Outbreak Investigation in Healthcare Settings

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Outline

- Review steps
- Common problems and scenarios
STEPS TO AN INVESTIGATION IN A HEALTHCARE SETTING
Take a Systematic Approach to Investigation

- Confirm the outbreak/establish background rate
- Confirm the diagnosis
- Define a case
- Case finding
- Line list
- Determine who is at risk
  - Observations
  - Interviews
  - Case review
- Develop a hypothesis
- Test hypothesis
- Follow-up/Communicate results
Key Point

- Outbreaks can be chaotic
- Might not proceed step by step
- Important that you consider each step
- Multiple steps may happen at once
- Might repeat steps
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Is It an Outbreak?

• For epidemiologists:
  – An increase in the incidence of a disease above what is normally expected
  – What is the background rate?

• Is it important?
  – One case can be an outbreak and may require investigation:
    • One case of healthcare associated \textit{Legionella}
    • First case of an important MDRO
  – May have lots of cases and may not be important

• Outbreak vs. cluster - basically the same
Pseudo-outbreaks

• Increase related to something other than an increase in true disease
  – New definitions
  – New tests
  – Change in culturing practices
  – Laboratory contamination
  – Misdiagnosis

• May still be important
M. abscessus

- 143 cultures positive in 2005-2006
- Indistinguishable by PFGE, took a long time to grow
- Clinical cultures from incubator grew M. abscessus
- Uninoculated control tubes also grew
M. abscessus

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- Indistinguishable by PFGE, took a long time to grow
- Clinical cultures from incubator grew M. abscessus
- Uninoculated control tubes also grew
How to Identify Outbreaks

• Surveillance systems
• Providers (“the astute clinician”)
• Reports from public health
• Laboratory reports
Not all Outbreaks Need a Large Investigation

• Sometimes common problems occur that are related to common breaches

• In these instances implementing well known interventions might control/resolve the problem

• Be cautious of the urge to continually “throw” interventions at a problem you don’t understand
Literature Review

• Is an important place to start.
• There are LOTS of published outbreak investigations- 71,688 as of March 2010!
• You will get good leads both on where and how to start your investigation.
  – What associations have been found before
  – Niches for organisms
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Case Definition

- Description of what you are looking for
- Narrow enough to focus efforts but broad enough to catch all the cases
- Orient with respect to person, place and time
  - An MRSA SSI developing in a person after undergoing cardiac surgery at hospital A between January 1 and December 31
- May change as time goes on
- Don’t get bogged down -- Goal is not to capture all cases!
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How do You Find Cases?

• Microbiology data
• Infection control or surveillance records
• Discussions with clinicians
• Pharmacy records
• Medical records
• Pathology reports
Case Finding Issues

• Remember goal is to stop the outbreak – do not need to find every case
• Finding patients with sub-clinical infections
  – Colonization – surveillance cultures
  – Empiric antibiotics – use of confirmed and possible case definitions
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Line listing from investigation of outbreak of gastroenteritis, Oswego, New York, 1940

<table>
<thead>
<tr>
<th>ID</th>
<th>AGE</th>
<th>SEX</th>
<th>TIME OF MEAL</th>
<th>ILL</th>
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<td>Y</td>
<td>4/18</td>
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Food items considered:
- Baked ham
- Spinach
- Washed potatoes
- Cabbage salad
- Jello
- Rolls
- Brown bread
- Coffee
- Water
- Cakes
- Ice cream
- Fruit salad
What do You put on Your Line List?

• Important dates (e.g., surgery)
• Admission dates
• Invasive procedures, surgery
• Staff contact
• Outcomes
• Lab results
• Medications
• Locations
### NSF Cases in Hospital A by Detection Date, City X 2002-06 (3\textsuperscript{rd} Qtr.) (n=27*)

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<th>Quarter and Year</th>
<th>Cases</th>
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<td>2002 3rd</td>
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<td>2002 4th</td>
<td>0</td>
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<td>2003 1st</td>
<td>0</td>
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<td>2003 2nd</td>
<td>0</td>
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<tr>
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<td>2004 1st</td>
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<td>2004 2nd</td>
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<td>2006 2nd</td>
<td>4</td>
</tr>
<tr>
<td>2006 3rd</td>
<td>1</td>
</tr>
</tbody>
</table>

*Note: Confirmed Case = Cyan, Suspect Case = Orange.
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Case Reviews

• More in depth chart review
• Looking for things that you might not have captured in your initial line list
• Previous literature might help determine things you should capture
Observations

• Might vary depending on outbreak scenario
• Talk to lots of people
  – What do they think the problem is?
  – How do things they are doing compare to protocols?
• Commonly observed practices
  – Hand hygiene
  – Surgical procedures
  – Use of Contact Precautions
  – Medication preparation
  – Respiratory Therapy
  – Environmental cleaning
Observations: Environmental Services

**Pros**
- Objective way to evaluate cleaning
- Opportunity to provide feedback
- Relatively simple

**Cons**
- Not completely standardized
- May not be completely representative
- May be perceived as punitive
Apply Environmental Marker

Soap dispenser

telephone

Light switch

Counter top

Call button
Observe under Black Light
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Implement Control Activities
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Environmental Sampling

- Often jumped to as an initial step but best to let epidemiology guide sampling
  - Allows for interpretation of results
- Understand limitations
  - Most clinical labs not set up to do this
  - Best to work with labs that are experienced
  - Expensive
- Certain organisms may make environmental sampling more useful
Water Cultures

• Often performed in outbreaks of Gram-negative rods, especially Pseudomonas and other rare GNR and non-tuberculous mycobacteria.
Challenges with Water Cultures

• Organisms reside in biofilms and might be released in detectable numbers only intermittently (e.g. during construction).

• Water pathogens have often adapted to live in low nutrient environments
  – Don’t grow well on standard media.

• Most tap water has residual chlorine which decreases the yield of cultures.
Surface Sampling

• Surface contamination has been reported as a source in outbreaks of Acinetobacter, VRE, C. difficile

• Best not done on things like walls and floors
  – Think of mechanisms of transmission
Challenges with Surface Sampling

• Surface contamination is not uniform and widely used methods can only sample a very small surface area.
  – No “standard method”

• Organisms have different survival capacities on surfaces

• Even with the best methods and a known inoculum the yield in getting bacteria off surface is low.

• Yield is further diminished by residual surface disinfectants.
Primary advantage of sponge wipes = Increased Surface Area

Traditional swab - limited to about 2 square inches per swab

Sponge wipes - can sample up to several square feet

In our investigations, sponge wipes have been positive in several instances when many swabs were negative.
Cluster identified
Terminal clean/active surveillance
CDC team arrives

Cases MDR-Ab, Hospital A,
October 2006-July 2007 (N=13)

- Intensive Care Unit (ICU)
- Telemetry Unit (Tele)

Cases

Month

July '06 Aug Sep Oct Nov Dec Jan '07 Feb Mar Apr May June July

Cluster identified
Terminal clean/active surveillance
CDC team arrives
Laboratory Results

• Case-patient isolates indistinguishable (ST10)
• Outbreak strain (ST10) recovered from two x-ray machines
• All isolates multi-drug resistant
Analytic Study

• Not always necessary
• Time consuming and challenging
• Small number of cases limits power
• Can be useful for supporting your hypothesis if no obvious source identified
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Follow-up

• Follow-up investigation
  – On-going case finding/surveillance
  – Review of control measures

• Communication
  – Keep administrators and stakeholders in the loop
  – Let PIO know and have talking points available if expect press attention
COMMON PROBLEMS AND SCENARIOS
Community as Setting for Outbreak

• Many investigations have focused on individual institutions (or units)
• Outbreaks (particularly of new MDROs) can be community-wide
• Coordinated effort might be required across multiple facilities
• Possible role of public health
Injection Safety-related Investigations
Healthcare-associated HBV/HCV outbreaks by year reported – July 1998 to June 2009

- 51 outbreaks  (42 non-hospital)
  - 17 long-term care
  - 16 outpatient settings
  - 9 hemodialysis
  - 9 hospital
- >75,000 persons potentially exposed
- 620 persons newly infected

Thompson et al. Annals of Int Med, 2009; and unpublished data
The Las Vegas Outbreak: Mechanism

- Two breaches contributed to transmission:
  - Re-entering propofol vials with used syringes
  - Using contents from these single-dose vials on more than one patient

MMWR 2008 57(19);513-517
Not all Outbreaks are Infectious

• Particularly problematic because there is not a great system to rapidly identify these clusters
  – The “Astute Clinician”
  – Public Health
  – MedWatch
A New Disease – Nephrogenic Systemic Fibrosis

- First identified in late 1990’s
- Characterized by thickening and hardening of skin
- Occurs only in dialysis patients
- Variable course
- Unknown cause
Noninfectious Outbreak

• January 7, 2008 DHQP got a call from a hospital epidemiologist about a group of anaphylactic reactions in kids undergoing dialysis...
<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Facilities with cases</th>
<th>Facilities without cases</th>
<th>P-value</th>
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<tr>
<td></td>
<td>N=21 Number (%)</td>
<td>N=23 Number (%)</td>
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<tr>
<td><strong>Heparin Used</strong></td>
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<tr>
<td>Baxter*</td>
<td>21 (100%)</td>
<td>1 (4%)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Abraxis</td>
<td>2 (10%)</td>
<td>20 (87%)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Other*</td>
<td>0 (0%)</td>
<td>2 (9%)</td>
<td>0.49</td>
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<td><strong>Dialyzer Type</strong></td>
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<td>Gambro</td>
<td>10 (48%)</td>
<td>8 (35%)</td>
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<tr>
<td>Fresenius</td>
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<tr>
<td>Other</td>
<td>7 (33%)</td>
<td>6 (27%)</td>
<td>0.75</td>
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<tr>
<td>Reuse dialyzers</td>
<td>15 (71%)</td>
<td>9 (39%)</td>
<td>0.04</td>
</tr>
<tr>
<td>Prime returned to patient</td>
<td>11 (52%)</td>
<td>13 (59%)</td>
<td>0.76</td>
</tr>
<tr>
<td>More than 70 patients</td>
<td>10 (48%)</td>
<td>12 (52%)</td>
<td>1.00</td>
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U.S. Identifies Tainted Heparin in 11 Countries

By Gardner Harris
Published: April 22, 2008

http://www.fda.gov/bbs/topics/news/heparin/heparinmap.html

FDA Links More Deaths to Blood Thinner

Apr 8, 2008

Contaminant In Heparin Is Identified
FDA Investigating Manufacturing Process

By Marc Kaufman
Washington Post Staff Writer
Thursday, March 20, 2008
Some Common Associations…

• If narcotics are involved:
  – Think of diversion as a possibility
• If healthcare-associated meningitis:
  – Think of injection safety issues or failure to wear a mask during spinal procedures
• If hepatitis B (or maybe hepatitis C transmission), particularly in long term care/assisted living:
  – Consider blood glucose monitoring as potential source
• If outbreaks of *Acinetobacter*, CDI (or maybe *Enterococcus*):
  – Think about contamination of shared equipment