



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

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SHARPPS Program  
North Carolina Division of Public Health

**Fall 2025**

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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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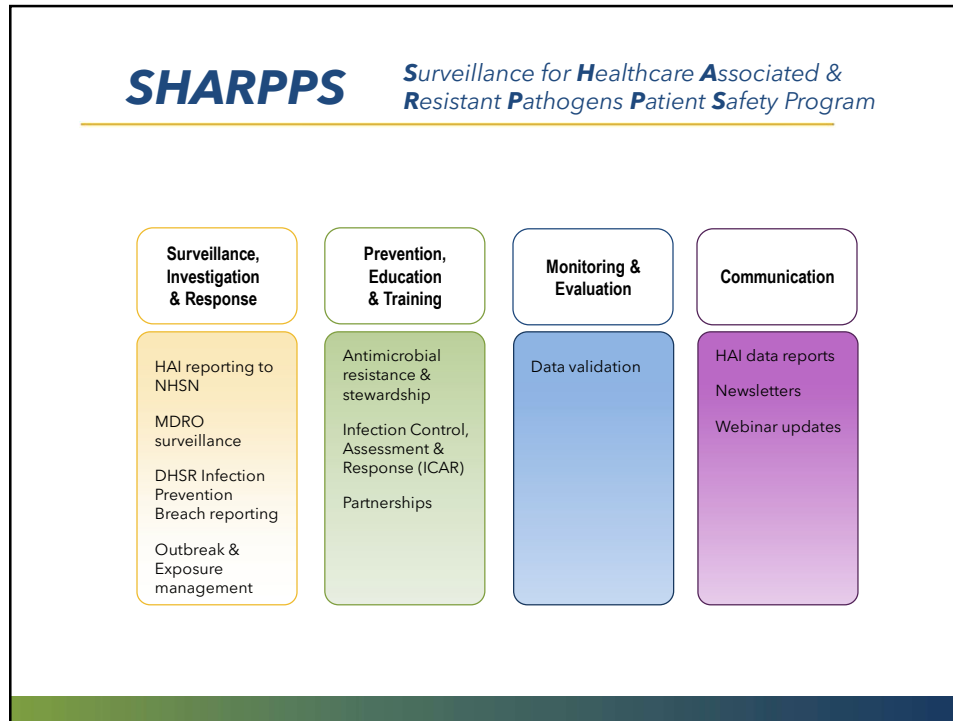
**SHARPPS**

*Surveillance for **H**ealthcare **A**ssociated &  
Resistant **P**athogens **P**atient **S**afety Program*

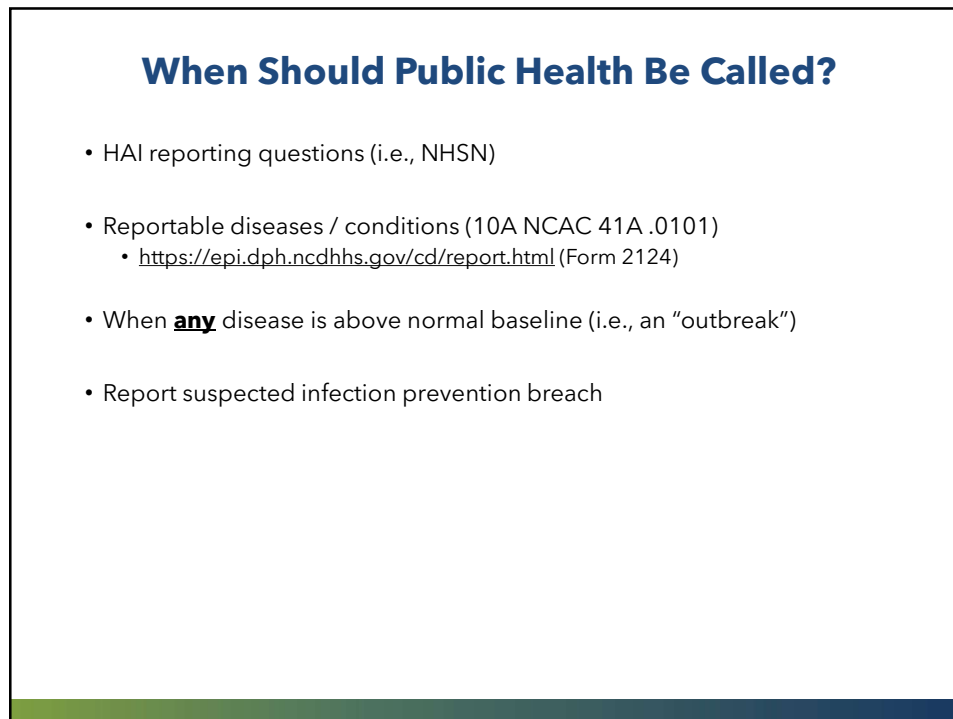
### **Mission**

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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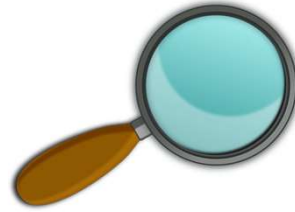
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## What Happens When Public Health is Called?

- 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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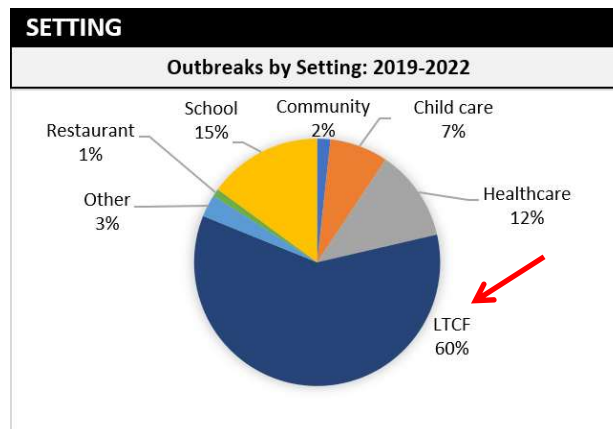


# Outbreak Summary



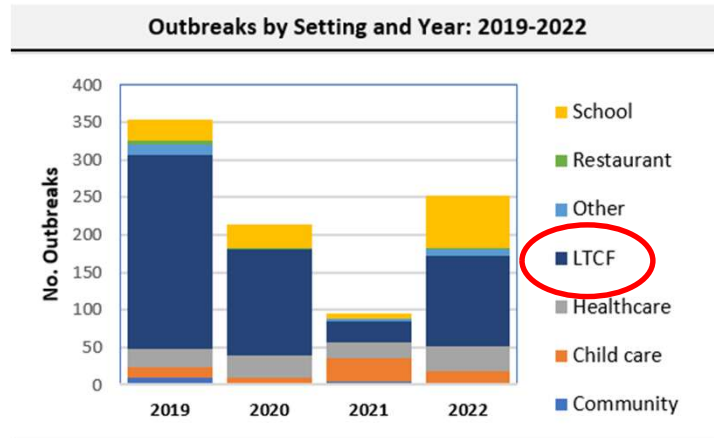
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## 2019-2022 Outbreak Summary



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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

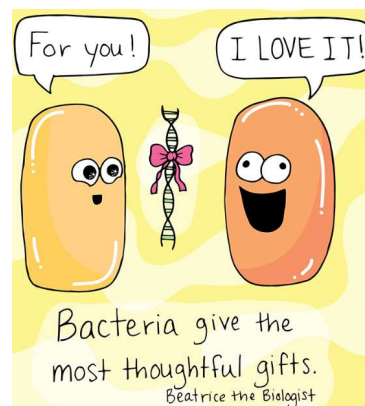
- Affects vulnerable patient populations
- Are easily transmitted in and between healthcare / congregate care settings
- Difficult to treat
  - Require more toxic antimicrobials to treat
- Improper treatment
  - Some organisms may produce another enzyme that makes it easier to transmit resistance
- Cause 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)

- 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

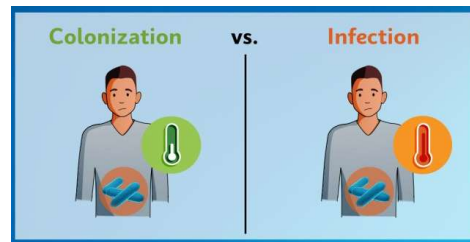


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## MDRO Colonization

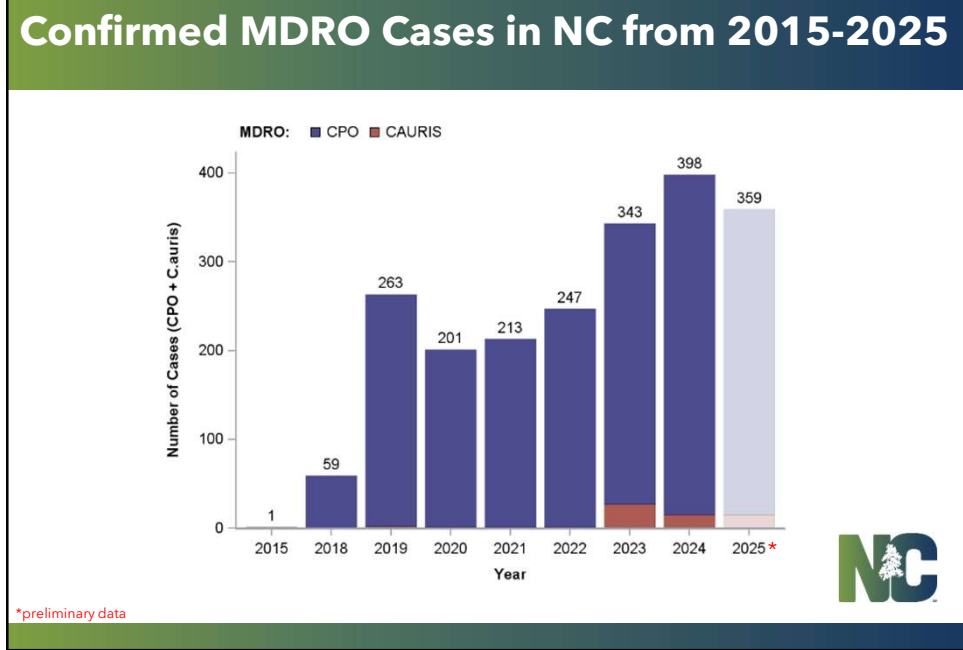
- Colonization means that a person is carrying a MDRO but does not have symptoms of an infection.
- Colonized people play a large role in the spread of MDROs to other people in healthcare settings (require infection control action).



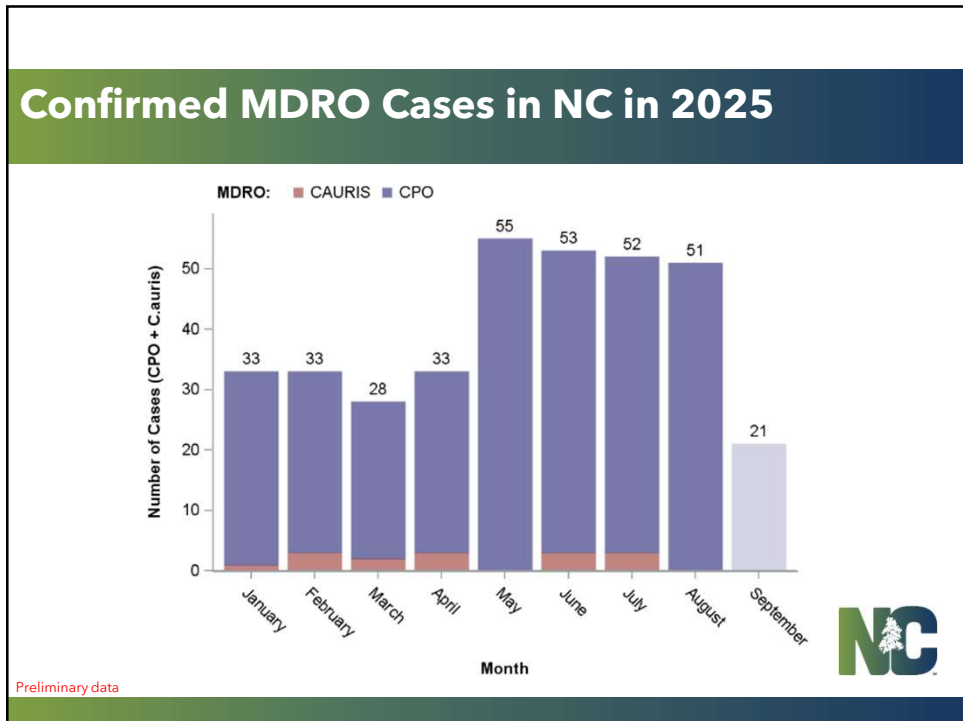
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TB2



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## Slide 25

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**CB1** update

Bryan, Catherine M, 2025-10-08T14:16:38.314

**TB2** [@Berns, Emily L] [@Bryan, Catherine M] Is there supposed to be a red asterisk on 2025 to denote the footnote?

Breeyear, Taylor L, 2025-10-14T12:14:23.301

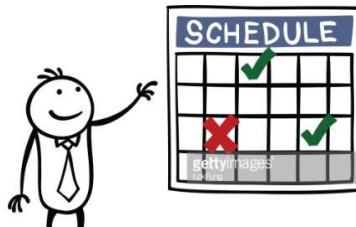
## Initial Control Measures



Gown and gloves



Hand hygiene



Prevent opportunities for transmission



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## Targeted MDRO Specific Infection Prevention Measures

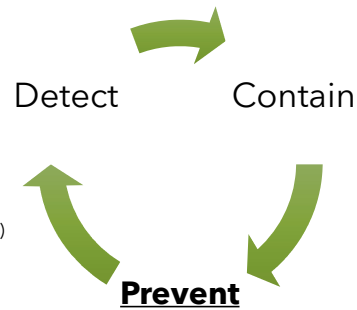
- Laboratory Notification
- Contact precautions
  - Indefinite contact precautions for colonized and infected patients.
  - Private room
  - Enhanced barrier precautions in skilled nursing facilities
    - For *C. auris*, with approval by DPH.
  - If necessary, cohort infected residents.
- Adherence 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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## DPH Response to MDROs

- Detect
  - *C. auris* and CPO: 1 case=outbreak
  - Nationally notifiable
  - Antimicrobial Resistance Laboratory Network (ARLN)
- Contain
  - Ensure rapid response & containment
    - Point-prevalence survey (PPS)
    - Infection control assessment and response (ICAR)
- Prevent
  - Stewardship efforts
    - Antimicrobial Stewardship Workgroup
    - Antibiotic Prescribing Guidelines
    - Antibiotic Stewardship Pledge
  - Education
    - Collaborative effort (DPH, LHD, SPICE)



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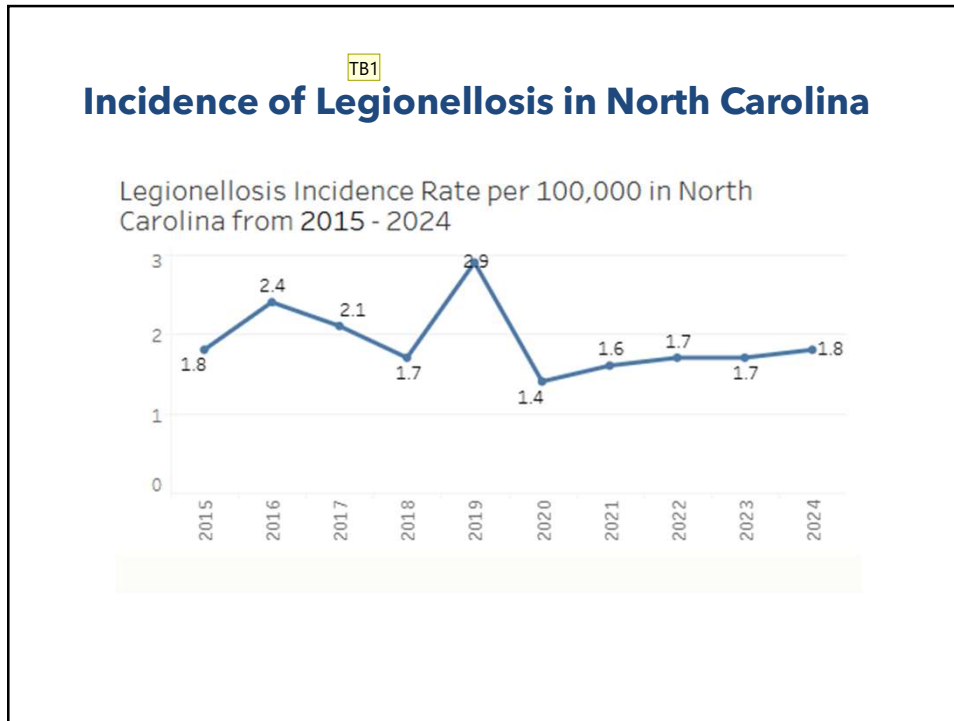
## Legionellosis

- Caused by inhalation *Legionella pneumophila*
- 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 <b>pneumonia</b>	Self-limited febrile illness; no pneumonia
Resolution	Typically requires antibiotics; ~15% case-fatality rate	Spontaneous recovery in 2-5 days




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## Investigation Steps




Lab

- Urine antigen
- Other



Risk

- Travel
- Water exposures
- Healthcare exposures



Clinical

- Symptom
- Onset date
- Radiographic evidence of pneumonia
- Previous hospitalizations

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**TB1** Updated numbers?

Breeyear, Taylor L, 2024-09-17T19:19:04.770

### 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  $\geq 14$  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)

- Recent outbreaks in poultry and dairy cows, including NC.
  - Beginning to detect new cases in birds in Fall 2025
- Current public health risk is low but there have been cases in humans in the U.S.
  - Mild symptoms
  - Almost all cases have been 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, gloves, eye protection
  - May require transfer
  - Contact DPH Epi On-Call



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## 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 in a LTCF?
  - Contact our RIPS team at [infectionprevention@dhhs.nc.gov](mailto:infectionprevention@dhhs.nc.gov) for assistance.



[CDC: Preventing Transmission of Viral Respiratory Pathogens in Healthcare Settings](#)

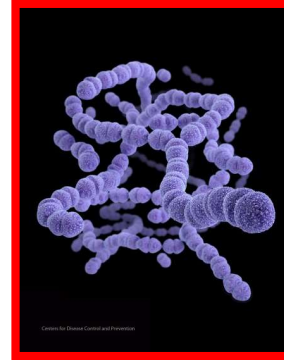
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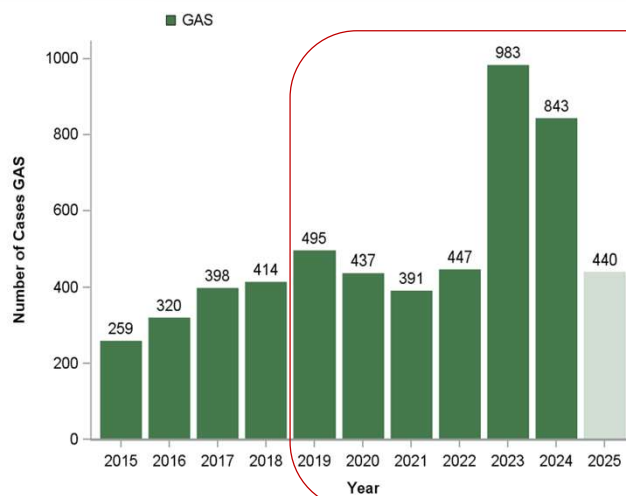
## Group A Streptococcus (GAS)

- 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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## North Carolina Confirmed iGAS Cases by Year



Preliminary data



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## Who is at higher risk for iGAS?

- Elderly at higher risk
  - ~ 15% of people aged 65 years or older die from their invasive GAS infection<sup>1</sup>
- Older adults in LTCFs have a 6x greater risk of disease and 1.5x greater risk of death than older adults in the community<sup>2</sup>
- 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
- Educate staff, site visit to assess practices



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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

- **End the outbreak!**
- Identify, describe the source
- Identify populations at risk
- Develop strategies to prevent future outbreaks
- Evaluate existing prevention strategies
- Describe new diseases / learn more about known diseases
- Opportunity to educate public about disease prevention
- Address public concern



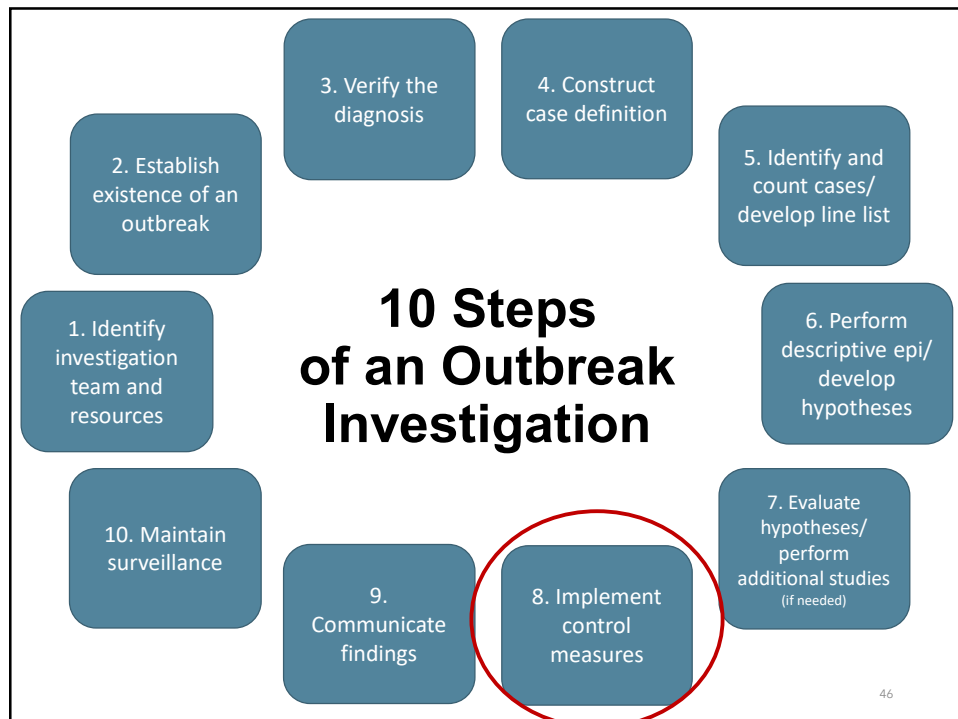
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## Principles of Outbreak Investigations

- 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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## 2. Establish existence of outbreak

### What is an Outbreak?



Increase in cases above what is expected in that population in that area



Occurrence of 2 or more 'epi-linked' cases

#### • 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



Obtain medical records, laboratory reports



Interview patients or their proxies



If needed:

Conduct additional testing

Hold specimens



Consult with DPH CDB, SLPH



In conjunction with CDB, request NCSLPH to perform bacteriologic, virologic, other testing



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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

**Onset of nausea, vomiting, or diarrhea in a patron of restaurant X within 7 days of eating or drinking food/beverage from restaurant X**

NC

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### GAS Outbreak Case Definition

**Invasive case definition:** Any resident or staff of the LTCF with GAS isolated by culture from a normally sterile site since MM/DD/YY

**Noninvasive case definition:** resident or staff of facility with positive culture or PCR from nonsterile site or positive rapid strep test, since MM/DD/YY

NC

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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

DEMOGRAPHICS					SYMPTOMOLOGY				LABORATORY INFORMATION				
First name	Last name	Date of Birth (MM/DD/YYYY)	Age	Unit	Rm #	Onset Date (MM/DD/YYYY)	Wound?	Sore Throat?	Rash?	Symptomatic? Y/N	Type of Specimen	Date of Collection (MM/DD/YYYY)	Name of Testing Lab
1													
2													
3													
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- Template also includes-
- Hospitalization
  - Outcome
  - Treatment

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## Epidemic 'Epi' Curve

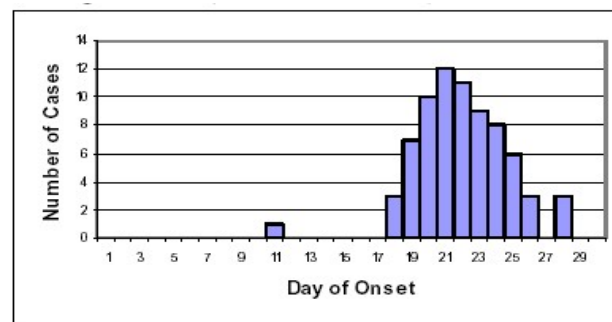
- A graphical representation of the number of outbreak cases by date of illness onset
- Visual representation of
  - Ill persons (cases) over time
  - Magnitude of outbreak
  - Number of cases on the vertical (y) axis
  - Time period (or date of illness onset) on the horizontal (x) axis
  - Type of outbreak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



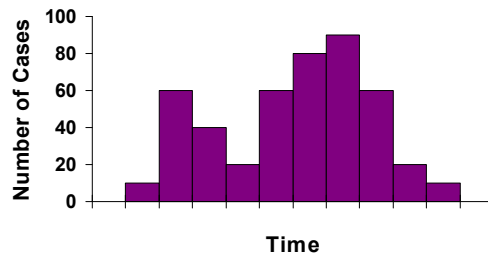
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## Epi Curves

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

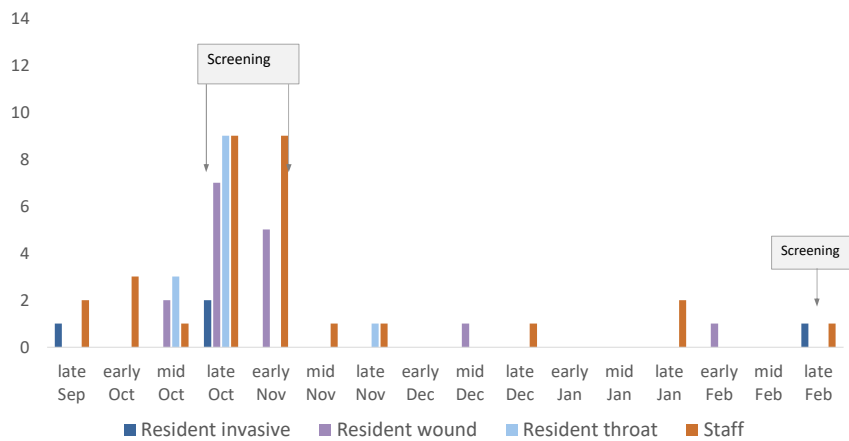
Epi Curve...Person to Person



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Example Epi Curve: GAS Outbreak Positive Results



- 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
    - In most outbreaks, this is sufficient
  - Perform additional studies (e.g., analytic)
    - Cohort or case-control
    - Assess exposures equally among ill and non-ill persons



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## 8. Implement Control Measures



Are applied as soon as possible



Implement immediately if source is known or there is a continued risk of exposure



May change during investigation- adapt



Examples- isolating, screening, masking



Should be guided by epidemiologic results



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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



To determine that the outbreak really is over



To ensure secondary outbreak is not occurring



Evaluate / document effectiveness of control measures



It is recommended to maintain surveillance for 2 average incubation periods following the last date of illness onset



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## Conclusions

- Epidemiologic investigations essential component of public health
  - Determine the source of outbreaks
  - End the outbreak by implementing control measures
- 10 steps provide systematic framework necessary to investigate any outbreak
  - Be systematic!
  - Communicate!

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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**
    - NC DPH Antimicrobial Stewardship  
<https://epi.publichealth.nc.gov/cd/antibiotics/stewardship.html>
- Antibiotic Prescribing Guidelines:
- [Adult Antibiotic Prescribing Guidelines](#) (PDF)
  - [Adult Antibiotic Prescribing Guidelines Brochure](#) (PDF)
  - [Adult Antibiotic Prescribing Guidelines \(Mobile Friendly\)](#) (PDF)
  - [Pediatric Antibiotic Prescribing Guidelines](#) (PDF)
  - [Pediatric Antibiotic Prescribing Guidelines Brochure](#) (PDF)
  - [Pediatric Antibiotic Prescribing Guidelines \(Mobile Friendly\)](#) (PDF)
- **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](mailto:infectionprevention@dhhs.nc.gov)

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



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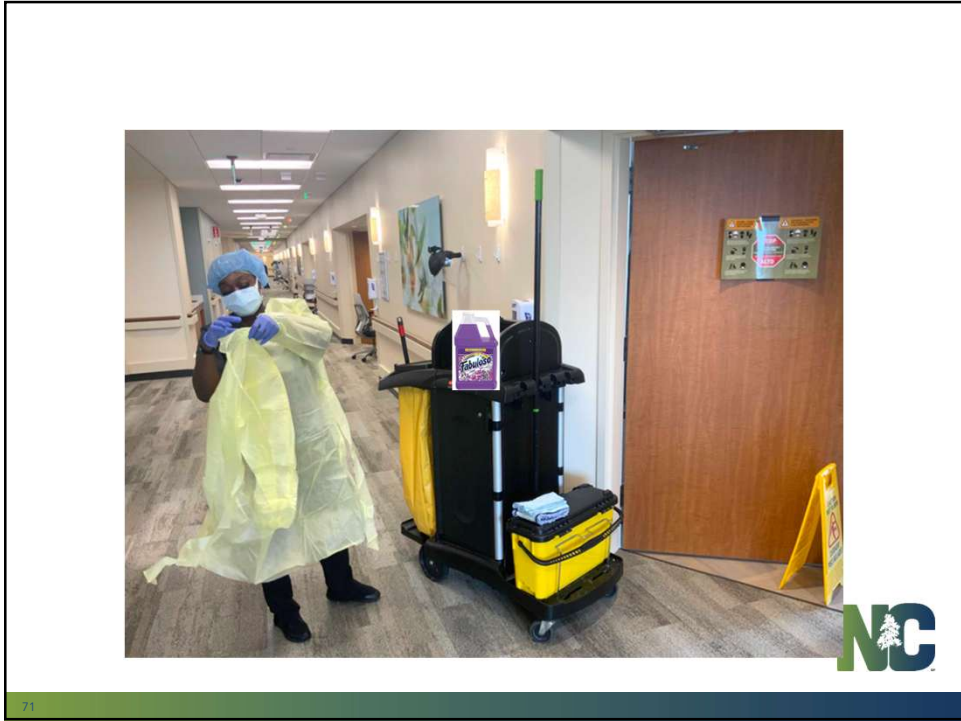
## ***C. auris* - Comprehensive Infection Prevention Response**

***C. auris* Case Study  
Fall 2025**

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# Infection Control and Response (ICAR)

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EPA United States Environmental Protection Agency

Search EPA.gov

Pesticide Registration CONTACT US

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

**MICRO-KILL Bleach**  
GERMICIDAL BLEACH WIPES

**EPA Reg. No. 37549-1**

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

KEEP OUT OF REACH OF CHILDREN  
**CAUTION**

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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 ).

**TO OPEN CANISTER:**

1. Always use personal protective equipment.\*
2. Remove lid from canister.
3. Lift top on canister lid.
4. Pull up corner of center wipe and snap off and discard. Take the end wipe, held to a point and thread through dispenser flap to lid.
5. DO NOT PUSH FINGER THROUGH OPENING.
6. Repeat 4b. Pull out exposed wipe and snap off. The next wipe snaps out automatically.
7. Snap center flap down when finished to retain moisture.
8. Do not flip over the lid.

**KILLS MRSA, HIV AND HCV ON PRECLEANED ENVIRONMENTAL SURFACES/OBJECTS PREVIOUSLY SOILED WITH BLOOD/BODY FLUIDS**

\* Health care settings or other settings in which there is an increased likelihood of soiling of environmental surfaces/objects with blood/body fluids and in which the surfaces/objects likely require disinfection with Micro-Kill Bleach Germicidal Bleach Wipes can be associated with the spread of transmission of HIV-1 (associated with AIDS), HIV-2 and HCV.

**SPECIAL INSTRUCTIONS FOR CLEANING AND DISINFECTION AGAINST MRSA, HIV, AND HCV ON SURFACES/OBJECTS SOILED WITH BLOOD/BODY FLUIDS.**

- **PERSONAL PROTECTION:** When handling items soiled with blood or body fluids, use disposable gloves, gown, masks and eye protection.
- **CLEANING PROCEDURE:** Blood/body fluids must be thoroughly removed from surfaces/objects before application of Micro-Kill Bleach Germicidal Bleach Wipes.

**CONTACT TIME:** Allow sufficient to remain visibly wet for 30 seconds to kill the bacteria and viruses\*\* on the label except a 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 minute contact time is required to kill *Clostridium difficile* spores\*.

• **DISPOSAL OF INFECTIOUS MATERIAL:** Blood/body fluids must be autoclaved and disposed of according to local regulations for infectious waste disposal.

• **SPECIAL INSTRUCTIONS FOR CLEANING PRIORITY DISINFECTING AGAINST *Clostridium difficile* SPORES:**

- **PERSONAL PROTECTION:** Wear appropriate barrier protective such as gloves, gown, mask, or eye covering.
- **CLEANING PROCEDURE:** Fecal matter must be thoroughly cleaned from surfaces before using Micro-Kill Bleach Germicidal Bleach Wipes. Cleaning is to include vigorous scrubbing, until all visible soil is removed. Special attention rooms are to be cleaned in an appropriate manner such as from right to left or left to right, on horizontal surfaces, and top to bottom, on vertical surfaces, in reference spreading of the spores. Restrooms are to be cleaned last. Do not reuse soiled wipes.

• **INFECTIOUS MATERIAL DISPOSAL:** Materials used in the cleaning process that may contain fecal matter must be disposed of immediately in accordance with local regulations for infectious material disposal.

\*\*\***SPECIAL INSTRUCTIONS FOR CLEANING PRIORITY DISINFECTING AGAINST *Candida auris*:**

- **PERSONAL PROTECTION:** Wear appropriate barrier protection such as gloves, gown, mask, or eye covering.
- **CLEANING PROCEDURE:** Fecal matter/moisture must be thoroughly cleaned from surfaces/objects before disinfection by application with Micro-Kill Bleach Germicidal Bleach Wipes. The cleaning is to include vigorous scrubbing, until all visible soil is removed. Surface of patient rooms are to be cleaned in an appropriate manner, such as from right to left or left to right, on horizontal surfaces, and top to bottom, on vertical surfaces, in reference spreading of the spores. Restrooms are to be cleaned last. Do not reuse soiled cloths.

• **INFECTIOUS MATERIAL DISPOSAL:** Materials used in the cleaning process that may contain fecal matter are to be disposed of immediately in accordance with local regulations for infectious material disposal.

**NC**

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## Mrs. Smith's Room

**NC**

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## Hallway



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## PT Room



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