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Assistant Professor, Department of Medicine, and Clinical Epidemiology and Biostatistics, McMaster University
Gathering Evidence...Solving the Case...
Tools to Identify, Contain and Prevent Outbreaks in Acute Care, Long-term Care and the Community...
Gathering Evidence...Solving the Case...
Tools to Identify, Contain and Prevent Outbreaks in Acute Care, Long-term Care and the Community...
Gathering Evidence...Solving the Case...Tools to Identify, Contain and Prevent Outbreaks in Acute Care, Long-term Care and the Community...In 30 minutes???
Objectives

1) What is an outbreak?
2) How to identify an outbreak?
3) Outbreak investigations
4) How to prevent outbreaks?
Objectives

1) What is an outbreak?

2) How to identify an outbreak?

3) Outbreak investigations

4) How to prevent outbreaks?
Outbreak definition
Outbreak definition

**Dr. Google**

**out·break**

Noun
The sudden or violent start of something unwelcome, such as war, disease, etc.

Synonyms
outburst - explosion - eruption - burst

**CDC**

What is an outbreak?

According to the CDC, an “outbreak” is the occurrence of more cases of disease than normally expected within a specific place or group of people over a given period of time.

**Wikipedia**

**Outbreak**

From Wikipedia, the free encyclopedia

For other uses, see Outbreak (disambiguation).

**Outbreak** is a term used in epidemiology to describe an occurrence of disease greater than would otherwise be expected at a particular time and place. It may affect a small and localized group or impact upon thousands of people across an entire continent. Two linked cases of a rare infectious disease may be sufficient to constitute an outbreak. Outbreaks may also refer to epidemics, which affect a region in a country or a group of countries, or pandemics, which describe global disease outbreaks.

**WHO**

A disease outbreak is the occurrence of cases of disease in excess of what would normally be expected in a defined community, geographical area or season. An outbreak may occur in a restricted geographical area, or may extend over several countries. It may last for a few days or weeks, or for several years.

A single case of a communicable disease long absent from a population, or caused by an agent (e.g. bacterium or virus) not previously recognized in that community or area, or the emergence of a previously unknown disease, may also constitute an outbreak and should be reported and investigated.
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Outbreak definition

We need to know:
- Current number of cases/incidence
- Baseline rate of disease
- Consistent case finding methods and definitions

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WHO
Outbreak definition

We need to know:
- Current number of cases/incidence
- Baseline rate of disease
- Consistent case finding methods and definitions

AND:
Is there a statistical significant excess above baseline?

 Greater than expected time/place/population
Objectives

1) What is an outbreak?
2) How to identify an outbreak?
3) Outbreak investigations
4) How to prevent outbreaks?
Tools

a) Epidemic curve
b) Control Charts
c) Formal statistical tests
Epidemic curve

a) Epidemic curve
b) Control Charts
c) Formal statistical tests
Epidemic curve

a) Epidemic curve

b) Control Charts
a) Epidemic curve

b) Control Charts
a) Continuous source type?
b) Point source type?
c) Propagated spread type?
a) Continuous source type?
b) **Point source type**: single curve, peaks, vanishes quickly
c) Propagated spread type?
a) Continuous source type?

b) **Point source type**: single curve, peaks, vanishes quickly

c) Propagated spread type?
Type of outbreak

Epidemic Curve Type 2

a) Continuous source type?
b) Point source type?
c) Propagated spread type?
a) **Continuous source type**: long and flat curve
b) Point source type?
c) Propagated spread type?
a) Continuous source type?
b) Point source type?
c) Propagated spread type?
Type of outbreak

Epidemic Curve Type 3

a) Continuous source type?
b) Point source type?
c) **Propagated spread type**: successive taller peaks after each incubation period
a) Epidemic curve

b) Control Charts

c) Formal statistical tests
Tools

a) Epidemic curve
b) Control Charts
c) Formal statistical tests
Tools

a) Epidemic curve

b) Control Charts

c) Formal statistical tests
a) Epidemic curve

b) Control Charts

c) Formal statistical tests

0, 1 or 2 outbreaks?
1. Baseline?
1. Baseline?
2. Point 14: n=3
   Concerning?
1. Baseline?
2. Point 14: n=3
3. Point 15: n=5

Concerning?
1. Baseline?
2. Point 14: $n=3$
3. Point 15: $n=5$

Concerning?
1. 2\textsuperscript{nd} peak: When do you start having concerns?
1. **2nd peak:**
When do you start having concerns?
Tools

a) Epidemic curve

b) Control Charts

c) Formal statistical tests
Tools

a) Epidemic curve

b) Control Charts

c) Formal statistical tests
   - “Gold standard”
   - Comparing incidence rates or cases at baseline to epidemic period using e.g. chi-square or t-tests
   - Based on 2 standard deviations from the mean → when compared to control charts, more sensitive than 3 control limits and more specific than 2 control limits
C. diff outbreak at Juravinski

Hamilton Health Sciences declared a C. difficile outbreak on Monday at the Juravinski General Hospital on the Mountain.

The outbreak comes three days after the hospital corporation declared an end to a three-week C. difficile outbreak at the Hamilton General Hospital.

HHS said the outbreak is on the E3 medical unit at the Concession Street facility. Four hospital-acquired cases of C. difficile have been diagnosed on the unit since Friday.

The potentially deadly bacterium causes mild to severe diarrhea.

HHS said Monday afternoon that E3 remains open. Enhanced infection prevention and control measures have been implemented to prevent the spread of the disease.

The Hamilton Spectator
Ontario Public Health and *C. difficile*

Baseline not considered to define notification thresholds for *C. difficile* cases for unit specific outbreaks.
Ontario Public Health and *C. difficile*

WHAT DIFFERENCE DOES IT MAKE

HOW THEY DIED?

EFINE IT?
C. difficile outbreaks…

- Public Health notification thresholds based on cases per time period, e.g. 5 cases / 28 days or 3 cases / 7 days

DOES BASELINE REALLY MATTER?
C. difficile outbreaks…

- Public Health notification thresholds based on cases per time period, e.g. 5 cases / 28 days or 3 cases / 7 days

DOES BASELINE REALLY MATTER?

Two hospital wards with 25 beds and 5 cases of C. difficile in 28 days
Baseline rates....
C. difficile outbreaks…

BASELINE REALLY MATTERS!
- Decision to declare an outbreak depends on baseline rates
- But: 5 cases is a reasonable trigger in most instances
- Sufficiently specific for most hospital wards to be used as an outbreak threshold (at least as long as the baseline is not significantly higher than 2 cases/28 days)
- Sensitivity to detect an outbreak too low for units with lower incidence rates

Take home message:
- Hospitals need to consider an outbreak even with less than 5 cases / 28 days in low incidence hospital units
- Challenge: Need to know baseline for each pathogen of interest for all hospital units and track continuously in real-time
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Outbreak investigation

IT IS VERY EASY, SIMPLY:
- Identify the etiologic agents
- Identify the reservoir
- Identify the mode of transmission
- Eliminate the reservoir and transmission
- Prevent future outbreaks
Outbreak investigation

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- May be known (e.g. CDI, AROs)
- Easy to detect (e.g. gastroenteritis)
- Sometimes unspecific symptoms or delay to diagnosis
Outbreak investigation

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- IPAC: Patients, environment, HCW
- Public Health: much more challenging
Outbreak investigation

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- Known once pathogen identified
- Challenging with emerging pathogens or if pathogen not yet identified
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Outbreak investigation

OUTBREAK MANAGEMENT CHECKLIST

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<tr>
<th>ACTION TO DO:</th>
<th>Individual(s) responsible</th>
<th>Date control measures discontinued</th>
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<tbody>
<tr>
<td>Notify Medical Director</td>
<td>ICP/PM</td>
<td>(Pulmonary/Infectious illness on file)</td>
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<td>Notify Administrator</td>
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<td>Notify Department heads</td>
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<td>Notify Pharmacy—Alert pharmacy when collecting NP tests</td>
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ADULT DAY PROGRAM (ADP)

Track antiviral medication use for unvaccinated staff

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<th>SUPERVISOR OF RESIDENT SERVICES</th>
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<td>STOP ADP, visits into the Lodge</td>
<td>Directors/Supervisor</td>
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<td>Notify Volunteers</td>
<td>Supervisor/Resident Services/Volunteer Coordinator</td>
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RECREATION, SOCIAL AND SUPPORT SERVICES

Track antiviral medication use for unvaccinated staff

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<td>Check for outside bookings (audition etc)</td>
<td>Supervisors/Resident Services</td>
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<td>Possible restriction of Lodge wide or off unit group programming</td>
<td>Supervisors/Resident Services</td>
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<td>Provide program that the limit use of shared equipment</td>
<td>Recreationist</td>
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<td>Notify OT and Physio</td>
<td>Supervisor/Resident Services</td>
</tr>
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<td>Notify hairdresser and barber</td>
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DISABILITY SERVICES

Track antiviral medication use for unvaccinated staff

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DIETARY SERVICES

Track antiviral medication use for unvaccinated staff

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<th>BUSINESS OFFICE</th>
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<td>Inform all Food Services staff</td>
<td>Business Office Supervisor</td>
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<td>Change voice message on answering machine if necessary</td>
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<td>Add Outbreak message to 'TV Tour'</td>
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<td>Notify Staffing clerks to ensure ongoing tracking of staff illness (Respiratory/Gastrointestinal illness on file)</td>
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For INFLUENZA CONFIRMED OB:

- Track antiviral medication use for unvaccinated staff
Outbreak investigation

IT IS VERY EASY, SIMPLY:
- Identify the etiologic agents
- Identify the reservoir
- Identify the mode of transmission
- Eliminate the reservoir and transmission
- Prevent future outbreaks

EVERY OUTBREAK IS DIFFERENT!
- Isolation/cohorting (if indicated)
- Active surveillance (case definition!)
- Promote hand hygiene and cleaning
- Posting / information for patients and visitors
- Consider closure to admissions
Outbreak investigation

IT IS VERY EASY, SIMPLY:

- Identify the etiologic agents
- Identify the reservoir
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- Prevent future outbreaks

Once outbreak identified, involve all key stakeholders (can include everyone from C-suite to front line staff)

E.g. hospital unit with *C. difficile* outbreak:

- Public Health
- (Executive) VPs Medical and Professional Affairs
- Physician and Surgeon-in-Chief
- Director, manager, and chief physician of affected unit
- (Stewardship) pharmacists
- Environmental cleaning
- Public relations
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- Last minute of my presentation…
Outbreak investigation indicated with n=1, e.g.:

- Single case of healthcare associated Legionnaire’s disease?
- Single case of post-operative group A streptococcus infection?
- Single case of fungal meningitis?
- Single case with hospital associated carbapenemase resistant enterobacteriaceae?
Outbreak investigation with \( n=1 \)?

*Exserophilum rostratum*
Outbreak investigation with $n=1$?

*Exserophilum rostratum*
Exserophilum rostratum

Sep 18: Tennesse DOH email from physician treating aspergillus meningitis who had recent epidural steroid injection
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**Day +2**: Two more cases locally. TN DOH contacts CDC → no similar cases reported
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Day +7: Further cases, all with epidural injection at same ambulatory surgery center; only first case culture positive
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Exserophilum rostratum

Outbreak investigation:
1) Identify the etiologic agents \( \checkmark \)
2) Identify the reservoir
3) Identify the mode of transmission \( \checkmark \)
4) Eliminate the reservoir and transmission
5) Prevent future outbreaks

Lancet Neurol. 2013,12(5):429
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COMMON LINKS/RESERVOIR:

SURGERY CENTER?
METHYL PREDNISOLONE ACETATE (MPA)?
PVP-IODINE?
LIDOCAINE?
SPINAL NEEDLES?
EPIDURAL TRAY KITS?
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*Lancet Neurol. 2013, 12(5):429*

**COMMON LINKS/RESERVOIR:**

- SURGERY CENTER?
- METHYLPREDNISOLONE ACETATE?
- PVP-IODINE?
- LIDOCAINE?
- SPINAL NEEDLES?
- EPIDURAL TRAY KITS?
Sep 18: Tennesse DOH email from physician treating aspergillus meningitis who had recent epidural steroid injection

Day +2: Two more cases locally. DOH contacts CDC → no similar cases reported

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**Exserophilum rostratum**

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Case definition shared with all involved states

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Day +10: Exposure and pathogen still not identified (only index). All patients exposed to these 3 lots notified

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Day +9: North Carolina DOH identifies first patient outside TN

Day +10: Exposure and pathogen still not identified (only index). 14,000 patients exposed to these 3 lots to notify

Day +16: FDA identified fungus in unopened vials

Exserophilum rostratum
Aftermath

- 733 infections in 20 states, 53 deaths
- Exserophilum rostratum predominant fungus identified in patients, also detected in unopened vials
- Largest healthcare associated infection outbreak in US
- Joint effort by:
  - Clinical community (hospitals, physician notifying of n=1)
  - Local and state public health departments
  - CDC
  - FDA
- and many, many more…

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Outbreak investigation:
1) Identify the etiologic agents ✓
2) Identify the reservoir ✓
3) Identify the mode of transmission ✓
4) Eliminate the reservoir and transmission ✓
5) Prevent future outbreaks…
Outbreak investigation with \( n=1 \)?

Outbreak investigation indicated with \( n=1 \), e.g.:

- Single case of healthcare associated Legionnaire’s disease?
- Single case of post-operative group A streptococcus infection?
- Single case of fungal meningitis?
- Single case with hospital associated carbapenemase resistant enterobacteriaceae?

YES!

IF EXPECTED NUMBER OF CASES (BASELINE) IS ZERO
Objectives

1) What is an outbreak?
2) How to identify an outbreak?
3) Outbreak investigations
4) How to prevent outbreaks?
Prevention: Hospital outbreaks
Prevention: Hospital outbreaks
Prevention: Hospital outbreaks

No hospitals, no outbreaks…
Prevention: Hospital outbreaks

No hospitals, no outbreaks...

for less invasive (but less effective) methods, come back next year
Take home messages

- Outbreak is an excess of cases as compared to baseline
- Tools to identify excess include epidemic curve, control charts, and formal statistical test
- *C. difficile* notification threshold specific but not very sensitive
- Outbreak investigation include identification of agent, reservoir, mode of transmission, and elimination of reservoir and transmission, and involvement off all key stakeholders
- Collaboration between individuals, clinics/hospitals, public health, federal agencies key to control outbreaks with a common reservoir
- Prevention of hospital outbreaks… come back next year