Emerging Pathogens and Outbreaks

Derek Forster, MD
Assistant Professor of Medicine, Division of Infectious Diseases
Medical Director, Infection Prevention and Control
UK HealthCare
Objectives

• Review emerging (and reemerging) pathogens in the United States

• Review how to recognize an outbreak

• Discuss steps in outbreak response
Emerging Infectious Diseases

- Zoonotic infections from wildlife
  - Ebola – bats, primates
- Zoonotic infections from non-wildlife
  - H7N9 – birds
- Vector-borne pathogens
  - Malaria
  - Chikungunya
  - Dengue
  - Zika
- Drug resistant pathogens
  - Carbapenem resistant Enterobacteriaceae (CRE)
  - Candida auris
- Vaccine preventable diseases
  - Measles
  - Mumps
AIR NETWORKS IN 1933

AIR NETWORKS IN 2005
27 yr old female presents to the emergency department due to fever (Tm 104), cough, runny nose, malaise, conjunctivitis and a maculopapular rash. She reports recently returning from India about 7 days prior to presentation. She stayed at a friend’s residence while there and reports being exposed to a child with fever and rash near the end of her stay. She reports not previously being vaccinated for any diseases.

Your are called for infection control recommendations. Which of the following would you recommend?

A. Droplet precautions
B. Contact and droplet precautions
C. Airborne infection isolation
D. No isolation
Measles

• Caused by rubeola virus
• Highly contagious
• Presents with a nonpruritic rash that begins on the head and face and spreads down the body, with fever and malaise
• Accompanied by conjunctivitis, cough, and coryza (3 C’s)
• Significant complications
Measles

• Contagious 4 days before rash appears and 4 days after rash onset
• Spread by droplets and by airborne route
• $R_0 = 12-16$ with secondary attack rates in susceptible household contacts $\sim 90\%$.
• When vaccination rates drop below 95%, measles outbreaks may occur
• Immunocompromised patients are at high risk to develop complications
Measles Complications

• Bacterial superinfection
  – May occur in respiratory tract, including middle ear

• Pneumonia
  – Accounts for 60% of deaths

• Acute Measles Encephalitis
  – Probably 50% of cases; most are subclinical
  – 0.5-1 / 1000 cases develop clinical syndrome
    • Fever, headaches, seizures
    • Ranges from mild to severe with neurologic impairment
Measles Complications

• Subacute Sclerosing Panencephalitis (SSPE)
  – Chronic, degenerative, fatal neurologic disease that occurs on average 7 years later
  – Most common in children who had measles before 2 years of age
  – May represent an autoimmune disease
  – Occurs in 1 / 100,000 cases
Measles - Epidemiology

Measles

U.S. Measles Cases by Year

*Provisional data reported to CDC’s National Center for Immunization and Respiratory Diseases
Measles

FIGURE 1. Number and percentage of measles cases that were directly imported and number of cases that were not directly imported* — United States, 2001–2013†

* Directly imported cases are those in patients who acquired measles outside the United States and brought their infection into the United States. Cases not directly imported include those that were acquired in the United States but linked to directly imported cases, imported virus, and cases with unknown sources.

† As of Aug 24, 2013.
Measles - Vaccination

• Effectiveness
  – After 1\textsuperscript{st} shot – 93%
  – After 2\textsuperscript{nd} shot – 97%

• Vaccine strain measles
  – Mild, self limiting

• Excellent safety profile with 50+ years use
  – Is not associated with autism
  – Temporary low platelet count – ITP (1/30,000 doses)
Measles – Infection Control

• Airborne Precautions
  – Single patient room

• Non-immune exposed healthcare personnel
  – MMR vaccine within 72 hours or IG within 6 days
  – Exclude healthcare personnel without evidence of immunity from day 5 after initial exposure to day 21 after last exposure
Question #2

19 yr old male college student presents to the emergency department for fever, headache, fatigue and swollen salivary glands under the ears after returning from a spring break trip to Panama City, FL two weeks earlier. She reports previous receipt of all recommended vaccines including the MMR series. You recall reports of several Mumps outbreaks at other college campuses during this time. Which of the following would be recommended?

A. Mumps PCR testing by swabbing the buccal mucosa while massaging the parotid gland
B. Place the patient in Airborne precautions
C. No specific precautions needed as the patient had been vaccinated for Mumps
D. None of the above
Mumps

MUMPS IS NOT JUST FOR KIDS ANYMORE

WHAT EXACTLY IS MUMPS?
Mumps is a highly contagious viral illness that can have serious complications in young adults. Mumps spreads easily and if you get it you will have to spend 9 days in isolation.

HOW DO YOU KNOW YOU HAVE MUMPS?
You might think you have the flu. You may have a fever, headache, muscle aches and pains, feel tired and lose your appetite. These symptoms may be followed by painful swelling of one or both of the glands located within your cheek near your jaw line. It may just start as an earache or tenderness along your jaw. Symptoms usually last for 9 days. Call your health care provider if you have any or all of these symptoms.

HOW DO YOU GET MUMPS?
Mumps is spread through:
- coughing,
- sneezing,
- kissing, or
- sharing food or drinks.

Even touching a surface contaminated by mumps and then touching your nose or mouth can give you the virus.

University and college campuses are the perfect places for mumps to spread, as students live and play in close proximity to each other. This is

MUMPS COMPLICATIONS IN YOUNG ADULTS ARE SERIOUS
MUMPS CAN CAUSE:
- meningitis or swelling of the brain and spinal cord,
- painful swelling of one or both testicles,
- painful swelling of ovaries and breasts,
- pancreatitis,
- permanent deafness, or
- spontaneous abortions if you get it in the first trimester of pregnancy.

MUMPS IS NO FUN
If you get mumps you will have to spend 9 days in isolation. This is the only way to prevent the spread of this highly contagious virus.

PROTECT YOURSELF: GET THE MUMPS CATCH-UP VACCINATION
If you have never had mumps and you are a young adult, you should get the mumps catch-up vaccination. Call your local health care provider. Vaccinations are available at your doctor's office, walk-in clinics, local public health units and some university and college campuses.
Mumps

• Average incubation period of 16 to 18 days
  – Range of 12 to 25 days

• Usually involves pain, tenderness, and swelling in one or both parotid salivary glands
  – Usually peaks in 1 to 3 days and then subsides

• Other salivary glands under the mouth can be involved
Mumps

• Non-specific prodrome may proceed parotitis by several days

• Ill individuals may shed virus in saliva for 5 days after development of parotitis

• Involvement of the testes (orchitis) can occur in 3-10% of infected males

• Other serious complications include meningitis, encephalitis and pancreatitis
Mumps - Vaccination

• Included in the MMR vaccines

• Effectiveness
  – 1\textsuperscript{st} dose - 78% effective
  – 2\textsuperscript{nd} dose - 88% effective
  – 3\textsuperscript{rd} dose - ???

• 2 dose vaccination coverage reduced disease rates by 99%
Mumps – Infection Control

• Droplet precautions
• Assess healthcare workers evidence of immunity
• Healthcare personnel exclusion
  – Persons with active mumps should be excluded for five days after onset of parotitis
  – Non immune persons with unprotected exposure (within 3 feet without proper PPE)
    • Excluded from the 12 days after first exposure through the 25th day after the last exposure
Candida auris:
A drug-resistant germ that spreads in healthcare facilities

*Candida auris* (also called *C. auris*) is a fungus that causes serious infections. Patients with *C. auris* infection, their family members and other close contacts, public health officials, laboratory staff, and healthcare workers can all help stop it from spreading.
Candida auris

• Often resistant to multiple antifungal drugs

• Difficult to identify with standard laboratory methods

• Known to cause outbreaks in healthcare settings
### Candida auris

<table>
<thead>
<tr>
<th>Identification Method</th>
<th>Organism <em>C. auris</em> can be misidentified as</th>
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| Vitek 2 YST                                 | *Candida haemulonii*  
|                                            | *Candida duobushaemulonii*                                                      |
| API 20C                                     | *Rhodotorula glutinis* (characteristic red color not present)  
|                                            | *Candida sake*                                                                  |
| BD Phoenix yeast identification system      | *Candida haemulonii*  
|                                            | *Candida catenulata*                                                            |
| Microscan                                   | *Candida famata*  
|                                            | *Candida guillermondii* (no hyphae/pseudohyphae present on cornmeal agar)  
|                                            | *Candida lusitaniae* (no hyphae/pseudohyphae present on cornmeal agar)  
|                                            | *Candida parapsilosis* (no hyphae/pseudohyphae present on cornmeal agar)        |

[https://www.cdc.gov/fungal/diseases/candidiasis/recommendations.html#modalIdString_CDCTable_0](https://www.cdc.gov/fungal/diseases/candidiasis/recommendations.html#modalIdString_CDCTable_0)
Candida auris

Countries from which *Candida auris* cases have been reported, as of August 31, 2017

https://www.cdc.gov/fungal/diseases/candidiasis/tracking-c-auris.html#world
Candida auris

U.S. Map: Clinical cases of Candida auris reported by state, United States, as of August 31, 2017

https://www.cdc.gov/fungal/diseases/candidiasis/tracking-c-auris.html
Candida auris

• Infection Control Recommendations
  – Single-patient room and using Standard and Contact Precautions

  – Clean and disinfect the patient care environment
    • CDC recommends use of an EPA registered disinfectant effective against Clostridium difficile spores

  – Screen contacts of newly identified case patients to identify C. auris colonization
Carbapenem Resistant Enterobacteriaceae (CRE)

https://www.cdc.gov/drugresistance/biggest_threats.html
Carbapenem Resistant Enterobacteriaceae

• CDC Definition
  – Enterobacteriaceae that are resistant to imipenem, meropenem, doripenem, or ertapenem
  OR
  – Documentation that the bacteria possesses a carbapenemase
    • KPC, VIM, NDM, or OXA-48
Carbapenem Resistant Enterobacteriaceae (CRE)

Patients with KPC-producing *Carbapenem-resistant Enterobacteriaceae* (CRE) reported to the Centers for Disease Control and Prevention (CDC) as of August 2017, by state
Carbapenem Resistant Enterobacteriaceae

• Important because...
  – Often resistant to multiple antibiotics
  – Infections are associated with high mortality rates
  – Resistance can be transmitted from one organism to another
  – Can spread in the community
CRE – Infection Control

Facility Guidance for Control of Carbapenem-resistant Enterobacteriaceae (CRE)

November 2015 Update - CRE Toolkit
Carbapenem Resistant Enterobacteriaceae – Infection Control

- Surveillance
- Hand Hygiene
- Contact Precautions
- Education
- Use of Devices
- Laboratory notification
- Interfacility Communication
- Antimicrobial Stewardship
- Environmental Cleaning
- Patient and Staff Cohorting
- Screening of Contacts of CRE patients
- Chlorhexidine bathing
Outbreaks
What is an “outbreak”

• Webster
  – A sudden rise in the incidence of a disease

• From epidemiologists
  – An increase in the incidence of a disease above what is normally expected
“Outbreaks” vs “Clusters”

• Functionally, there is no difference between the two
  – Both are a problem
  – Both need to be investigated and controlled
Is it an outbreak?

• It’s not just about the numbers...
  
  – One case of healthcare associated Legionella
  
  – Once case of post-operative group A streptococcus infection
How do you find outbreaks?

• Surveillance
  – Ideal since rates are tracked over time

• In the end, most outbreaks in healthcare are discovered by observant healthcare workers
When to investigate?

• Some are easy...
  – Weird or important organisms
    • Legionella, group A strep, Ralstonia sp., Burkholderia cepacia

• Some are not...
  – 50% increase in SSIs for one quarter?
  – Doubling of MRSA BSI for one month?
When to investigate?

• You have to confirm the existence of a cluster / outbreak...
Stages of an outbreak investigation

- Initial investigation
  - Literature review
  - Case definition
  - Case finding
  - Chart review and line list
  - Observation and review of patient care
  - Environmental sampling?
  - Implement interim control measures
Stages of an outbreak investigation

• Follow up investigation
  – Refine the case definition
  – On-going case finding / surveillance
  – Review of control measures
  – ? Analytic studies (case control, etc...)
Remember...

• Outbreak investigations are neither linear nor orderly!

• Multiple steps happen simultaneously

• Steps have to be repeated
Before you begin...

• Always ask the lab to save ALL isolates that might be part of the outbreak!
Literature Review

Welcome to Outbreak Database, the worldwide database for nosocomial outbreaks!

You can find information about Outbreak Database on the page About.

You can find news on the page News.

Status

The current release provides most features and access to nearly all data. However, parts of Outbreak Database are still under reconstruction. We are currently adding new Outbreak Articles and improving both the data quality and the website. E.g., we are adding more documentation.

Contact

If you have any further questions or comments please do not hesitate to contact the Outbreak Database team.

Case Definition

• Initial case definition should be narrow enough to focus efforts, but broad enough to catch all possible cases
Case Definition

• For Example...
  – Any patient who grew *B. cepacia* from a clinical or surveillance culture while in an ICU from October 2013 through January 2014
How do you find cases?

• Microbiology data
• Surveillance
• Discussions with clinicians or other healthcare staff
Case Finding Challenges

• Difficult when you can’t rely on microbiology and requires more effort in chart review
  – Example
    • Influenza vs. Influenza Like Illness
The Line List

• Single most important part of the investigation since it drives all investigative efforts
• Often includes...
  – Signs and symptoms
  – Medications
  – Procedures
  – Consults
  – Location
  – Staff contact
  – Host factors
The Line List

• Gathering the information is the most resource intensive part of the investigation

• Caveats...
  – A limited line list can be misleading
  – Not every case is exposed to the source and is truly part of the outbreak
  – Many cases may be exposed to something that is only an associated factor
Observations

• Who and what to observe is generally driven by the line list
• Initial observations and review of procedures can be very informative
Observations

• What are you looking for?
  – How does actual practice compare to written (or verbal) protocols?
  – Do different people do the same thing in different ways?
Observations

• A lesson from my children...
  – Ask a lot of questions...
    • Have you always done it this way?
    • Do others do it differently?
    • What are the challenges with maintaining good technique?
    • What do you think is causing the outbreak?
    • What might be missing from our review?
    • What data might be missing because it is not in the chart for review?
Environmental Sampling

• Can be the most powerful and definitive aspect of an investigation
• Can also be expensive, misleading, and frustrating
  – What do negative cultures mean?
  – Did we culture the right things?
• Typically low yield
Environmental Sampling

• Culture AFTER you have data from the line list and have done observations
• Culture what makes sense for the organism (Burkholderia cepacia – fluids)
• Remember...
  – The environment is big and the swab is small
Implementing Control Measures

• Ultimately, the goal is to stop the transmission, not necessarily find the source
• Typically implement a variety of control measures
Analytic study

• May be the “icing on the cake”, but not necessary to control the outbreak

• Helpful in guiding more investigation when the source remains unclear

• Can help support hypothesis when there is no “smoking gun”
Molecular Typing

• Can provide the “slam-dunk”
• But... there are challenges...
  – You have to have the organism
  – It's not available everywhere
  – It does not always answer the question
  – Just because the isolates are different, it doesn’t automatically mean there is not a problem
Conclusions

• Emerging pathogens continue to occur
  – Continued readiness is required

• Outbreak investigation is a multi-step process
  – Starts with recognition
Thank You!