a risky, and perhaps unnecessary, practice.

The report concludes by summarizing various solutions that can reduce possible threats to public health without lasting negative impacts on animal production. Greater awareness of and precautions against air emissions could reduce respiratory and cardiac symptoms associated with CAFOs. Appropriate storage and handling of manure can reduce the likelihood of water contamination, and the elimination of nontherapeutic antibiotics could help reduce the prevalence of antibiotic-resistant bacteria. The report cites successful examples where implementation of these solutions has created little or no economic impact on producers, while significantly improving quality of life near and downstream from CAFOs.

This report has been supported by a donation from Roxanne Conlin of Des Moines, Iowa and by contributions from other Plains Justice supporters.

Public Health and Livestock Confinements: Identifying Threats to Human Health

INTRODUCTION

Changing consumer demands, an increased emphasis on speed and efficiency, and a shifting agricultural economy have led farmers and farm owners to specialize to meet an ever-fluctuating market. Animal production, in particular, has increasingly shifted toward high density confined animal feeding operations (CAFOs) to produce many animals on a small area of land.

Many individual and family farmers have turned to CAFOs as a way to maintain their livelihood. For some, the expected or proposed benefits have not been fully realized. Public health researchers have also raised concerns about the safety of this form of animal agriculture.

The World Health Organization (WHO), Centers for Disease Control and Prevention (CDC), Union of Concerned Scientists, American Academy of Pediatrics, Environmental Integrity Project, Pew Commission on Industrial Farm Animal Production, and Iowa Policy Project are among the organizations that have expressed concerns over the potential threats to public health that CAFOs pose. This report examines some of these concerns, including possible health risks related to air quality, water quality, heavy metals, and pathogens (viruses and bacteria). The goal of this report is to help educate the public about potential health risks associated with industrial animal agriculture practices. Recent research highlights threats to air and water quality and implications for effective medical treatment. The report concludes with possible solutions for mitigating these risks. Through the combined efforts of farmers, regulators, and the public, animal food production practices can be both safe and profitable.

EPIDEMIOLOGICAL EVIDENCE

Epidemiology has a variety of definitions, but it is generally accepted as the study of populations and diseases and of factors that affect health or disease. These can include both internal factors such as genetics and external factors such as environmental exposure. Although direct and irrefutable causal relationships cannot always be identified through epidemiological research, epidemiology is considered a cornerstone of public health and is credited with many historical and current improvements in human health such as vaccinations and smoking prevention. Some of the specific concerns highlighted in this report warrant additional study, but based on existing information there is sufficient evidence to support suggestions and recommendations for protecting public health. Much of the research cited in this report is also consistent with epidemiological guidelines for causal relationships, such as the following:

Replication of findings – multiple sources reporting similar findings

Specificity of the association – symptoms or health factors that are specific, though not necessarily unique, to an identified cause or causes

Biologic plausibility – associations that agree with current knowledge regarding physiology

Temporal relationship – appearance of symptoms that occur in an appropriate time frame relative to the proposed causative event or events

In short, epidemiology takes advantage of both observational and medical data to try to identify and characterize factors that influence disease.[1] Based on this perspective, this report addresses the role of CAFOs as a likely contributing factor to public health problems.

ANIMAL CONFINEMENT OPERATIONS IN IOWA

According to a recent U.S. Department of Agriculture report, Iowa ranks first in the nation for both hog and egg production and second in the nation for commercial red meat production.[2] This translates into large numbers of animals being raised in the state while the total number of farms in Iowa has declined. The result is a smaller overall number of facilities housing many animals in a relatively small area. This also results in each facility generating a quantity of animal waste (such as manure or urine) that may have previously been equivalent to many farms spread out over a larger area. The CDC notes that a small percentage of CAFOs account for more than half of the manure generated nationally[3], which is further evidence that the concentration of animals in confined animal facilities also concentrates potential sources for public health risks.

While swine and poultry are generally housed in confinements with full roofs, cattle are more often confined to open feedlots. Air emissions from swine operations have been more commonly studied as sources of air quality impairment (as will be discussed in further detail later) although cattle and poultry facilities also generate manure and particulate matter that can impair air quality. Both full confinement and open feedlot facilities have the potential to generate large quantities of manure, and both have the potential to result in contamination of waterways.[4] Consequently, this report refers to both full confinement and to feedlot operations as CAFOs in terms of public health risks, though specific risks may vary based on characteristics of individual facilities. Heavy metal pollution is exclusive to poultry operations, while contamination from endocrine disrupting compounds is most associated with cattle operations. Concerns regarding pathogens apply to multiple types of CAFOs. Specifics of these concerns will be addressed in separate sections.

AIR QUALITY ISSUES

Impaired air quality represents serious risks to human health

Researchers have expressed concerns over air quality for residents living near CAFOs.[5,6,7] These include odors, which are generally regarded as a nuisance issue, and impaired air quality, which can be a more serious health hazard. Both have similar causes, and in some cases offending odors are an easily identifiable indicator of poor air quality. For example, ammonia, which is a potentially dangerous air emission, also has a distinctive odor.[9] Gases such as ammonia and hydrogen sulfide and the associated odors are perhaps the most recognizable CAFO air emissions, but other emissions include volatile organic compounds, particulate matter, and microbes.[5,8] These emissions can pose serious potential health risks not only to CAFO workers, but to neighboring homes and communities as well.[5]

Ammonia gas is an irritant, particularly to the eyes and respiratory system. Even short-term exposure may cause eye irritation, coughing, and breathing difficulties. Long-term exposure may impair normal lung function and accelerate normal declines in lung function, such as those associated with increasing age or with preexisting respiratory disease. Persons with existing respiratory problems such as asthma or chronic obstructive pulmonary disease may be particularly sensitive to the negative effects of inhaled ammonia, which can trigger potentially fatal respiratory distress.[9]

Hydrogen sulfide, like ammonia, can irritate the eyes and airways. Even short-term exposure may cause breathing difficulties in persons with asthma. It is unknown if long-term exposure causes changes in lung function because potential effects have not been well-studied to date, but it is likely that long-term effects would be similar to those observed with ammonia exposure.[10]

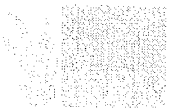
Although exposure to airborne particulate matter is often associated with living in densely populated areas where vehicle and other emissions are a concern, CAFOs also have the potential to generate particulate air pollution in the form of fecal matter, fur, feathers, and dust. The health risks of particulate air pollution are well-documented.[11,12,13] Exposure to particulate air pollution affects heart function and the ability of the heart to respond properly following changes in heart rate. Particulate air pollution is a contributing factor in early death due to respiratory and cardiac effects. Evidence shows that short-term exposure to airborne particulates can contribute to an increased risk of heart attack[11] and may even play a role in triggering heart attacks.[13] Risk is higher for those with pre-existing cardiovascular disease.[11] Long-term exposure to particulate air pollution also increases the risk of cardiac mortality.[12] Respiratory problems, such as those associated with living near CAFOs as a result of exposure to ammonia and hydrogen sulfide, further increase the risk of early mortality.[12] Importantly, similar respiratory and cardiac effects have been shown for larger particulate matter and in healthy young adults, suggesting that air quality may be a serious concern for individuals of all ages and that these effects are not limited to smaller particles.[14]

Taken individually, ammonia, hydrogen sulfide, and particulate matter each represent a serious potential risk to human health. In and around CAFOs, however, this combination leads to documented evidence of health problems. Among the health effects documented for CAFO workers are altered lung function and an assortment of respiratory complications including a worsening of existing asthma, asthma-like symptoms, and chronic bronchitis.[5] Workers in hog confinement facilities have also been identified as being at risk for hydrogen sulfide poisoning as a result of prolonged exposure.[15] CAFO workers are not the only ones at potential risk, however. A study of air quality at residences near a swine CAFO found levels of hydrogen sulfide that were higher than recommended by the Agency for Toxic Substances and Disease Registry for chronic exposure, indicating that those living near CAFOs may also be at risk.[16]

Even short-term exposure can result in symptoms, as illustrated by a study which examined responses to air from a hog CAFO. This study found that even healthy individuals who were exposed for relatively short periods of time reported symptoms such as nausea and eye irritation.[17] This research further illustrates that CAFOs can contribute to health problems for neighbors and communities as a result of air quality impairment, since air samples were diluted to levels that might be found at distance from the generating facility.

Additional evidence that CAFOs may contribute to breathing difficulties can be found by looking at the development of chronic respiratory problems. In Iowa, a study examining asthma rates in schoolchildren found that children living near a CAFO had a significantly higher prevalence of asthma than children who did not live near any large scale farming operation.[18] Although development of asthma is a complex physiological process, it appears likely that environmental exposure to the combination of particulate matter, toxic gases, and airborne pathogens contributes to the development of this serious and costly respiratory illness.[18] The development of chronic respiratory problems, like asthma, in children is a more sensitive measure of the impacts of poor air quality because children and infants are likely to be at higher risk from potential air pollution from CAFOs. This is due to the fact that infants' lungs continue to develop after birth and children are generally more likely than adults to be outdoors and active and have higher rates of respiration. The elderly are also considered a high risk population for air pollution effects since they are more likely to suffer from health problems that will affect cardiac or respiratory function and may be more likely to have declining lung function.

Airborne bacteria pose a separate risk, as discussed in greater detail in a separate section. Briefly, air plumes from CAFOs can carry bacteria to neighboring homes and communities, where they can be inhaled by neighbors and other residents. Although many factors such as wind direction and speed and air temperature may influence the range and area of effect of airborne pollutants, a 2006 study identified airborne bacteria downwind of a swine CAFO. This study recommended that any CAFO be a minimum distance of 200 meters or approximately 0.12 miles from residential areas.[19] Unfortunately, this figure does not take into effect the broader effects of water quality and water supply contamination.



WATER QUALITY

The concept of sanitation – separating human waste from drinking water supplies to limit the spread of disease - is thousands of years old, dating back at least as far as ancient Rome. This common practice is a part of everyday life in developed countries, and a precaution that most city dwellers generally take for granted. This practice, however, does not fully extend to the separation of animal waste from drinking water supplies. In fact, the vast majority of animal manure generated by CAFOs (approximately 500 million tons annually) is untreated and often poorly regulated.[3] Numerous spills have affected rivers and other waterways that provide drinking water both in Iowa and elsewhere, though this report will highlight some of the impacts to water quality in Iowa.

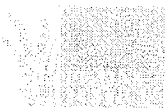
Impairment of Iowa's waterways has been documented

Information from the Iowa Department of Natural Resources (IDNR) provides evidence that manure contamination of Iowa's waterways is a serious problem. IDNR reports that manure spills were responsible for killing over 1 million fish over a five-year period.[20] Similarly, Environmental Integrity Project reported that IDNR had documented at least 329 manure spills, resulting in fish kills totaling more than 2.6 million over the course of a decade.[4] From September 2005 until November 2009, there were at least 66 confirmed or suspected manure spills documented by IDNR, nearly 30% of which resulted in documented fish kills.[21] Manure, ammonia, and bacteria have resulted in many of the state's rivers and streams being declared "impaired" by IDNR.[22] This includes waterways that provide drinking water to Iowa citizens, such as the Raccoon River, as well as hundreds of other bodies of water.[22]

In April 2009, an IDNR report listed 439 waterbodies with a total of 581 impairments.[22] These impairments include indicator bacteria (*E.coli*), biological impairments, or fish kills for rivers and streams; and algae, indicator bacteria, and suspended sediment for lakes. All of these impairments can be attributed, at least in part, to manure spills. In a recent event, an estimated 500 gallons of manure from a hog facility, approximately half of a 1,000 gallon spill, reached a tributary of the Raccoon River[23]. Although manure spills or fish kills in Iowa are often reported by individuals and these reports may or may not be confirmed by IDNR personnel, this event illustrates the type of manure spill events which contribute to impaired waterway designations.

CAFOs may affect entire watersheds

Although there are many public health risks associated with working in or living close to a CAFO, the actual area affected by a CAFO can be considerably larger. Spills that impact waterways can pollute drinking water supplies for hundreds of thousands of residents downstream, many of whom may have not even realize that a CAFO or CAFOs are located upstream. To arrive at appropriate protections against CAFO-sourced water pollution, it is critical to consider impacts on the watershed and not simply the areas immediately surrounding an individual CAFO. It is also important to recognize the cumulative impacts of multiple CAFOs in a particular area.



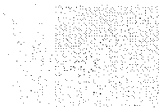
Improperly handled manure contaminates rivers, streams, and groundwater

Manure from CAFOs is often handled in one of two ways – liquid manure may be stored in lagoons on the CAFO property or manure may be stored in piles to dry. Liquid manure can be sprayed onto fields or injected into soil as a fertilizer, while solid or dry manure can be spread directly on fields. Manure application can provide vital nutrients for crops, but even when applied at recommended rates there is the possibility of contamination of waterways as a result of runoff or leaching.[24] A range of physical and mechanical problems can also lead to manure spills, including incidents identified by IDNR such as severed or failed hoses and couplings, plugged or cracked pipes, and storage overflows.[21,24] Manure runoff is also a common source of water contamination.[21,24] Siting of a CAFO is also a possible cause for concern, particularly if it is near a shallow water table or in a flood plain.[24]

Concerns over leaching of manure or manure spills are associated, in part, with concerns that pollutants from animal waste can contaminate recreational or drinking waters. Evidence has shown that both surface and ground water have been contaminated with pollutants from animal waste.[24] Contamination can include pathogens such as fecal bacteria, parasites, and viruses.[24] Animal waste spills can also result in hypoxia and high ammonia levels in the receiving waters, which can contribute to kills of fish and other aquatic wildlife.[24] In contrast to arguments that these effects are transient and short-lived, evidence shows that bacteria and other pathogens may survive for week or months following a spill, resulting in a significant and prolonged risk after only a single manure spill event.[24] Although the risks of drinking water contaminated with pathogens are relatively low for communities with water treatment facilities, contamination can and does occur. One report estimates that as many as 19.5 million illnesses occur each year in the United States, often as a result of often temporary failures at water treatment facilities.[25] These failures mean that contaminants, including fecal bacteria from CAFOs, can infiltrate drinking water supplies. In addition, private water wells are a source of potential exposure.[24] Contamination of recreational waters is also a concern because contact with contaminated water can cause irritation or infection or accidental ingestion may occur.[24]

Algae blooms, which can include increased levels of toxic forms of algae, can also result from manure spills.[24] In addition to producing unsightly algae masses that can impair recreational waterways by clogging watercraft motors or impeding swimming or fishing, these algae blooms can also affect drinking water supplies. In 2009, the Iowa water utility Des Moines Water Works ceased using the Raccoon River as a source of drinking water due to high levels of algae.[26] Although other factors may also contribute to high levels of algae, the link between manure spills and algae blooms suggests that CAFOs may be at least partially responsible for the algae levels found in the Raccoon River.

In addition to concerns over pathogen contamination of in waterways as a result of manure spills, there are concerns specific to the type of waste generated at CAFOs. Manure from CAFOs may also contain hormones, heavy metals, and bacteria or other



pathogens – all of which pose potential hazards to human health if they reach drinking water or infect humans through recreational contact with contaminated water.

Manure runoff pollutes waterways with endocrine disrupting compounds

One of the emerging concerns about manure runoff and contamination of waterways relates to the presence of hormones in drinking and recreational water supplies.[27] Growth-promoting compounds, which can contain estradiol, testosterone, or other steroids, are routinely administered to cattle to promote growth in both steers and heifers.[27] These hormones, which are the same or similar to those found in humans and other vertebrates, are referred to as endocrine disruptors or endocrine disrupting compounds because they have the potential to alter or impair normal hormone regulation such as sexual development. These compounds have been detected in runoff from animal feeding operations, suggesting that the chemicals used in CAFOs to promote growth in livestock are not fully contained in the animals to which they are administered.[27] Both intact hormones and their metabolites can be found in the urine and feces of treated animals[27], and their presence contributes to the risks associated with manure spills. Once introduced to a waterway, these compounds can have serious effects on aquatic life. Research from the University of Nebraska raises concerns about the effects of these hormones in waterways, including disruption of normal sexual development and sexual function in exposed fish.[28] Although these effects have not been documented in humans, the possibility for similar disruption of human health exists as a result of exposure to these CAFO-generated endocrine disrupting compounds in recreational waters or in drinking water supplies.

Arsenic in poultry litter increases the risk of human exposure

The practice of adding arsenic to chicken feed is controversial. Although proponents argue that it improves poultry production by promoting growth and preventing disease, the presence of arsenic in poultry litter is a serious exposure concern.[29] Arsenic is a dangerous heavy metal and a potent carcinogen that is implicated in a variety of health problems in humans. Instantaneous or rapid death can occur at high levels of arsenic exposure, but even lower levels have been implicated in a variety of health problems.[30] Chronic or prolonged exposure to arsenic can contribute to the development of specific types of cancer, including cancers of the skin, lung, liver, and bladder. Arsenic exposure can also damage blood vessels, resulting in impaired cardiovascular function.[30]

If arsenic-containing poultry litter is part of a manure spill, there is the risk of introducing a powerful and dangerous carcinogen into drinking water or recreational waters.[29] Application of poultry litter that contains arsenic can also contribute to increased arsenic content of the soil on which it is spread.[31] This also increases the risk of arsenic leaching into groundwater, where it can contaminate potential drinking water supplies.[32] This combination of factors makes dealing with poultry litter particularly problematic. While solutions such as burning poultry litter or converting it into dry fertilizer pellets have been proposed, the arsenic content of the waste creates a prohibitive health hazard to fully implementing these alternatives to land application.[32]

PATHOGENS

CAFOs are a potential breeding ground for new viruses

In June 2009, the WHO announced that the outbreak of influenza A (H1N1) or "swine flu" had reached pandemic status.[33] Both in the United States and worldwide, the majority of cases of influenza over the months of April to November 2009 were identified as the new H1N1 variant.[34] Although H1N1 mortality has been relatively low and most reported symptoms have been mild to moderate, the concerns expressed by federal, state, and local agencies echo concerns from researchers and scientists regarding animal-derived influenza strains. Unlike seasonal influenza, variations of the influenza virus that incorporate genetic material from swine or poultry, such as H1N1, are of particular concern to humans who may have no natural immunity or resistance to these variations.

Prior to the 2009 H1N1 pandemic, researchers described the likelihood that a pandemic influenza event would originate in animals.[35,36] This prediction was based on evidence that swine workers are at elevated risk of becoming infected with swine influenza[35] and on evidence that CAFOs in particular could serve as amplifiers of a new strain of influenza.[36] Swine are not the only possible source of a new influenza strain, however. Further evidence also suggests that poultry workers may be at risk of infection from avian (bird) influenza variations.[37,38]

Part of the risk of infection associated with CAFOs is based on the number and proximity of animals housed in such facilities.[36,38] Crowded conditions in CAFOs increase the risk of transmission of variants of the influenza virus both among animals and between animals and humans.[36] In a CAFO setting, a single worker may also be exposed to thousands of animals a day, each of which could potentially transmit a virus from animal to human.[38] The possibility of transmission back and forth between species (humans or swine or poultry) and the possibility of transmission from animal to animal (swine to swine or poultry to poultry) also increases the risk of the emergence of a new variation of influenza that could be passed among populations and could contain genetic material from multiple species.[38] Although full details of the origin of H1N1 are not known, the scenario of a pandemic influenza virus that incorporates genetic material from humans, swine, and birds is precisely what has unfolded over the last year.[39]

CAFOs contribute to antibiotic resistance

Antibiotics, also known as antimicrobials, are drugs that kill bacteria which cause illness. Antibiotic resistance is the ability of a pathogen such as bacteria or viruses to withstand the intended effects of an antibiotic.[40] In 2004, the American Academy of Pediatrics released a technical report calling antibiotic resistance "an increasing and serious problem." It also identified the practice of nontherapeutic use of antibiotics in animal agriculture as directly and negatively affecting human health.[41] Other researchers have agreed, citing the nontherapeutic use of antibiotics in animal food production as an important contributor to the emergence of some antibiotic resistant bacteria.[42] Similarly,

the WHO has identified nontherapeutic use of antibiotic use in food animal production as a contributing factor in the rise of antibiotic resistant bacteria.[43]

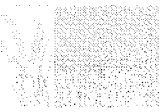
It is estimated that approximately 35%-80% of all antimicrobials used in the United States are used in animal agriculture.[44,45] The majority of these drugs (approximately 75%) are used not for therapeutic purposes such as treating sick animals, but to promote growth or improve feed efficiency in healthy animals.[41] Many of these drugs are the same or similar to those used to treat human disease, which raises concerns over the development of antibiotic resistance.

Controlled study of the practice of administering nontherapeutic antimicrobials showed that (1) antibiotic resistance can develop quickly, (2) single-drug resistance can become multi-drug resistance, (3) drug resistance can spread from animal to animal and from animals to humans, and that (4) stopping the use of antimicrobials decreases drug resistance.[46]

Antibiotic resistant bacteria can reach and infect humans through consumption of contaminated food, through direct contact with animals, or through contamination of soil or water with antibiotic resistant bacteria.[41] The same resistant bacteria found in swine waste lagoons have also been found hundreds of meters downstream[47], which further illustrates concerns over the size of an area that can be affected by a CAFO. Environmental contamination has been demonstrated[48], and there is evidence that antimicrobial residues can be found in animal waste and, consequently, in waste lagoons and on fields where manure is used as a fertilizer. In addition, these residues have been found in both surface and groundwater supplies.[49] Antimicrobials have also been found in private water wells, demonstrating that contamination of drinking water supplies is a reality and not simply a theoretical possibility.[50]

Although antibiotic resistance is a public health concern for people of all ages, children are particularly at risk. *Campylobacter*, the leading cause of bacterial food borne illness, affects infants younger than one year at a rate that is twice that of the general population[51] and 20% of all cases of illness occur in children under 10 years old.[52] Following the approval of the antibiotic fluororquinolone in poultry, infections in humans with a drug resistant form of *Campylobacter* increased. Although a specific causal relationship is difficult to confirm, the increase in drug resistant *Campylobacter* occurring subsequent to an increased use in poultry meets epidemiological evidence criteria. Yet another concern associated with a greater prevalence of antibiotic-resistant Campylobacter is that drug-resistant strains of bacteria may be more dangerous than those that are sensitive to antibiotics.[41]

Salmonella, another common bacteria that can be found in food, accounts for an estimated 600 deaths per year, mostly in the elderly and the very young.[53] Once again, children are at particular risk since more than a third of all cases occur in children under the age of 10.[52] As early as 1984, scientists had evidence that antibiotic resistant bacteria from animal fed sub-therapeutic doses of antibiotics could result in contamination of meat and subsequent infections in humans.[54] As a result of increasing drug resistance,



the treatment of young children and adults infected with *Salmonella* has become increasingly difficult.

In addition to concerns regarding contaminated food, another risk to public health – *methicillin resistant Staphylococcus aureus* (MRSA) - has been gaining broad attention. The antibiotic vulnerable form of this bacteria (*Staphylococcus aureus*) is relatively widespread, occurring in approximately one-third of the United States population, while MRSA prevalence is considerably lower. Though individuals can carry either antibiotic vulnerable and antibiotic resistant strains without developing infections, there is evidence that infection with MRSA results in both longer and more costly hospital stays than infection with the antibiotic vulnerable bacteria.[55] Historically, MRSA infections have been most commonly associated with exposure in a health care setting though exposure outside of health care settings, also referred to as community-acquired infections, may be on the rise. This potential rise in MRSA infection from community or unidentified sources has significant public health concerns. The United States' burden of MRSA in a single year (2005) was estimated at 94,000 infections and 18,000 deaths,[56] and personal and financial costs are likely to escalate as MRSA becomes more prevalent. While some sources of MRSA remain unidentified, evidence from the Midwest shows that both swine and swine workers can serve as a reservoir for MRSA. In fact, a study of swine and swine workers in Iowa and Illinois showed that both animal and human populations were colonized with the same strain of MRSA, suggesting that bacteria are transmitted between humans and animals and that swine and swine workers may be a potential source of MRSA.[57] As with other bacteria, the increasing prevalence of resistant strains limits options for successful and effective treatment.

Quite simply, with few to no new antibiotics being developed, medicine is running out of effective drugs with which to treat those infections. And without effective treatments, these infections can become life-threatening more costly to treat and more likely to become life-threatening.

SOLUTIONS

This report highlights some of the public health concerns related to CAFOs. As with many potential public health threats, one of the crucial first steps is the identification of factors that may contribute to impaired health of affected populations. Once this is accomplished and likely contributing factors are known, subsequent steps can be taken to address these concerns. While some of the potential health risks associated with CAFOs are serious, the following recommendations could help reduce or eliminate many of the issues described in this report.

1. Improve emission control to reduce air quality impairments

Improved monitoring and surveillance of air quality in areas surrounding CAFOs would not only provide researchers with additional information on the extent of possible health effects, but it could also provide CAFO owners and operators with the necessary data to

measure improvements in air quality as a result of technological or procedural changes. A University of Iowa report on CAFOs and air quality lists a variety of possible solutions to reduce air emissions, including frequent manure removal and treating the air from building where animals are housed, covers for manure storage, and land application recommendations.[58]

2. Proper manure management to reduce or eliminate spills

As noted previously, a variety of equipment or storage facility failures can result in manure spills. These types of events might be avoided through better monitoring or maintenance of facilities and equipment. Improper manure management, including over-application, misapplication, and inadequate storage, also contribute to manure spills. Improved knowledge of and attention to proper manure management standards and recommendations, such as those outlined by the EPA and other agencies, could help reduce manure spills.

3. Remove arsenic from poultry feed to limit exposure

Arsenic is not spontaneously generated by normal biological or physiological processes of poultry growth and development. The source of arsenic in poultry litter is entirely of artificial origin. The elimination of arsenic from poultry feed, would remove a potential challenge to waste disposal[32] and remove a source of exposure for a toxic and dangerous compound. Furthermore, evidence from Denmark indicates that overall no negative effects on poultry production result from the elimination of arsenic from poultry feed.[59]

4. Utilize vaccinations and basic safety precautions to limit the spread of influenza

According to researchers, including CAFO workers in vaccination programs could help limit or even prevent the spread of influenza.[35] In addition, basic sanitary practices such as hand washing and the use of personal protective equipment could also help protect CAFO workers from infection.[60] As discussed previously, limiting the spread of influenza to humans who work with animals could limit opportunities for viruses to proliferate and mutate into new strains.

5. Eliminate the use of nontherapeutic antibiotics to reduce the prevalence of antibiotic resistant pathogens

By 1999, Denmark had eliminated the use of antimicrobials as growth promoters in cattle, broilers, and hogs.[59] Although some reports have inaccurately indicated that therapeutic use of antimicrobials increased as a result, both the WHO and Danish scientists have clarified that overall increases in antibiotic use were not found. The elimination of nontherapeutic antibiotics also did not affect productivity or profitability overall.[59,61] Furthermore, this change resulted in significant reductions in observed antibiotic resistant pathogens and bacteria.[61] The substantial reduction in antibiotic resistant bacteria subsequent to the elimination of nontherapeutic antibiotics in food

production serves as additional epidemiological evidence that CAFOs contribute to antibiotic resistance.[59]

The preceding steps outline some of the methods possible for reducing or eliminating certain public health risks associated with CAFOs. Importantly, these steps may have no negative effects on overall food production or on profitability of CAFOs. Through cooperation and communication, food producers and regulators can protect human health by making CAFOs less likely to impair air or water quality without impairing food production. As stated previously, the purpose of this report is to help educate individuals and regulators about some of the possible public health risks associated with CAFOs while providing basic information on how to limit and eliminate those threats.

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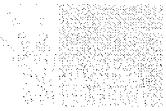

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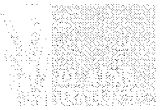

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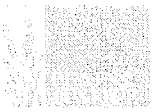

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