Basics of Outbreak Management
Dr. William R. Jarvis, Jason and Jarvis Associates
A Webber Training Teleclass

Hosted by Paul Webber
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Basics of Outbreak Management

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Purpose

1. Review the approach to investigating outbreaks in healthcare facilities.
2. Illustrate the value of combined epidemiologic and laboratory investigations.
3. Illustrate how YOU can impact on patient outcomes (locally and nationally) through outbreak investigations.

Epidemic

- Increase in incidence beyond the expected in a defined geographic area, within a defined period of time.
- A significant increase (p < 0.05) in the rate of adverse events above that noted in the past.

Nosocomial Infections and Outbreaks

- Each year 2 million patients acquire a healthcare-associated infection*
- Outbreaks:
  - Among hospitals in the National Nosocomial Infections Surveillance (NNIS) System, 5% of healthcare-associated infections occur in epidemics/outbreaks**
  - Most are small clusters; many are unrecognized
  - Outbreaks can lead to morbidity, mortality, consume time, effort and resources


“By definition, all outbreaks are preventable.”

Richard P. Wenzel

Nosocomial Infections

- Endemic infections
  - sporadic
  - 1/3 preventable?
  - majority of infections
- Outbreaks/Epidemics
  - significant increase from endemic rate
  - minority of infections
  - 100% preventable
### Implicit Assumptions
- Case definition has not changed.
- Methods for diagnosing the disease or identifying the organism have not changed.
- Case finding methods have not changed.

### Pseudoepidemic
- Real clusters of false infections
- False clusters of real infections

### Pseudoepidemics
- 20 (11%) of 181 nosocomial epidemics investigated by the CDC between 1956 and 1975 were pseudoepidemics.
- 55% resulted from errors of collecting, handling, or processing specimens.
- 30% resulted from surveillance artifacts.
- 15% resulted from errors of clinical diagnosis.

Weinstein and Stamm, Lancet 10/22/77

### Goals of an Outbreak Investigation
- Identify the etiologic agents
- Identify the reservoir(s)
- Identify the mode of transmission
- Eliminate the reservoir(s) and transmission
- Prevent future outbreaks

### Two Approaches to Outbreak Investigation
- Quick and dirty
- Detailed epidemiologic and laboratory investigation

### The Quick and Dirty Outbreak Investigation
- Quickest
- Least expensive
- Approach
  - Case definition
  - Case ascertainment
  - Line list
  - Identify common exposures
  - Introduce control measures.
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The Detailed Outbreak Investigation

- Personnel and resource intensive
- Combines epidemiology and laboratory investigations.
- Least expensive
- Approach
  - Case definition
  - Case-ascertainment
  - Line-list
  - Epidemic curve
  - Comparative study (case-control, cohort, personnel, etc.)
  - Laboratory studies (e.g., inanimate/animate cultures, isolate comparison)
  - Observational studies
  - Introduction of control measures
  - Post-outbreak surveillance to document termination of the outbreak

Microbiology Laboratory

- Important source for case finding if you know the etiologic agent
- Identify the organisms as completely as possible
  - Genus and species
  - Epidemiologic typing
- Save all isolates!!

Case Definition

- A description of the cases that changes as new data are accumulated, include time, place and person.
- Example (who, what, when and where):
  - SSI outbreak. Pus at the operative site in a patient in the SICU at Hospital A from May 1-10, 2005 with wound or blood cultures positive for MRSA that has a particular PFGE pattern.

Literature Review

- What is the usual reservoir?
- What is the usual mode of transmission?
- Has it been reported to cause outbreaks?
- What factors were important in those outbreaks? (IV lines, contaminated products or food items, respiratory therapy, breaks in sterile technique, etc.)?

Define the Extent of the Problem

- Surveillance system
- Microbiology laboratory
- Employee health
- Other healthcare facilities
- City, county, state, federal health agencies
- Reference laboratories

Attack Rate

- Number of patients affected divided by number of patients at risk
- Number of infections divided by number of patients at risk
- Number of adverse outcomes divided by number of patients at risk

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## Epidemic Period
- The time from the onset of the first case to the cases currently under investigation

## Pre-Epidemic Period
- Arbitrarily defined period of time that is long enough to provide sufficient cases of a low frequency event
- Usually at least 6 months of surveillance data should be examined
- 12 months will avoid seasonal bias

## Epidemic Curve
- Graphic display of outbreak with time (minutes, hours, days, weeks, months, years) on the X-axis and the number of persons meeting the case definition on the Y-axis.
- Both pre-epidemic and epidemic periods should be plotted.

## Search for Risk Factors: The Line Listing
- Admission date
- Infection data
- Demographic data
- Underlying diseases
- Pre-infection exposures to
  - service
  - Ward, unit, bed or room e.g., operating)
  - Diagnostic tests
  - Therapeutic interventions
  - Personnel

## Form a Hypothesis
- Using data from the epidemic curve, line-listing, literature, etc. form a hypothesis regarding:
  - the reservoir
  - the mode of spread

## Test the Hypothesis Using a Comparative Study
- Case-control study
- Cohort study
- What factors determine the choice?
  - Number of cases
  - Duration of the outbreak
  - Rarity of the adverse event
  - How much time you have

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### Test the Hypothesis Using a Case-Control Study

- Cases are compared to controls.
- The proportion in each group exposed to various risk factors are compared.
- Were case-patients exposed to a risk factor that controls were not exposed to?
- Is the association statistically strong (Chi-square or Fisher’s exact test $p < 0.05$)?

### Selecting Controls

- Choose patients from appropriate subpopulation
- 2 to 4 controls per case, if fewer than 10 cases
- Initially don’t match
  - Stringent matching obscures risk factor
  - Can’t analyze matched variables

### Clues Important in Investigating an Outbreak

- Multiple organisms causing infection at a single site or associated with invasive procedures may suggest problems with aseptic technique
- A single organism, particularly clonal, suggests a common source.
- The epidemic curve may suggest the mode of transmission
- An unusual organism may be a clue to a problem (*Enterobacter cloacae*, *Enterobacter agglomerans*, *Salmonella muenchen*)

### Epidemiologic Typing

- Epidemiologically related isolates:
  - Are derived from a single clone
  - Share characteristics that differ from those of epidemiologically unrelated isolates
- Are isolates from > 2 patients or from patients & environment the same or different?
- Doesn’t replace epidemiological analyses!!!

### Evaluating Typing Systems

- **Typeability:** Ability to obtain an unambiguous positive result for each isolate analyzed
- **Reproducibility:** Ability to give the same result each time a strain is tested
- **Discriminatory power:** Ability to differentiate among unrelated strains

### Hierarchical Approach to Typing

- Start with simple, inexpensive, readily available tests
- Do more expensive, more difficult, less readily available tests only if the clinical, epidemiologic, and microbiologic data indicate that they are necessary
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Phenotypic Techniques

• Colony morphology  
• Biotyping  
• Serotyping  
• Phage typing  
• Immunoblotting  
• Antimicrobial susceptibility  
• Multilocus enzyme electrophoresis

Characteristics of Phenotypic Typing Systems

<table>
<thead>
<tr>
<th>Typing System</th>
<th>Proportion of Strains Typeable</th>
<th>Reproducibility</th>
<th>Discriminatory Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biotyping</td>
<td>All</td>
<td>Poor</td>
<td>Poor</td>
</tr>
<tr>
<td>Antibiogram</td>
<td>All</td>
<td>Good</td>
<td>Poor</td>
</tr>
<tr>
<td>Serotyping</td>
<td>Most</td>
<td>Good</td>
<td>Variable</td>
</tr>
<tr>
<td>Phage typing</td>
<td>Most</td>
<td>Fair</td>
<td>Variable</td>
</tr>
<tr>
<td>Immunoblotting</td>
<td>All</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>MLEE</td>
<td>All</td>
<td>Excellent</td>
<td>Good</td>
</tr>
</tbody>
</table>

Maslow & Mulligan ICH E 17:595-604:1996

Molecular Techniques

• Cellular fatty acids  
• Pyrolysis mass spectrometry  
• Whole cell polypeptide analysis  
• Plasmid pattern analysis (PPA)  
• Ribotyping  
• Pulsed Field Gel Electrophoresis (PFGE)  
• Polymerase chain reaction (PCR)

Characteristics of Genotypic Typing Systems

<table>
<thead>
<tr>
<th>Typing System</th>
<th>Proportion of Strains Typeable</th>
<th>Reproducibility</th>
<th>Discriminatory Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>PPA</td>
<td>Most</td>
<td>Fair</td>
<td>Variable</td>
</tr>
<tr>
<td>REA</td>
<td>All</td>
<td>Variable</td>
<td>Variable</td>
</tr>
<tr>
<td>Ribotyping</td>
<td>All</td>
<td>Excellent</td>
<td>Good</td>
</tr>
<tr>
<td>PFGE</td>
<td>All</td>
<td>Excellent</td>
<td>Excellent</td>
</tr>
<tr>
<td>PCR</td>
<td>All</td>
<td>Excellent</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

Maslow & Mulligan ICH E 17:595-604:1996

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PFGE: Advantages

- Less hands-on-time
- All organisms should be typeable
- Less nonspecific shearing of DNA
- Fewer bands per pattern/easier to read
- Does not require probes; can be extended to include probes
- May be more discriminatory than ribotyping

PFGE: Disadvantages

- High start-up costs
- Method/interpretation not standardized
- May need two gels to visualize upper and lower MW ranges
- Takes longer than PCR

Polymerase Chain Reaction

- Arbitrarily primed PCR (AP-PCR)
- Randomly amplified polymorphic DNA (RAPD)
- Specific sequence polymorphisms
- Polymerase chain reaction ribotyping

PCR: Advantages

- Rapid
- Relatively inexpensive
- Universally applicable
- Types organisms that:
  - grow slowly or not at all in vitro
  - are nonviable
  - are in tissues
  - are hazardous to grow
PCR: Advantages

- Can use sheared/single-stranded DNA
- Can use nanogram amounts of DNA
- Good discrimination for some organisms
- Can use endonucleases to increase discrimination
- Equipment/method can be used for diagnostic tests

PCR: Disadvantages

- Amplifies any contaminating DNA
- Sensitive to conditions—Mg, temp
- Method/interpretation not standardized
- May be difficult to identify good primers
- Each primer requires a separate gel
- Limited data

Comparison of Typing Methods

<table>
<thead>
<tr>
<th></th>
<th>PPA</th>
<th>PFGE</th>
<th>PCR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supplies $/run</td>
<td>8</td>
<td>17</td>
<td>8</td>
</tr>
<tr>
<td>Hands on time (min)</td>
<td>120</td>
<td>125</td>
<td>90</td>
</tr>
<tr>
<td>Overall time (days)</td>
<td>1.5</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Equip. costs ($)</td>
<td>2,000-4,000</td>
<td>15,000-20,000</td>
<td>10,000</td>
</tr>
</tbody>
</table>

One Hospitals Approach

- The microbiology lab:
  - saves all isolates from normally sterile body sites and all nosocomial infections
  - processes surveillance cultures and cultures of the environment as necessary
  - does ribotyping (via RiboPrinter) and/or PFGE to determine whether isolates are the same

Serratia marcescens Bloodstream Infections in a Surgical Intensive Care Unit

Background

Events at Hospital A:
- July to September 1998
  - 9 episodes of Serratia marcescens bloodstream infection in the Surgical Intensive Care Unit (SICU).
- September 1998 to February 1999
  - Extensive culturing did not reveal a source.
- By March 1999
  - More than 10 additional S. marcescens bloodstream infections detected; CDC assistance requested.

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Background

- Hospital A
  - 455 bed tertiary care facility
  - Level 1 trauma center
  - Several Intensive Care Units (ICU)- geographically separated
  - Surgical Intensive Care Unit (SICU)
    - Three stations
    - 150-200 admits per month
    - Most common admission-post cardiac bypass
    - 12% admits trauma

S. marcescens, gram-negative bacilli

- Found in water and the environment.
- It is not a part of the normal human flora.
- Rare, but serious cause of infection*
  - Urinary tract
  - Wound
  - Bloodstream
- Hospital outbreaks from diverse sources.


S. marcescens Outbreaks

<table>
<thead>
<tr>
<th>Source</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure transducers</td>
<td>Donowitz, JAMA, 1979 Villarino, JCM, 1989</td>
</tr>
<tr>
<td>Flexible bronchoscopy</td>
<td>Web, Chest, 1975</td>
</tr>
<tr>
<td>Employees hands/nails</td>
<td>Passaro, JID, 1997</td>
</tr>
<tr>
<td>Reduced nurse:patient ratio</td>
<td>Archibald, Ped Infect Dis, 1997</td>
</tr>
</tbody>
</table>

Comparisons

Review of clinical microbiology data for Serratia spp. blood culture isolates at Hospital A:

<table>
<thead>
<tr>
<th>Location</th>
<th>Location: SICU</th>
<th>Hospital-Non SICU</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Isolates/1000 patient days)*</td>
<td>6.17</td>
<td>0.056</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

In SICU over time:

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>(Isolates/1000 central line days)*</td>
<td>8.07</td>
<td>0.13</td>
</tr>
</tbody>
</table>


Case Definition

- Case-patients: SICU patients at Hospital A with a S. marcescens bloodstream infection
- Epidemic Period: June 30, 1998-March 18, 1999

Distribution of S. marcescens Bloodstream Infections, Hospital A

Number of patients

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Case-Patient Characteristics (n=26)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male, n (%)</td>
<td>17 (65)</td>
</tr>
<tr>
<td>Age, years mean (range)</td>
<td>48 (17-87)</td>
</tr>
<tr>
<td>SICU stay, days median (range)</td>
<td>14 (3-40)</td>
</tr>
<tr>
<td>Mortality, n (%)</td>
<td>3 (12)</td>
</tr>
</tbody>
</table>

Case-Infection Characteristics n=26 (%)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polymicrobial</td>
<td>8 (31)</td>
</tr>
<tr>
<td>– with Enterobacter sp.</td>
<td>7 (27)</td>
</tr>
<tr>
<td>Persistent bacteremia</td>
<td>13 (50)</td>
</tr>
<tr>
<td>On antibiotics at time of culture</td>
<td>18 (69)</td>
</tr>
</tbody>
</table>

Control/Containment

- Assessment for patient colonization
  - Evaluation of all SICU patients on the one day 3/17/99
  - Tracheal or urine sample within 7 days*
  - Of 24 patients samples, only 1 patient with tracheal Serratia colonization
- Review of microbiological data for clinical isolates of Serratia spp. at other anatomical sites-rare

Control/Containment

- Assessment for environmental contamination
  - Cases in all 3 nursing stations, in >10 patient rooms
  - Multiple cultures (>50 done by infection control staff 9/98 to 3/99)- no Serratia spp.

Case Control Study Definitions

- Epidemic period: June 30, 1998-March 18, 1999
- Case-patients: SICU patients with an S. marcescens bloodstream infection
- Control-patients: Randomly selected SICU patients with a >48 hour stay during epidemic period and with no gram-negative organism bloodstream infection

Summary of Factors Evaluated*

<table>
<thead>
<tr>
<th>Factor</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respiratory care</td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td></td>
</tr>
<tr>
<td>Surgical procedure</td>
<td></td>
</tr>
<tr>
<td>Intubation/mechanical ventilation</td>
<td></td>
</tr>
<tr>
<td>Mortality**</td>
<td></td>
</tr>
<tr>
<td>Increased for cases if definite and possible cases included</td>
<td></td>
</tr>
</tbody>
</table>

Risk Factors for *S. marcescens* Bloodstream Infection

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Cases n=26 (%)</th>
<th>Controls n=65 (%)</th>
<th>Odds Ratio</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trauma</td>
<td>16 (62)</td>
<td>14 (22)</td>
<td>6</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Transfusion</td>
<td>26 (100)</td>
<td>52 (80)</td>
<td>Undefined</td>
<td>0.02</td>
</tr>
<tr>
<td>Bronchoscopy</td>
<td>11 (42)</td>
<td>4 (6)</td>
<td>11</td>
<td>&lt; 0.001</td>
</tr>
</tbody>
</table>

Evaluation of Fentanyl Exposures

<table>
<thead>
<tr>
<th>Fentanyl Exposure</th>
<th>Cases n=26 (%)</th>
<th>Controls n=65 (%)</th>
<th>Odds Ratio</th>
<th>p-values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fentanyl in SICU</td>
<td>25 (96)</td>
<td>29 (45)</td>
<td>31</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Continuous infusion in SICU</td>
<td>25 (96)</td>
<td>24 (37)</td>
<td>42</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Days of fentanyl, median (range)</td>
<td>5 (1-27)</td>
<td>2 (1-7)</td>
<td>-----</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Total amount (cc)</td>
<td>28,000</td>
<td>6,100</td>
<td>-----</td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>

**Medications**

- Fentanyl:  
  - Analgesia and sedation  
  - Opiate narcotic, 80 times more potent than morphine  
  - Used widely at Hospital A- OR, SICU, MICU  
  - Can be given multiple routes  
    - Continuous infusion ✓  
    - Intravenous bolus ✓  
    - Epidural infusion ✓  
    - Oral x


**Tracking of Medications - an Observational Study**

Did the Fentanyl get contaminated?  
How?

Contamination:  
- Intrinsic - in manufacture  
- Extrinsic - after manufacture

Infusions bags are taken from 2 cases (#21 & #24) at the time of their symptoms

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Laboratory Cultures

**Fentanyl related:**

- Ampules outside SICU: negative
- Ampules inside SICU: negative
- Equipment, infusion bags: negative
- Infusions: positive*

* Cultures positive for *S. marcescens, E. cloacae* from infusions from 2 cases

Laboratory Results

- *S. marcescens* isolates from 24/25 case-patients related by pulsed-field gel electrophoresis (PFGE)*
- All 7 *Enterobacter* isolates were indistinguishable by PFGE
- Confirmed fentanyl infusion growth

*Exception: 1 cases where *S. marcescens* was not related, did not get fentanyl infusion

### Personnel Study

- Patient care provided by many healthcare workers
- Reviewed medical records for exposure to healthcare workers
  - ~ 100 SICU nurses
  - ~ 80 physicians
  - ~ 50 respiratory therapists (RTs)

### Respiratory Therapist (RT) Exposures

<table>
<thead>
<tr>
<th>Therapist</th>
<th>Cases n=26 (%)</th>
<th>Controls n=65 (%)</th>
<th>Odds Ratio</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>RT3</td>
<td>18 (69)</td>
<td>20 (31)</td>
<td>5.1</td>
<td>0.001</td>
</tr>
<tr>
<td>RT11</td>
<td>19 (73)</td>
<td>25 (39)</td>
<td>4.3</td>
<td>0.004</td>
</tr>
<tr>
<td>RT13</td>
<td>19 (73)</td>
<td>21 (32)</td>
<td>2.8</td>
<td>0.04</td>
</tr>
<tr>
<td>RT16</td>
<td>19 (73)</td>
<td>32 (49)</td>
<td>5.7</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>RT18</td>
<td>23 (88)</td>
<td>24 (37)</td>
<td>13.1</td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>
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Respiratory Therapist Exposures for 26 Case-Patients

<table>
<thead>
<tr>
<th>RT3</th>
<th>RT18</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td>8</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>RT13</th>
<th>RT16</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>16</td>
</tr>
<tr>
<td>7</td>
<td>3</td>
</tr>
</tbody>
</table>

Implicated Healthcare Worker

RT18
- SICU supervisor
- Associated with most case-patients (23/26)
- Witnessed tampering with fentanyl infusions of a case-patient (#21)

Hospital Administration Actions

- Removed RT18
- Asked consent to:
  - Search
  - Culture hands and antecubital fossa
  - Test for drugs (hair testing)

Multivariate Model for S. marcescens Bloodstream Infections

<table>
<thead>
<tr>
<th>Exposure</th>
<th>Cases n=26 (%)</th>
<th>Controls n=65 (%)</th>
<th>Odds Ratio</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous fentanyl infusion</td>
<td>25 (96)</td>
<td>24 (37)</td>
<td>44</td>
<td>0.001</td>
</tr>
<tr>
<td>RT3</td>
<td>18 (69)</td>
<td>20 (31)</td>
<td>9.5</td>
<td>0.02</td>
</tr>
<tr>
<td>RT18</td>
<td>23 (88)</td>
<td>24 (37)</td>
<td>6.7</td>
<td>0.002</td>
</tr>
</tbody>
</table>

Laboratory Analyses-Implicated Healthcare Worker (RT18)

Hand cultures done by handiwick methods*
Hands & antecubital fossa cultures negative

Laboratory Analyses-Implicated Healthcare Worker (RT18)

Hair testing for fentanyl positive
--Evidence of habitual use


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Distribution of S. marcescens Bloodstream Infections After Intervention

Removal of RT 18

Mystery Solved by Epidemiology & Laboratory
• RT 18
• In the SICU
• With the continuous fentanyl infusion

How Fentanyl Became Contaminated?
• During manipulation by implicated employees hands
• Reuse of Devices-needles
• Common source of liquid for replacement of fentanyl

Laboratory Cultures
Environment / water sources:
• Sinks and showers (>15) negative
• Bottles of fluid negative


Public Health Scope
• National estimates*: 4.2% of hospital workers admit to present illicit drug use (8.9% to past use)
• 1983 survey**: 214 (74%) of 289 U.S. anesthesia residency training programs reported at least one drug abuse/dependence
  – Meperidine and Fentanyl most common

Summary
• Outbreak of S. marcescens bloodstream infections in the SICU of Hospital A associated with contamination of fentanyl
• Epidemiology, a witnessed event, and drug testing suggest extrinsic contamination by a single healthcare worker
• Use of epidemiology and laboratory methods aided in termination of outbreak
• The outbreak had complicating factors

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Epilogue

- Official CDC reports were disseminated to Hospital A administration
- RT18 was permanently relieved of his duties
- A Hospital A official presented the findings to the District Attorneys Office- case not pursued due insufficient evidence
- State Health Department Officials informed

Summary

- An outbreak occurring at your facility may be an indicator of a nationwide outbreak.
- Combined laboratory and epidemiologic investigation can identify the source of the outbreak.
- Investigation-based prevention interventions can terminate the outbreak.

Thank You!

March is Novice Month

- March 6
  - Basic Microbiology with Jim Gauthier
- March 13
  - Basics of Cleaning, Disinfection and Sterilization with Dr. Lynne Sehulster
- March 20
  - Basics of Outbreak Management with Dr. Bill Jarvis
- March 27
  - Surveillance 101 with Mary Andrus

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