Outbreak Investigations, Emerging Pathogens, and the Role of Public Health

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SHARPPS Program
North Carolina Division of Public Health

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Objectives

- Describe legal framework for disease surveillance, investigation, and response
- Review outbreak surveillance data and trends over time
- Discuss emerging infections & specific healthcare-associated pathogens
- Discuss role of Public Health in infection prevention and outbreak response
- Describe the 10 steps of an outbreak investigation

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Public Health: Legal Framework

- Public Health Laws and Rules:
  - General Statutes
  - NC Administrative Code rules
- Health Director's Authority (State & Local)
  - Surveillance
  - Investigation
  - Control Measures

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Public Health Law

General Statutes §130A-144: Investigation and Control Measures

(a) The **local health director shall investigate**… cases of communicable diseases and communicable conditions reported to the local health director

(b) Physicians, persons in charge of medical facilities or laboratories, and other persons shall… **permit a local health director or the State Health Director to examine, review, and obtain a copy of medical or other records…**

(d) The **attending physician shall give control measures**… to a patient with a communicable disease or communicable condition and to patients reasonably suspected of being infected or exposed to such a disease or condition.

(e) The **local health director shall ensure that control measures**… have been given to **prevent the spread** of all **reportable communicable diseases** or **communicable conditions** and **any other communicable disease or communicable condition that represents a significant threat to the public health.**

(f) All **persons shall comply with control measures**, including submission to examinations and tests…

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Public Health Law

10A NCAC 41A .0103: Duties of local health director: report communicable diseases

(a) Upon receipt of a report of a communicable disease or condition… the **local health director** shall:

(1) immediately **investigate** the circumstances… [to] include the collection and submission for laboratory examination of specimens necessary to assist in the diagnosis and indicate the duration of control measures;

(2) determine what **control measures** have been given and ensure that proper control measures… have been given and are being complied with;

(c) Whenever an **outbreak of a disease or condition** occurs which is not required to be reported… but **which represents a significant threat to the public health**, the local health director shall give appropriate control measures… and **inform the Division of Public Health**

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Public Health Law

10A NCAC 41A .0101: Reportable diseases and conditions

- **80+ reportable diseases and conditions**
  - Timeline of reporting varies between immediately and within 7 days
- **Laboratory** reporting requirements

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Public Health Law

- **10A NCAC 41A .0106**
  - Infection Prevention – Reporting of Healthcare Associated Infections
- **10A NCAC 41A .0206**
  - Infection Prevention – Health Care Settings, 1992
- **10A NCAC 41A .0201**
  - General Control Measures
- **10A NCAC 41A .0202 - .0205**
  - Control Measures for HIV, Hepatitis B, STDs, TB

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SHARPPS

Surveillance for Healthcare Associated & Resistant Pathogens Patient Safety Program

Mission

To work in partnerships to prevent, detect, and respond to events and outbreaks of healthcare-associated and antimicrobial resistant infections in North Carolina.

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SHARPPS

Surveillance for Healthcare Associated & Resistant Pathogens Patient Safety Program

Surveillance, Investigation & Response	Prevention, Education & Training	Monitoring & Evaluation	Communication
HAI reporting to NHSN MDRO surveillance DHSR Infection Prevention Breach reporting Outbreak & Exposure management	Antimicrobial resistance & stewardship Infection Control, Assessment & Response (ICAR) Partnerships	Data validation	HAI data reports Newsletters Webinar updates

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When Should Public Health Be Called?

- HAI reporting questions (i.e., NHSN)
- Reportable diseases / conditions (10A NCAC 41A .0101)
  - https://epi.dph.ncdhhs.gov/cd/report.html (Form 2124)
- When **any** disease is above normal baseline (i.e., an "outbreak")
- Report suspected infection prevention breach

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What Happens When Public Health is Called?

- Data Review
- Clinical Investigation
- Environmental Investigation
- Control Measures
- Communication (Resident/Family/Public)
- Laboratory Support

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Outbreak Assistance

We can assist with:

- Determining if it is an outbreak
- Guidance, tools and onsite support
- Facilitating and coordinate calls with partners
- Written recommendations

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Examples of Responses

- Multidrug Resistant Acinetobacter (CRAB) in a nursing home
- Scabies in long-term care facilities
- Acute Hepatitis B among shared glucometer patients
- Potential C. auris transmission in dialysis facility
- Post-op endocarditis among patients receiving same surgical device
- Legionellosis associated with healthcare facilities
- National responses:
  - Non-tuberculosis mycobacterium (NTM) and heater-cooler units
  - Resistant Pseudomonas and artificial tears
  - Botulism-like illness following cosmetic surgery

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Partnerships

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Outbreak Summary

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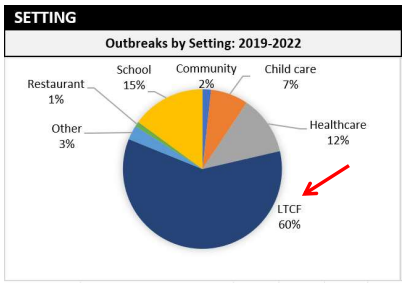
2019-2022 Outbreak Summary



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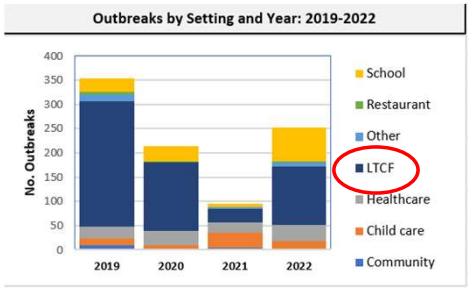
2019-2022 Outbreak Summary



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Outbreak Response & Emerging Infections

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Multidrug-Resistant Organisms (MDROs)

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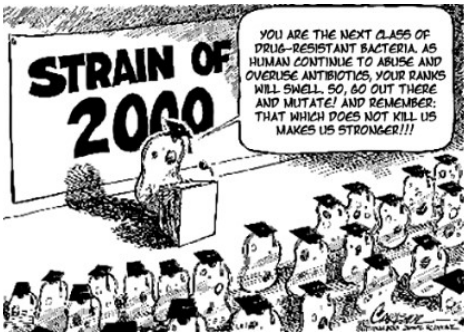
Multidrug-Resistant Organisms (MDROs)



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Significance of MDROs

- Affects vulnerable patient populations
- Are easily transmitted in and between healthcare / congregate care settings
- Difficult to treat
  - Require more toxic antimicrobials to treat
- Improper treatment
  - Some organisms may produce another enzyme that makes it easier to transmit resistance
- Cause increase in:
  - Mortality
  - Healthcare costs
  - Length of stays
- Estimates of economic costs vary, up to 20 BILLION dollars in direct healthcare costs

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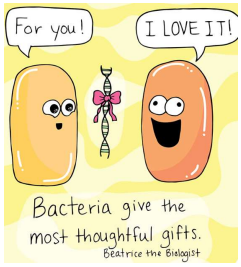
Significance of Carbapenemase-producing Organisms (CPO)

TBO

- Carbapenemase-producing organisms
  - Mobile genetic elements, such as plasmids
  - Highly resistant
- **Urgent public health threat**
- Over 9,000 healthcare-associated infections each year
- Up to 50% mortality



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Candida auris

Highly drug-resistant

Patients can become colonized and develop invasive infections

Spreads in healthcare settings

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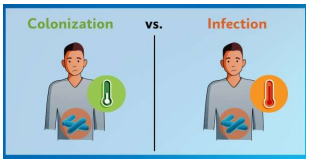
MDRO Colonization

- Colonization means that a person is carrying a MDRO but does not have symptoms of an infection.
- Colonized people play a large role in the spread of MDROs to other people in healthcare settings (require infection control action).



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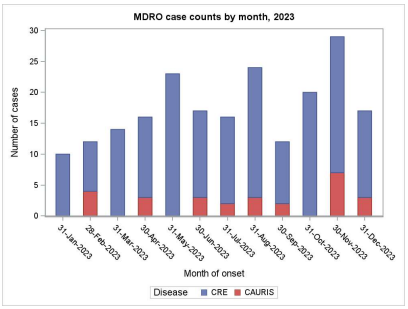
Slide 22

TB0 Update slide content for CPO specific info
Breeyear, Taylor L, 2024-09-17T19:16:36.630

North Carolina



First NC-acquired *C. auris* case identified February 2023.

*preliminary data

TB0

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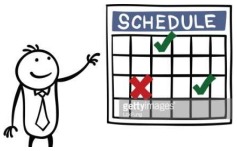
Initial Control Measures

Gown and gloves



Prevent opportunities for transmission

Hand hygiene

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Targeted MDRO Specific Infection Prevention Measures

TB0

- Laboratory Notification
- Private room
  - Indefinite contact precautions for colonized and infected patients.
  - Enhanced barrier precautions in long-term care
    - For *C.auris*, with approval by DPH.
  - If necessary, cohort infected residents.
- Adherence to hand hygiene and transmission-based precautions.
- Clean with List P disinfectant for *C. auris*.
- Conduct screening.
- Educate staff about organism and reasons for precautions.
  - Including non-clinical staff like EVS
- Review infection prevention policies and procedures.
- Communicate diagnosis with other facilities on transfer or discharge.
- Antimicrobial Stewardship

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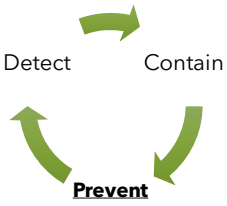
TB0

DPH Response to MDROs

- Detect
  - C. auris and CPO: 1 case=outbreak
  - Nationally notifiable
  - Antimicrobial Resistance Laboratory Network (ARLN)
- Contain
  - Ensure rapid response & containment
    - Prevent transmission through:
      - Point-prevalence survey (PPS)
      - Infection control assessment and response (ICAR)
- Prevent
  - Stewardship efforts
    - Antimicrobial resistance workgroup
    - Get Smart Campaign
    - STAR Partners
  - Education
    - Collaborative effort (SPICE, DPH, LHD)



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Legionellosis

- Caused by inhalation *Legionella pneumophilia*
- Transmission: Inhalation of aerosolized water
- Risk factors
  - >50 years old, smokers, compromised immune systems
- Two manifestations:

	Legionnaires' disease	Pontiac Fever
Incubation period	2–14 days	5–72 hours
Symptoms	Non-productive cough and **pneumonia**	Self-limited febrile illness; no pneumonia
Resolution	Typically requires antibiotics; ~15% case-fatality rate	Spontaneous recovery in 2–5 days

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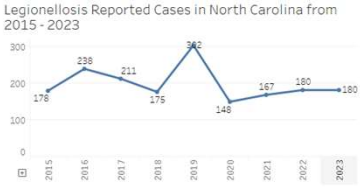
Incidence of Legionellosis in North Carolina



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Slide 25

TB0 Update
Breeyear, Taylor L, 2024-09-17T19:18:10.873

Slide 27

TB0 See comment on Major Findings slide
Breeyear, Taylor L, 2024-09-17T19:35:24.716

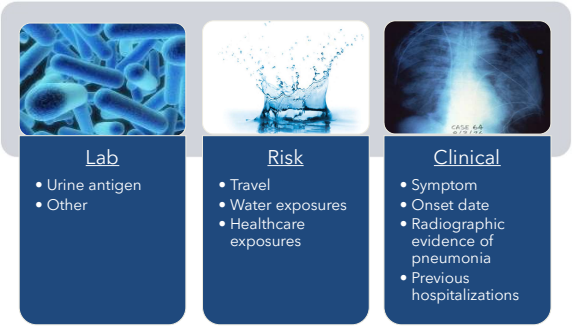
Slide 28

TB0 See comment on Major Findings slide. Talk more about screening collaboration with DPH
Breeyear, Taylor L, 2024-09-17T19:35:51.669

Slide 30

TB0 Updated numbers?
Breeyear, Taylor L, 2024-09-17T19:19:04.770

Investigation Steps



Lab	Risk	Clinical
• Urine antigen • Other	• Travel • Water exposures • Healthcare exposures	• Symptom • Onset date • Radiographic evidence of pneumonia • Previous hospitalizations

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The most important question…

Was the patient in the healthcare facility during the 14 days before symptom onset?

Create a timeline:

- When was the patient admitted to the facility?
- When did symptoms start?
- Where did the patient go during the 14 days before symptom onset?

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Healthcare-associated Legionellosis

- Definite healthcare-associated case
  - Confirmed case of legionellosis in a person who has spent ≥14 days **continuously** in a healthcare facility before illness onset
- Possible healthcare-associated case
  - Confirmed case of legionellosis in a person who has spent **part but not all** of the 14 days before illness onset in a healthcare facility

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Avian Influenza (H5)

- Type A influenza that is widespread in wild birds worldwide but can cause outbreaks in some mammals
- Recent outbreaks in poultry and dairy cows, including NC
- Current public health risk is low but there have been cases in humans in the U.S.
  - Mild symptoms
  - Almost all cases were poultry and dairy farm workers, exposed to animals
- NCDHHS is collaborating with CDC and NCDA&CS
  - Surveillance
  - Infection prevention resources for poultry and dairy farm workers
- Suspected or confirmed novel avian influenza
  - AIIR
  - N95 or higher, gown, eyes protection
  - May require transfer

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TBD

Tis the (respiratory virus) season!

- Encourage vaccine uptake
- Provide face masks, tissues and hands-free trash can, hand sanitizer
- Post signs with respiratory hygiene/cough etiquette reminders
- Ensure staff do not work while sick
- Ongoing outbreak?
  - Contact our RIPS team at infectionprevention@dhhs.nc.gov for assistance.

CDC: Preventing Transmission of Viral Respiratory Pathogens in Healthcare Settings

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Group A Streptococcus (GAS)

- A group of gram-positive bacteria
- Commonly found in the throat and on the skin
- Illness varies depending on site of infection
- **Invasive GAS (iGAS)**: severe infection when **bacteria invade areas of the body that are normally sterile**
  - Invasive GAS is reportable

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Slide 35

TB0 My thought was to somehow use this as plug for RIPS doing respiratory outbreak visits
Breeyear, Taylor L, 2024-09-17T21:19:03.423

LTCF residents at higher risk

- Elderly at higher risk
  - ~ 15% of people aged 65 years or older die from their invasive GAS infection[1]
- Older adults in LTCFs have a 6x greater risk of disease and 1.5x greater risk of death than older adults in the community[2]
  - Age, comorbidities, breaks in skin, indwelling devices
  - **Wound care**
    - **Careful attention to IP practices essential to prevent transmission**

1. Centers for Disease Control and Prevention. Active Bacterial Core Surveillance Bact Facts Interactive Data Dashboard, Emerging Infections Program Network, Group A *Streptococcus*. Available at ABCs Bact Facts Interactive Data Dashboard | CDC.

2. Invasive Group A Streptococcal Infection in Older Adults in Long-term Care Facilities and the Community, United States, 1998–2003 - Volume 13, Number 12—December 2007 - Emerging Infectious Diseases journal - CDC

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Public Health Response to iGAS
(LTCF, postpartum, postsurgical)

- **LHD and DPH will provide guidance on response steps:**

- Identify additional symptomatic cases
- Identify potential asymptomatic carriers
- Assess and re-emphasize infection prevention practices

=

- Retrospective chart review
- Survey staff for GAS symptoms
- Culture residents, possibly epi-linked staff (if an outbreak)
- Prospective active surveillance
- Site visit to assess IP, educate staff

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Possible Site Visit Findings: Infection Risk Factors

- Gaps in hand hygiene
- Staff working while sick
- Opportunities for cross-contamination during wound care:
  - Glove use
  - Dedicated wound care supplies
  - Scissor use- in GAS outbreak, dedicate scissors to individual residents
  - Wound care carts- uncluttered, remain outside pt rooms, perform HH before accessing items

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Summary: Example GAS Outbreak

Over the course of a year:
- 30+ symptomatic cases, 7 invasive cases
- 30+ asymptomatic carriers
- 8 hospitalizations, 3 deaths

- Epi, laboratory, site assessments:
  - All invasive cases had wounds
  - Whole genome sequencing from 21 positives showed all but 3 were related, many months apart
  - Wound care observations identified opportunities for cross contamination

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10 Steps of an Outbreak Investigation

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Reasons to Investigate an Outbreak

- Identify, describe the source
- Describe new diseases / learn more about known diseases
- Identify populations at risk
- Evaluate existing prevention strategies
  - e.g., immunization requirement
- Opportunity to educate public about disease prevention
- Address public concern
- Develop strategies to prevent future outbreaks
- Fulfill legal obligation and duty to care for the public
- **End the outbreak!**

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Principles of Outbreak Investigations

- Be systematic
  - Follow the same steps for every type of outbreak
  - Write down case definitions
  - Ask the same questions of everybody
- Stop often to re-assess what you know
  - Line list and epidemic curve provide valuable information
  - Consider control measures to be applied
- Coordinate with partners

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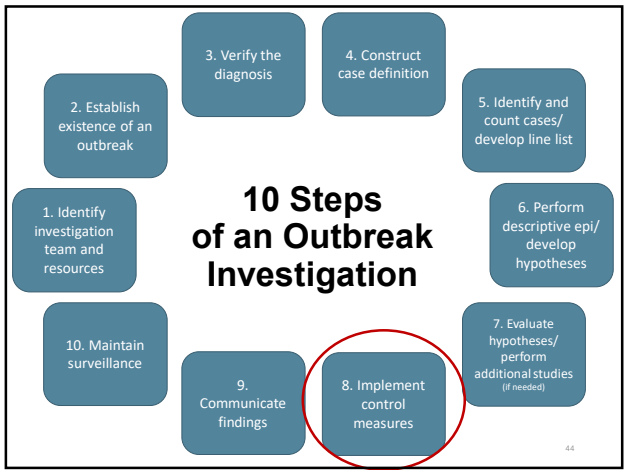

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2. Establish existence of outbreak

What is an Outbreak?

- Anything above what is normally seen for any given time period
- If you aren't sure, call us!
- In a facility setting, an outbreak is generally defined as two or more individuals with the same illness
- **Caveat to this rule:**
  - One case of certain diseases = Outbreak
    - **C. auris, MDROs with novel carbapenemases**
    - Disease not normally seen (Avian Flu, SARS, Ebola)

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GAS Outbreak Summary

This example outbreak opened with:

- Invasive resident case followed by six resident and staff non-invasive cases
- Two additional invasive cases
- Within one month timeframe

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3. Verify the diagnosis

- Review medical records, laboratory reports
- Talk with patients
- Request additional testing if needed
- Consult with local health department, communicable disease branch, state public health lab

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4. Construct a case definition

What is a Case Definition?

- Allows a simple, uniform way to identify cases
- "Standardizes" the investigation
- Is specific to the outbreak

3 components:

Person..... Type of illness, characteristics (e.g., "a person with...")
Place..... Location of suspected exposure
Time..... When exposure or illness occurred

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4. Construct a case definition

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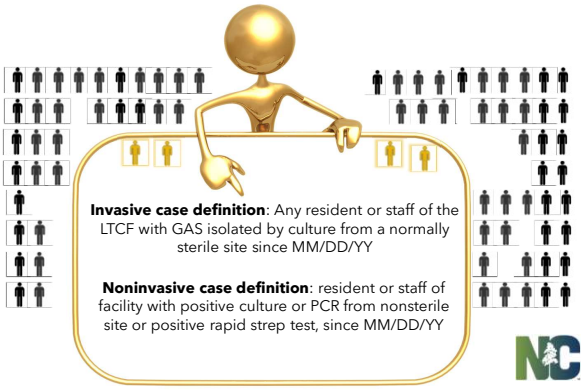
GAS Outbreak Case Definition



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5. Identify and count cases/develop line list
6. Perform descriptive epi and hypothesize

- **Identify additional cases through data and records**
- **Descriptive Epidemiology**
  - Provides systematic method
  - Characterize, or describe what has occurred
  - **Person, place, time**
- Components
  - Line list
  - Epi curve

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Descriptive Epidemiology

- Person
- Place

} Line List

- Time

} Epidemic curve ('Epi curve')

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Line List

- Method to systematically record information
- Simple to review, update, summarize
- Each row represents data for a single 'case'
- Information to include:
  - Identifying information
  - Demographics
  - Clinical- symptoms, specimen date and source, outcome
  - Exposure/risk factor

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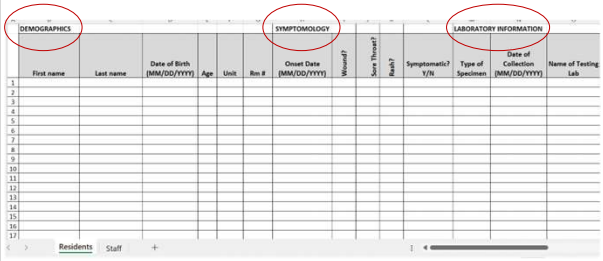
Example - GAS template line list



Template also includes-
- Hospitalization
- Outcome
- Treatment

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Epidemic 'Epi' Curve

- A graphical representation of the number of outbreak cases by date of illness onset
- Visual representation of
  - Ill persons (cases) over time
  - Magnitude of outbreak
  - Number of cases on the vertical (y) axis
  - Time period (or date of illness onset) on the horizontal (x) axis
  - Type of outbreak
    - Point source
    - Propagated (person-to-person)

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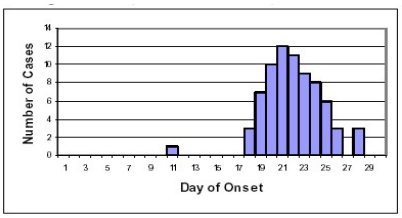
Epi Curves

- Point source
  - Common source outbreak
  - Sharp upward slope and a gradual downward slope
  - Period of exposure is brief
  - Cases occur within one incubation period



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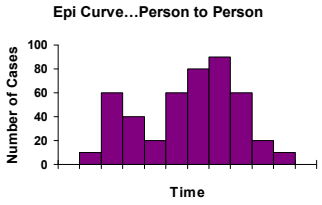
Epi Curves

- Propagated (person-to-person)
  - Progressively taller peaks, an incubation period apart
  - Person to person transmission
  - May last a long time
  - May have multiple waves



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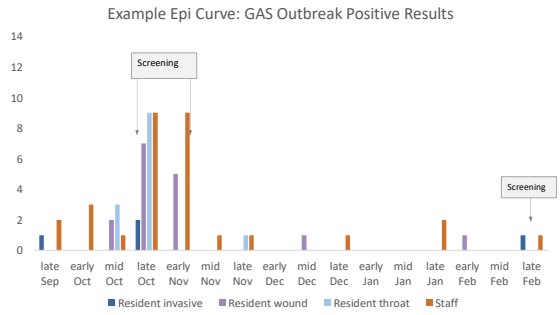

- All invasive cases had wounds
- All isolates but three were related
- Opportunities for cross-contamination during wound care observations

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6. Develop hypotheses

- Statements which help us describe why and how the outbreak occurred (i.e., educated guess)
- How do you generate hypotheses?
  - Review the existing body of knowledge
  - Examine line list, epi-curve
  - Conduct open-ended interviews with few case-patients

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7. Evaluating the Hypotheses

- Two methods:
  - Compare hypothesis with established facts
  - Perform additional studies (e.g., analytic)
    - Cohort or case-control
    - Assess exposures equally among ill and non-ill persons

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8. Control Measures

- When should control measures be implemented *immediately*
  - Source is known
  - Continued risk of either exposing others or being exposed (e.g., HCW diverting injectable drugs)
- Control measures:
  - Are applied as soon as possible
  - May change during investigation
- Example GAS outbreak control measures
  - Screen residents and staff via cultures, treat all positives
  - Ill staff stay home from work
  - Appropriate precautions for ill residents
  - Refresher education for staff
  - IP observations and support
  - Masking during wound care; universal masking at onset
  - Halted admissions with wounds for ltd time period (d/t transmission not controlled)

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9. Communicate Findings

- Oral
  - Internally with team
  - Externally to public, media, health care providers
- Written
  - Daily updates (e.g., Situation Reports)
  - Final outbreak report

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10. Maintain Surveillance

- Evaluate / document effectiveness of control measures
- To ensure outbreak is over
- To ensure secondary outbreak is not occurring
- For many outbreaks, maintain surveillance for 2 average incubation periods following the last date of illness onset
- GAS outbreak surveillance- continues for 4 months following the last date of illness onset

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Conclusions

- Epidemiologic investigations essential component of public health, present opportunities to:
  - Characterize diseases
  - Identify populations at risk
  - Evaluate programs, policies, or existing prevention strategies
  - Train public health staff
  - Educate the public
  - Fulfill legal obligations and duty of care for the public
- 10 steps provide systematic framework necessary to investigate any outbreak

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Resources

- **MDROs**
  - CDC Strategies to Prevent and Contain MDROs https://www.cdc.gov/healthcare-associated-infections/php/preventing-mdros/index.html
  - NCDHHS Healthcare-Associated Infections (HAIs) https://epi.dph.ncdhhs.gov/cd/diseases/hai.html
- **Injection Safety**
  - CDC Preventing Unsafe Inject Practices https://www.cdc.gov/injection-safety/hcp/infection-control/index.html
  - CDC Project Firstline https://www.cdc.gov/project-firstline/index.html
- **Antimicrobial Stewardship**
  - Be Antibiotics Aware Campaign https://epi.publichealth.nc.gov/cd/antibiotics/campaign.html
  - NC DPH Antimicrobial Stewardship https://epi.publichealth.nc.gov/cd/antibiotics/stewardship.html
  - NC DPH STAR Partners https://epi.publichealth.nc.gov/cd/antibiotics/star_partners.html
- **Group A Strep in LTC (CDC resources)**
  - https://www.cdc.gov/group-a-strep/php/ltcf-toolkit/increased-risk.html
  - https://www.cdc.gov/group-a-strep/php/ltcf-toolkit/transmission.html

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Thank you!

infectionprevention@dhhs.nc.gov

919-733-3419 (24/7 Epidemiologist On-Call)

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***C. auris* – Comprehensive Infection Prevention Response**

***C. auris* Case Study**
Fall 2024

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Infection Control and Response (ICAR)

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List P: Antimicrobial Products Registered with EPA for Claims Against Candida Auris

FUNGICIDAL
1 minute contact time
Candida albicans
Trichophyton interdigitale
2 minute contact time
*Candida auris****

EPA Reg. No. 37549-1

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HOSPITAL DISINFECTION

1. Always use personal protective equipment.
2. Open Micro-Kill Bleach Germicidal Bleach Wipes canister.
3. Remove pre-saturated 7 in x 8 in wipe.
4. Apply pre-saturated towelette and wipe desired surface to be disinfected.
5. Gross soil must be removed prior to disinfecting. A 30 second contact time is required to kill the bacteria and viruses** on the label except 1 minute contact time is required to kill *Candida albicans* and *Trichophyton interdigitale*, a 2 minute contact time is required to kill *Candida auris****, and a 3 minutes contact time is required to kill *Clostridium difficile* spores*. Reapply as necessary to ensure that the surface remains visibly wet for the entire contact time.
6. Allow surface to air dry and discard used wipe and empty canister (see **STORAGE AND DISPOSAL**).

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Mrs. Smith's Room

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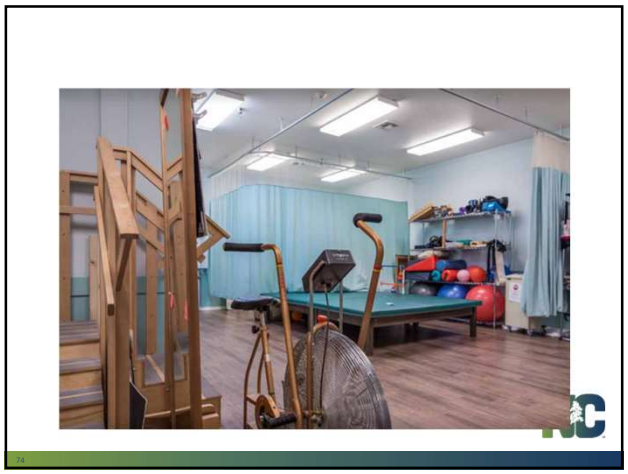

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