



Ministry of Health & Family Welfare  
Government of India

# Management of HAI outbreaks

Training Session – VII-B



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National Center for Disease Control, New Delhi

# Outline

## Management of HAI outbreaks

- “Outbreaks” vs “Clusters”
- “Outbreak” vs “Pseudo-outbreak”
- Commonly detected organisms in HAI outbreaks
- Identifying a potential outbreak
- Modes of transmission of outbreak pathogens

## HAI outbreak investigation - steps



# Management of HAI Outbreaks

# What is an outbreak?

- An outbreak is defined as an occurrence of disease at a rate greater than that expected within a specific geographical area over a defined time period
- In the context of HAIs, the geographical area may be a hospital, ward, an ICU or OT
- When there are more cases of infection with the same organism than would normally be expected in one area or period, this constitutes an outbreak
- It is important to investigate an HAI outbreak immediately, as the availability and quality of microbiological evidence and epidemiological data diminishes rapidly with time between illness and investigation

## “Outbreak” vs “Pseudo-outbreak”

- An “outbreak” is generally an increase in clinical disease or clinically relevant lab reports (e.g. acute diarrheal disease, dengue, measles, etc.)
- A “pseudo-outbreak” is generally an increase in reports or positive cultures without evidence of disease
- This may be a surveillance or laboratory artifact due to:
  - New definitions
  - Improved surveillance
  - New practitioners
  - New lab tests or change in testing frequency
  - Poor sample collection
  - Laboratory error or contamination

# Identifying a potential outbreak

- An outbreak can be identified by regular reviews of surveillance and laboratory data
- Clinician reports of notifiable diseases/ AMR alert pathogen can provide an alert to an unusual increase in a disease
- In many outbreaks due to common encountered pathogens, comparison is made with previous occurrence of the same infection during the same time period
- Occurrence of any unusual organism needs to be investigated

**Some outbreaks are easy to investigate, e.g. unusual or important organisms; others are not that easy, e.g. a 50% increase in SSIs for one quarter or doubling of MRSA BSIs for one month**

# Outbreak transmission in HCFs

- There might be various modes of transmission of outbreak pathogens in healthcare facilities
- Sometimes outbreaks occur in the community and the hospital acts as an amplifier, e.g. the sick patient admitted to the hospital (index case) transmits the infection to other patients and staff and the number of cases with infection increase
- This has happened in the outbreaks of SARS CoV, Influenza, Ebola and Nipah virus outbreaks

# Modes of transmission of outbreak pathogens

- Common source (Water well, Food outlet etc.)
- Human reservoir
- Cross-infection (person to person)
- Airborne (Flu, Measles)
- Other environmental (e.g. fomite or medical device)
- Zoonotic (Anthrax, Melioidosis)
- Vector-borne (Malaria, Dengue, Japanese encephalitis)
- Uncertain



# HAI outbreak investigation – steps

1. Verification of diagnosis
2. Confirm the existence of the outbreak
3. Inform key stakeholders about the investigation
4. Construct a case definition
5. Identify the cases and collect information
6. Examine descriptive epidemiological features of cases
7. Observe and review patient care
8. Generate a hypothesis and test the hypothesis
9. Collect and test environmental samples
10. Implement control and prevention measures
11. Follow-up and communicate results (staff, patients, press, public)

**Although the steps are listed sequentially the process of outbreak investigation may occur in a different order, often simultaneously or repeated many times as new information is received**

# Why should we investigate outbreaks?

- Define the magnitude in terms of time, place and person
- Identify the cause and mode of transmission
- Control the outbreak
- Prevent similar outbreaks in the future
- Evaluate and improve existing IPC strategies

# HAI outbreak Investigation Team

- A trained and well coordinated team is very crucial for investigating a healthcare associated outbreak
- Every hospital should have an emergency/ Rapid response teams (RRT) available for investigating HAI outbreaks
- The teams may include the following members based on the type of outbreak and mode of transmission
  - Infection control officer(Physician/ microbiologist i/c of IPC)
  - Infection Control Nurse
  - Clinician HICC Committee member
  - Laboratory personnel
  - Epidemiologist/ member from Social and Preventive Medicine department
- Optional members : Veterinary experts in case of Zoonotic diseases, Health PWD Engineers, Biomedical Engineers, based on the need etc.



# 1. Verification of Diagnosis

# How to verify diagnosis?

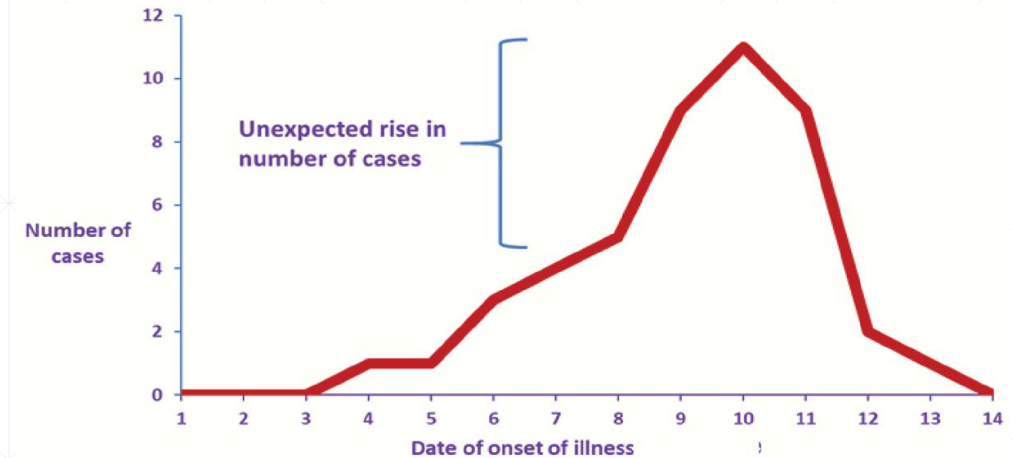
- Verification of diagnosis is the first step in an outbreak investigation as sometimes spurious or misinterpreted reports might give a false alarm
- It is necessary to have on-the-spot verification of diagnosis as quickly as possible
- Common steps involve :
  - Evaluating the clues
  - Evaluating signs and symptoms
  - Laboratory findings
  - Duration of symptoms
  - Suspected exposure
  - Suspected virus, bacteria, fungi or toxin
  - Hospital onset



## 2. Confirm the Existence of the Outbreak

# Confirm the existence of the outbreak

- This is done by review of surveillance data or reports from clinical departments and the lab
- Confirm that the cases have the same disease
- Confirm that the number of cases exceeds what would be expected for the population over the specific time period



Distribution of cases from a surveillance system confirming an outbreak

# Laboratory confirmation

- Laboratory confirmation is required to have a definite diagnosis
  - Identifying the pathogen will help identify the potential incubation period, which will pinpoint at what time the exposure took place
  - It is essential to test clinical specimens such as blood, urine, etc. to determine the agent causing the illness
  - Sometimes the investigation must move forward before a definitive diagnosis is reached
  - Since laboratory results can take time, do not wait for laboratory diagnosis
  - Once an agent is identified, the laboratory may be able to conduct further tests, to “fingerprint” the agent and verify that all cases/patients are related to the outbreak



## 3. Inform Key Stakeholders about the Investigation

# Key stakeholders in an outbreak investigation

- Hospital administration
- Health facility staff (clinicians, nurses, etc.)
- Hospital Infection Control Committee (HICC)
- Infection control team
- Laboratory staff with request to save all isolates that might be part of outbreak
- Local, state and public health officials
- NCDC/ IDSP\* as appropriate as per notification protocols

\*NCDC- National Centre for Disease Control  
IDSP -Integrated Disease Surveillance Programme

## 4. Construct a Case Definition

# Construct a case definition

- This is one of the most important steps in identifying the cases in outbreak investigation
- Before counting cases, the investigating team must decide what to count, that is, what to call a case by using a set of standard criteria for classifying whether a person has a particular disease, syndrome, or other health condition called as case definition
- Some case definitions, particularly those used for national surveillance for notifiable diseases by IDSP could be adopted as national standards that ensure comparability
- Using an agreed upon standard case definition ensures that every case is equivalent, regardless of when or where it occurred, or who identified it

# Elements of case definition

- Clinical criteria (signs and symptoms)
- Person, place and time criteria
- Laboratory test
- **Suspected case:** Illness in a person with compatible clinical symptoms, but maybe not all symptoms, and a likely epidemiological link has not yet been confirmed
- **Probable case:** This means that the clinical symptoms and epidemiology are compatible with the case definition
- **Confirmed case:** Strongest level of certainty. A suspected or probable case who has had a positive laboratory test for the disease

**Laboratory confirmation may not always be possible and is often unavailable early on in an investigation**



# 5. Identify the Cases & Collect Information

# Case identification & Data collection

- With every case detected, one can gather more information about potential exposures, personal characteristics, and the geographical extent of the potential outbreak

## Active case finding

- Case finding helps in providing more information about an outbreak and defining the exposed population
- The following sources can help in case finding:
  - Microbiology data
  - Infection control or surveillance records
  - Discussion with clinician
  - Medical records, operative notes

## Active case finding contd

- Pathology reports
- Pharmacy records, such as antimicrobial usage
- Central service/supply records, CSSD registers
- Occupational health records (NSI register, vaccination records)
- Log books
- Nurse's handover notes
- Hospital billing records



# Potential risk factors or exposures

- Medications
- Procedures
- Dates of admission and discharge
- Where admitted from (e.g.: referred from HCF, community)
- Facility locations or units
- Healthcare providers
- Host factors (age, gender, immunity)
- Co-morbidities

# Data collection

- The data should be confidential
- Any written materials containing personal identifiers should be stored in a secure and locked location
- Demographic identifiers of who is at risk
  - Demographic information that may be collected are age, gender, occupation, place of occupation and travel history
- Clinical information should be collected to verify that the case definition has been met, to characterize the disease and to create an epidemic curve – this includes the symptoms, the date of symptom onset, the severity of illness, and lab test results

# Data collection tool/form

- The data of each individual should be collected in a standard data collection form/tool
- These forms should be designed specifically for investigation to describe cases and potential risk factors depending on the type of infection
- The tool should be administered only by a trained investigator or team involved in the outbreak investigation

## 6. Descriptive Epidemiological Features

# Descriptive epidemiology

**Descriptive epidemiology is a very important part of the investigation since it drives all the investigation efforts and includes the following details:**

- Describes data by person, place and time
- Characterizes the outbreak
- Identifies the population at risk
- Provides clues about the agent, source or mode of transmission
- Provides information to begin control measures

# Line listing of cases

## Line-list is created from case data:

- Each row is a case
- Each column is a variable of interest
- Signs and symptoms, onset date
- Medications, intravenous solutions
- Invasive procedures, surgery
- Staff contact
- Host factors (e.g. age, underlying disease)
- Lab results

# Sample line-list from XYZ hospital during an outbreak in surgical ICU

Case ID	Hospital name	Unit Type	Age	Gender	Date of Admission	Location prior to admission	Outcome	Organism	Date of Sample collection
19.2 A	XYZ hospital	Surgical ICU	11	F	18/08/21	Home	Died	<i>Burkholderia cepacia</i>	21/08/21
19.2 B	XYZ hospital	Surgical ICU	4	F	20/08/21	Home	Undergoing treatment	<i>Burkholderia cepacia</i>	22/08/21
19.2 C	XYZ hospital	Surgical ICU	3	M	20/08/21	Home	Transferred to ward 21	<i>Burkholderia cepacia</i>	22/08/21
19.2 D	XYZ hospital	Surgical ICU	2	F	20/08/21	Home	Discharged	<i>Burkholderia cepacia</i>	22/08/21

# Epidemic curve

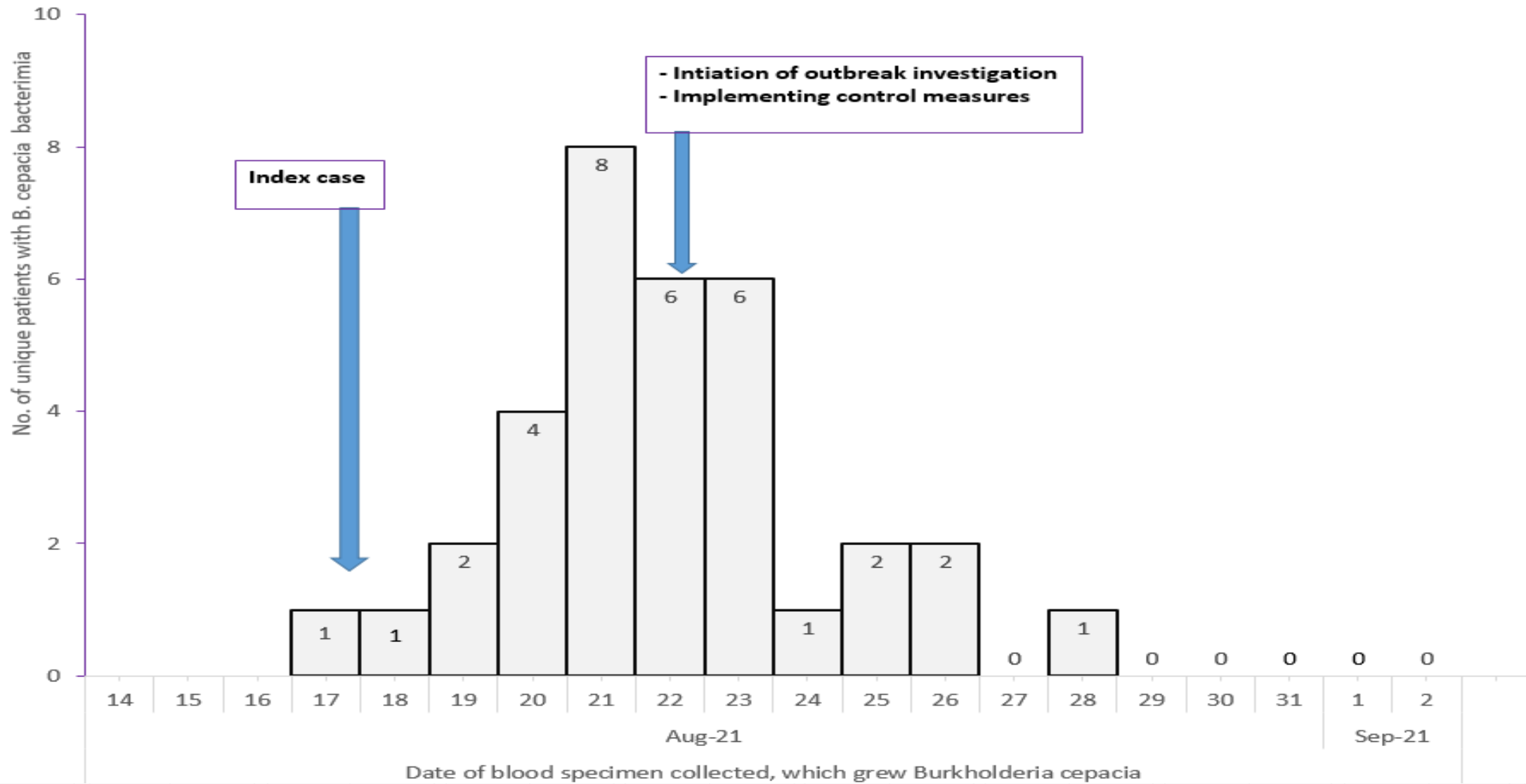
- It is a graphical representation of the distribution of cases by time of onset of illness
- In an epidemic
  - **Y-axis:** Number of cases of illness
  - **X-axis:** Date or time of illness onset
  - Unit of time often based on incubation period
- The epidemic curve should distinguish between confirmed and probable cases
- The shape of the epidemic curve may suggest a single point source, ongoing transmission or an intermittent source



## Epidemic curve contd.

- The epidemic curve helps us to
  - Understand the magnitude of the outbreak
  - Show the time trend of the outbreak
  - Define the incubation period or exposure period
  - Show the pattern of spread and highlight outliers

**Please refer to next slide for epi curve; distribution of *B. cepacia* blood stream infection in a surgical ICU of XYZ Hospital, August 2021**



**Observe how the outbreak investigation and concurrent control measures help in reducing the number of new infections**

# Descriptive epidemiology: Attack rate

- Descriptive data allow the calculation of an attack rate, defined by
  - The number of people who are infected divided by the total number of people at risk
  - The attack rate can also be calculated stratified by relevant characteristics such as sex, age, location or specific exposure (ventilation, catheterization, OTs and occupational exposure)

# Descriptive analysis results

- This information will help to suggest the intervention so as to control the outbreak or chances of occurrence of new cases and to take initial precautionary measures suggested by the IPC team or HICC, such as
  - Exclusion of cases from high-risk activities
  - Isolation and/or cohorting (charting and grouping) of patients
  - Restricting movement of patients, staff and visitors
  - Screening of patients with isolation of patients and cohorting of contacts
  - Prophylactic treatment/immunization

## 7. Observe and Review Patient Care

# Observe and review patient care

- Initial observations can be useful in facilitating the creation of a standard observation tool, if needed.
- Clinical observations for who and what to observe are generally driven by the line-list and may include:
  - Medication details
  - Vascular access care
  - Laboratory and other Clinical investigation reports
  - Hand hygiene practices
  - Adherence to isolation precautions
  - Surgical practices
  - Sterilization practices
  - Respiratory care practices

## 8. Generate a Hypothesis and Test the Hypothesis

# Generating a hypothesis

- A hypothesis in the context of an outbreak investigation is an educated guess about an association between an exposure and the outcome of interest or disease which can be tested
- Descriptive data collected in the previous step of the investigation provide information that is very useful in the development of hypotheses



# Testing a Hypothesis

- Any hypotheses that are generated by investigators will need to be tested to confirm the association
- Hypotheses can be tested in an analytical study, such as a case–control study/ cohort study that compares exposures among case patients to hospital-matched controls
- Comparing hypotheses with established facts such as laboratory evidence, clinical evidence, environmental and epidemiological evidence can be helpful in guiding more investigation when the source remains unclear or to support a hypothesis

# 9. Collect and Test Environmental Samples

# Environmental sampling

- Outbreaks are one of the reasons for performing environment surface sampling
- This can be a powerful and definitive aspect of an investigation
- However, environmental testing can have the following fallacies
- A negative culture implies
  - The right samples may not have been collected
  - The methodologies may not be standardized (there may be overgrowth of other organisms, some samples require neutralization steps to get rid of disinfectants, etc.)

# Fallacies in environmental testing

- Even using the best methods, the yield can still be low
- The organism may have been present but is not there now
- Environmental pathogens may have adapted to low nutrition environments and need special media to grow
- There may be limited bacterial yield in getting the bacteria off the surface onto the swab
- There may be limited yield getting the bacteria off the swab into the media

# Guidance for environmental sample collection

- Culture should be done after the data have been received from the line-list and observations
- Culture should be guided by the epidemiology of the organism (e.g. *Serratia* spp. – fluids, VRE objects/surfaces)
- Epidemiological typing of the organisms isolated using phenotypic and genotypic methods may be performed to identify the characteristics of the pathogen causing the outbreak

**Culture should be done only of things that are likely routes of transmission (e.g. high-touch surfaces, intravenous fluids etc.)**

# 10. Implement Control and Prevention Measures

# Implement control and prevention measures

- The primary goal is to stop transmission, not necessarily to find the source
- Thus, a variety of control measures should be implemented targeting various possibilities based on initial observations
- Implement targeting IPC activities
- Conduct risk assessment and plan mitigation strategies
- Ensure standard precautions and transmission precautions based on the risk assessment are implemented

# 11. Follow-up and Communicate Findings



# Follow-up and communicate findings

- Ongoing case finding and surveillance – If active surveillance is being done it should continue, and if not, it should be initiated
- Ongoing surveillance is needed to monitor the outbreak to determine if the IPC activities are working and target areas where they need to be directed
- Another reason to conduct surveillance is to ensure that the outbreak has not spread to new areas

# Communicate findings

- A final report of the outbreak investigation should be shared with all the key stakeholders like hospital administrators and HICC, which describes the outbreak, interventions and effectiveness of measures taken, and summarizes the learnings
- It should also make recommendations to prevent future occurrence
- Outbreaks are sentinel events that help us understand and confront emerging challenges in implementing quality healthcare services
- They can play an important role in developing recommendations that improve overall patient care and provide important opportunities for education

# Communicate findings

## Develop a risk communication policy

- Information about the outbreak and the risks should be communicated to all key staff as soon as an alert of an impending emergency has been declared
- Patients and visitors in HCF educated about prevention strategies (e.g.: hand washing, why entry is restricted )

# Summary

- **Surveillance of HAIs** – types, data sources, SSI, UTI, RTI, BSI, etc.
- **Management of HAI outbreaks** – Outbreaks, clusters, pseudo-outbreak
- **HAI outbreak investigation** – steps
  - Importance of verification of diagnosis and confirming the outbreak
  - Constructing a case definition and collecting information
  - Descriptive epidemiological analysis of outbreak data
  - When and how to collect environmental samples
  - Implementing control measures and communicating the findings
  - Risk communication plan for HAI outbreaks



# Questions?