HEALTH HOLDING

HAFER ALBATIN HEALTH CLUSTER
MATERNITY AND CHILDREN HOSPITAL

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1. PURPOSE:

1.1 To outline the actions to be taken in the management of an infectious disease outbreak in the hospital.
1.2 To promptly identify an outbreak and initiate appropriate control and containment measure to prevent it's spread
1.3 To define the activities of outbreak control and assign responsibility for these activities.

2. DEFINITONS:

2.1 Healthcare-Associated Outbreak:
2.1.1 It is an increase in the number of healthcare-associated infections among patients or staff over and above the expected number of cases.
2.1.1.1 In addition, healthcare-associated outbreak is met when there are two or more cases of infection caused by the same organism, epidemiological linked to the location, exposure, and duration.
2.1.1.2 For emerging and re-emerging diseases, and high-risk pathogens, one pathogen is enough to declare an outbreak in healthcare facilities that unlikely to be affected by that type of pathogen.
2.2 Outbreaks in healthcare facilities are often multifactorial including breaches in infection control or clinical practices, contaminated devices infected or colonized patients and /or healthcare workers.
2.3 Case definition: a set of uniformly applied criteria such as clinical, laboratory, and other diagnostic modalities for identifying a particular infectious disease, but in the context of outbreak investigation, there may be added limitation on time and place to reflect the unique scope of the suspected event.
2.4 Cluster: an aggregation of cases grouped by time and place that may be greater than the expected number, whether the expected number is known or not; also referred to as a small outbreak.
2.5 Colonization: the presence, growth, and multiplication of a microorganism(s) in a host, but without clinical response or damage to the host; often found to be a precursor to infection. Common source: an outbreak transmission mode that involves intermittent or continuous exposure to a common harmful source.
2.6 Levels of disease occurrence:
2.6.1 Sporadic level: Occasional cases occurring at irregular intervals
2.6.2 Endemic level: Persistent occurrence with a low to moderate level
2.6.3 Hyperendemic level: Persistently high level of occurrence
2.6.4 Epidemic or outbreak: Occurrence clearly in excess of the expected level for a given time period and location
2.6.5 Pandemic: Epidemic spread over several countries or continents, affecting a large number of people.
2.7 Outbreak: an increase in the occurrence of cases of infection or disease over what is expected in a defined setting or group in a specified time period; synonym of epidemic but used more often when limiting the geographic area.
2.8 Pseudo-outbreak: an increase in positive culture results without evidence of disease, frequently attributed to contaminated specimen collection, lab reporting inaccuracies, and bias.

2.9 Training records of all OMT members and continuous job specific training on management of outbreaks based on the latest national MOH guidelines & regulations. (Manual or electronic dashboards).

Impacts of pathogens:

2.9.1 Infection

2.9.1.1 Infection is the entry and multiplication of organisms in the tissue of a host.

2.9.1.2 Infection may be clinical or subclinical and may not produce identifiable disease.

2.9.1.3 However, it is usually accompanied by measurable host response(s), either through the appearance of specific antibodies or through cell-mediated reaction(s).

2.9.2 Colonization

2.9.2.1 The multiplication of a microorganism at a body site or sites without any overt clinical expression or detected immune reaction in the host at the time that the organism is isolated.

2.9.2.2 Colonization may or may not be a precursor of infection.

2.9.2.3 Colonization may be a form of carriage and a potential transmission source.

2.10 Types of patients:

2.10.1 Case

2.10.1.1 A case is a person who has the pathogen multiplying (infected) and meets the case definition of a specific disease

2.10.1.2 A clinical case is a term that refers to overt disease when the signs and symptoms are apparent

2.10.1.3 The subclinical case is a term that refers to an apparent (subclinical) infection, and an immune response can occur without overt clinical disease.

2.10.2 Carrier

2.10.2.1 A carrier is a person in whom organisms are present and may be multiplying but who shows no clinical response to their presence.

2.10.2.2 The carrier state may be permanent, with the organism always present; intermittent, with the organism present for various periods; or temporary, with carriage for only a brief period.

2.10.2.3 Carriers may shed microorganisms during the incubation period and recovery.

2.11 Timelines for infection and disease

2.11.1 Infection-wise

2.11.1.1 Latent period: It is the time interval between the moment of infection and the point at which the infected individual becomes capable of transmitting the infection to others.

2.11.1.2 It is usually shorter or sometimes similar to the incubation period.

2.11.1.3 Infectious period (also known as the period of communicability or infectivity): It is the time during which the host is infectious (capable of transmitting pathogens to other susceptible individuals)

2.11.1.4 A related term is a shedding period, which is defined as the period during which a host or patient excretes pathogens through sputum, saliva, urine, feces, or other bodily fluids

2.11.2 Disease-wise

2.11.2.1 Incubation period: It is a term that refers to the time between exposure to an infectious disease and the start of symptoms.

2.11.2.2 It is usually longer or sometimes similar to the latent period.

2.11.2.3 It determines the duration of quarantine for exposed persons until they can resume regular activities

2.11.2.4 Symptomatic period: It is the period in which characteristic symptoms of the disease are present.

2.11.2.5 Although variable form disease to disease, the patient can be infectious before and after the symptomatic period.

3. POLICY:

3.1 The primary goal is control of the outbreak and prevention of additional cases. Control measures include, but not limited to: Strict hand hygiene compliance , Isolation / Cohorting , staff training and education, thorough environmental cleaning and so on and additional control measures required when needed.

3.2 A screening policy for all MDROs implemented for the admissions and transferred patients to the critical care areas in MCH according to the up-to-date national MOH guidelines.

3.3 Duplicate MDRO Isolate for blood isolate:

3.3.1 Any MDRO blood isolate from the same patient and location, following a previous MDRO blood isolate within 14 days across calendar months and readmission to the same location, **should not be reported** .

3.3.2 There should be 14 days with no blood isolates for the patient and specific location before another blood event is entered into NHSN for the patient and location.

3.3.3 The date of specimen collection is considered Day 1.

3.4 Outbreak management team (OMT) chaired by hospital director or medical director with clear roles & responsibilities and include all key members involved in outbreak management.

3.5 Investigation and control measures of confirmed healthcare-associated outbreaks are led by the director of the IPC department in the hospital

3.6 The outbreak management team members are trained and having experience and skills in management of outbreaks based on the latest national MOH guidelines & regulations.

3.7 If an outbreak is confirmed, the IPC department alerts the hospital director through approved channel of communication and the OMT will be activated consequently and will be discussed in the nearest committee.

3.8 If an outbreak is confirmed, the infection prevention & and control department activates the notification through an approved national platform based on the national MOH guidelines and regulations within 48 Hours.

3.9 If an outbreak is confirmed, the OMT members meet as required, and the meeting-recommended actions will be implemented and followed.

3.10 If an outbreak is confirmed, the facility implements outbreak management approaches (investigation forms, line lists, contact tracing, and outbreak management action plan (OMAP) based on the national MOH guidelines and regulations within 72 hours

4. PROCEDURE:

4.1 Steps of initial investigation of an outbreak

4.1.1 Step 1. Verify the Diagnosis

4.1.1.1 Early in the investigation, identify as accurately as possible the specific nature of the disease by:

4.1.1.1.1 Ensuring that the diagnosis is correct;

4.1.1.1.2 Evaluating for possible laboratory error as the basis for increased diagnoses;

4.1.1.1.3 Evaluating possible changes in surveillance and case definitions

4.1.1.1.4 Reviewing clinical findings and microbiological testing results.

4.1.2 Step 2. Confirm presence of an HAI Outbreak

4.1.2.1 An early major step in the investigation is verifying that a suspected outbreak is real.Cases in excess of historical or predicted levels might not necessarily indicate an outbreak

4.1.2.2 Some cases might be part of an actual outbreak with a common cause, whereas others might be unrelated.

4.1.2.3 Reporting might be increased because of changes in local reporting procedures, changes in the case definition, increased interest reflecting local or national awareness, or improvements or other changes in diagnostic procedures.

4.1.2.4 Possible community-associated or other explanations for illness not associated with healthcare should be investigated. Public health surveillance data sometimes can inform investigators about an increase in infections that is initially recognized in healthcare settings but actually is part of a broader community outbreak.

4.1.2.5 Pseudo-outbreaks (e.g., those caused by laboratory processing errors or contamination of clinical diagnostic equipment, such as bronchoscopes, without clinical illness) are important to investigate and control because they can lead to unnecessary antibiotic prescriptions, diagnostic procedures, and other potentially harmful interventions to patients. Pseudo-outbreaks also represent opportunities to recognize and correct inadequate infection control processes (e.g., device reprocessing).

4.1.3 Step 3. Alert key partners about the investigation

4.1.3.1 After confirming an HAI outbreak, investigators should inform key partners.

4.1.3.2 Include relevant facility staff (e.g., hospital epidemiologist, infection control practitioner, environmental services department staff, medical staff, administrative leaders, media relations director, and department leads for the affected facility area).

4.1.3.3 Ask the clinical laboratory director to save all isolates that might be related to the outbreak.

4.1.3.4 Notify local, state, national, and international public health officials, as required

4.1.3.5 Notify regulatory partners (e.g., Food and Drug Administration, Environmental Protection Agency) if the investigation involves regulated medical devices or products.

4.1.3.6 Notify professional oversight organizations, as required (e.g., pharmacy boards, clinician licensing boards).

4.1.4 Step 4. Establish case definitions: A case definition is used to identify persons who are, or might be, infected and to characterize them in relation to the disease, time and location of exposure or illness onset, and other persons affected. A case definition usually includes:

4.1.4.1 Clinical information about the disease (e.g., laboratory test results, symptoms, and signs);

4.1.4.2 Demographic characteristics of affected patients (e.g., age, race/ethnicity, sex, and occupation);

4.1.4.3 Information about the location of possible exposure or time of onset (e.g., what part of an intensive care unit, radiology suite, operating room, ward, or other unit); and

4.1.4.4 A defined time during which exposure or onset occurred.

4.1.4.5 The case definition also should be based on the etiologic agent, if known, and can include clinically infected and colonized patients. The specificity of the definition can vary.

4.1.4.6 A stratified case definition (e.g., confirmed vs. probable vs. possible [i.e., suspected], or confirmed vs. probable) can be applied to account for the uncertainty of certain diagnoses.

4.1.4.6.1 Confirmed: Usually must have laboratory verification.

4.1.4.6.2 Probable: Usually has typical clinical features and an epidemiologic link to confirmed cases but lacks laboratory confirmation.

4.1.4.6.3 Possible: Usually has fewer of the typical clinical features or weaker epidemiologic links to confirmed cases.

4.1.4.7 The following are example of case definitions:

4.1.4.7.1 A methicillin-resistant Staphylococcus aureus bloodstream infection in a patient in Hospital A's neonatal intensive care unit during January 1–December 31.

4.1.4.7.2 Isolation of Burkholderia cepacia complex matching the outbreak strain in a hospitalized patient who received Medication A any time during January 1–June 30

4.1.4.7.3 Fever (temperature >38.5ºC) and compatible symptoms in a patient who had been in an Ebola virus infection–affected country 21 days or less before symptom onset.

4.1.4.8 Identify and Count Cases: Outbreaks often are first recognized and reported by perceptive HCW or identified during surveillance activities. Additional cases related to the outbreak can be identified through multiple types of data and records, for example,

4.1.4.8.1 Central service or supply records,
4.1.4.8.2 Occupational health records,
4.1.4.8.3 Hospital billing records,
4.1.4.8.4 Operative notes,
4.1.4.8.5 Infection control assessment,
4.1.4.8.6 Pathology reports,
4.1.4.8.7 Interviews with physicians,
4.1.4.8.8 Pharmacy reports,
4.1.4.8.9 Log books,
4.1.4.8.10 Purchasing records,
4.1.4.8.11 Medical records,
4.1.4.8.12 Radiology reports,
4.1.4.8.13 Microbiology data, and
4.1.4.8.14 Surveillance records.

4.1.5 Step 5. Organize data according to person, place, time, and size

4.1.5.1 Create a Line Listing. For each case, collect and array the following types of information encompassed by the case definition:

4.1.5.1.1 Location information. Location within the facility (e.g., room number, bed number, and adjacent rooms).

4.1.5.1.2 Demographic information. Typically, age, sex, race/ethnicity, and occupation, plus other relevant characteristics of the affected population or others at risk.

4.1.5.1.3 Clinical information. Symptoms, signs, and laboratory tests (e.g., culture, serology, or polymerase chain reaction results).

4.1.5.1.4 Risk factor information. Adjust the investigation to the specific disease in question.

4.1.5.2 Data to obtain in a line listing

4.1.5.2.1 Patient characteristics (e.g.,age, sex, race/ethnicity, comorbidities, birthweight)
4.1.5.2.2 Date of admission
4.1.5.2.3 Date of illness onset
4.1.5.2.4 Date of discharge
4.1.5.2.5 Facility locations/units (i.e., room number, bed, and adjoining room numbers)
4.1.5.2.6 Medications
4.1.5.2.7 Procedures
4.1.5.2.8 Consults (e.g., laboratory or nursing)
4.1.5.2.9 Attending healthcare personnel (e.g., specific nursing staff, respiratory therapists, and physicians)

4.1.5.3 Construct an Epidemic Curve

4.1.5.3.1 Illustrates the course of the epidemic by day, week, or month and can help project its forward trajectory;

4.1.5.3.2 Might help estimate a probable exposure period and, therefore, focus a questionnaire on that period, especially when an approximate incubation period is known or suspected.

4.1.5.3.3 Might enable inferences about the epidemic pattern (e.g., whether common source or person-to-person).

4.1.6 Step 6. Conduct targeted observations, review key concerns with setting healthcare providers, and develop abstraction forms

4.1.6.1 Focus on whether actual practices deviate from recommended infection control practices and the facility's policies. Such discrepancies are best identified through a combination of direct observations and review of HCW self-reported practices.

4.1.6.2 Examine whether practices differ among HCW.

4.1.6.3 Review recent scientific literature related to the key concerns involved with the outbreak.

4.1.6.4 Observe key activities (e.g., medication preparation, care of vascular access, hand hygiene, adherence to isolation precautions, device and equipment reprocessing, environmental services, and respiratory therapy) related to suspicions about likely transmission pathways that might be involved in the outbreak.

4.1.6.5 Review key concerns with facility HCW to help generate hypotheses about the source and mode(s) of transmission.

4.1.6.6 Are protocols accurate and up-to-date?

4.1.6.7 How does actual practice compare with written or verbal protocols?

4.1.6.8 Are procedures consistently adherent to protocols?

4.1.6.9 Do instances exist where procedures must be performed differently?

4.1.6.10 Have other HCW been observed to perform procedures differently from protocol?

4.1.6.11 What are the challenges with maintaining accurate and consistent techniques?

4.1.6.12 What do you think is the root cause of the outbreak?

4.1.6.13 What procedures or medications might not be documented in the medical record?

4.1.6.14 Is all information in patients' medical records accurate and current?

4.1.6.15 Develop, modify if necessary, and complete abstraction forms.

4.1.7 Step 7. Formulate and test hypotheses

4.1.7.1 Conduct analytic studies

4.1.7.1.1 The frequency of exposure to a risk factor among a group of case-patients (i.e., persons with the HAIs) is compared with the frequency of exposure to that risk factor among a group of controls (i.e., persons without the HAIs).

4.1.7.1.2 The following considerations can influence the decision to conduct an analytic study:

4.1.7.1.2.1 Will an analytic study add to what is already known about the cause of the outbreak or contribute to the control recommendations?

4.1.7.1.2.2 Is the necessary technical and statistical support available?

4.1.7.1.2.3 Is the number of cases large enough to support statistical inferences?

4.1.7.1.2.4 Can enough controls be selected to minimize bias?

4.1.7.1.2.5 Is information available for testing possible risk factors?

4.1.7.2 Conduct Environmental Sampling and Testing:

4.1.7.2.1 For environmental sampling, it is essential to follow standardized protocols to ensure accuracy and reliability. See attachment 7.7

4.1.7.3 Considerations for Testing of HCWs:

4.1.7.3.1 Testing HCWs can further support or confirm possible associations between HCW colonization and infection transmission to patients.

4.1.7.3.2 HCW testing should only be undertaken after careful consideration of (1) how the results will help control the outbreak, (2) what duty or work restrictions might need to be applied, and (3) a known decolonization or other specific control strategy to undertake for personnel who test positive

4.1.7.3.3 Testing of HCWs provokes anxiety, and positive results can be highly stigmatizing. The rationale for testing should be clearly explained to HCWs, and strict discretion should be emphasized when obtaining samples and communicating results.

4.1.7.3.4 Positive results should not necessarily be regarded as evidence of causality because HCW frequently acquire microorganisms from infected patients.

4.1.7.3.5 Because of limitations in the sensitivity of cultures and the potential for transient contamination, negative results can be reassuring in certain scenarios but should not be regarded as excluding the possibility that HCWs were involved in transmission.

4.1.8 Step 8. Implement initial control measures

4.1.8.1 Take action and implement infection control measures without delay.

4.1.8.2 Full implementation of infection control measures as recommended by the IPC

4.1.8.3 Special cleaning and disinfection procedures.

4.1.8.4 Depending on the type of pathogen, incubation period, and susceptibility, consider the isolation of patients, staff, and visitors and initiate contact tracing as appropriate.

4.1.8.5 Determine patients/staff at risk of becoming ill and offer the appropriate treatment, e.g., antimicrobial agents, active and/or passive immunization

4.1.8.6. It is always appropriate to educate or reinforce HCWs about IPC precautions and to develop a plan to ensure ongoing compliance with them.

4.1.87. Closure of catering facilities, if considered appropriate.

4.1.88 Closure of health care facilities, if necessary.

4.1.9 Step 9. Identify potentially implicated health practices (refine hypothesis)

4.1.9.1 An outbreak can be stopped by identifying and interrupting the chain of transmission.

4.1.9.2 Information from the literature review on the type of pathogen and infection, and a review of the cases in the line list, may help identify which healthcare practices to focus on.

4.1.9.3 Discussing the outbreak and possible causes with staff is also essential.

4.1.9.4 Investigations are more productive if investigators are seen as partnering with the staff rather than attempting to find someone to blame.

4.1.9.5 Observations should at first be done without a detailed data collection form and should focus on workflow and practices that are different from best practices, recommended IPC guidelines, and hospital policies.

4.1.9.6 General IPC practices such as hand hygiene and Standard Precautions should be observed.

4.1.9.7 It can be helpful to ask about shortcuts and methods that have been created by staff to work around perceived barriers to make workflow easier.

4.1.9.8 Examples of useful questions/measures to ask during observations:

4.1.9.8.1 Exposure to a reusable instrument: Review of the facility's reprocessing procedures for that instrument.

4.1.9.8.2 Infections associated with indwelling devices: Review of procedures for the access and maintenance of these devices

4.1.9.8.3 MDRO: Assessment of staff adherence to hand hygiene and contact precautions, as well as cleaning and disinfection of high-touch surfaces and shared medical equipment

4.1.9.8.4 Environmental organisms (e.g., Aspergillus): Review and observations of construction activities in or near patient areas

4.1.9.8.5 Waterborne pathogens (e.g., Legionella or Pseudomonas aeruginosa): Assessment for potential routes of exposure to tap water. Review of local wound care practices, preparation, and handling of injectable or aerosolized medications (near vicinity of sinks)

4.1.9.8.6 Similar types of injectable medications among case-patients: Review of medication preparation and handling in the affected unit, central pharmacy, particularly if the medication was prepared or compounded onsite

4.1.9.8.7 Assessing environmental cleaning and disinfection: 1.Fluorescent markers 2. Adenosine triphosphate (ATP) bioluminescence assay can also be used to detect residual organic material after cleaning

4.1.10 Step 10. Communicating information about outbreaks. Communicate early:

4.1.10.1 If an outbreak is identified, it is important to communicate early and clearly.

4.1.10.2 Notification process should be started according to the steps described in the Operation of Outbreak. See 4.10.

4.1.10.2.1 Meeting the MOH outbreak criteria of notification.

4.1.10.2.2 New or emergent pathogen that is first identified in the healthcare facility.

4.1.10.2.3 Outbreak with the source is suspected or traced to an iatrogenic

4.1.10.2.4 Outbreaks that are deemed not manageable by the facility

4.1.10.3 Keep the staff, patients, relatives, and visitors informed and assured.

4.1.10.4 Flag the electronic medical system in certain conditions (such as MDRO) to allow other staff to deal with the patient using appropriate infection control measures.

4.1.10.5 Communication between health care facilities in case of transfer to enable the receiving institution to put in place appropriate precautions.

4.1.10.6 Communication between laboratory and clinicians to provide instant information about the organism and resistance

4.1.10.7 Communication between pharmacy and clinicians to provide instant information about appropriate medication and to modify formulary if required

4.1.10.8 It is also essential that the spokesperson, not the staff members, would communicate directly with the media.

4.1.10.9 Write preliminary and final confidential outbreak reports

4.1.10.9.1 The report must summarize complete investigations, lessons learned, and recommendations to prevent a recurrence in the future.

4.1.10.9.2 All the requirement report requested from ministry of health should be completed.

4.1.10.10 When to declare that the outbreak is over.The point at which an outbreak can be declared over depends on the nature of the outbreak (type of microorganism).

4.1.11

Outbreak	Explanation
Healthcare associated outbreaks	o There are no new cases epidemiologically linked to the relative outbreak are identified within 14 days from the last outbreak case (the last case included in the outbreak should be either negative, discharged, or deceased)

	o The declaration of outbreak end must be arranged with GDIPC
Ebola outbreak	o No confirmed or probable Ebola cases are detected for a period of 42 days (i.e. twice the maximum incubation period for Ebola infections) since the death/recovery of the last confirmed case
MERS-CoV outbreak	o No confirmed MERS-CoV cases are detected for a period of 28 days (i.e. twice the maximum incubation period for MERS-CoV infections) since the death/recovery of the last confirmed case
Cholera	o No new cases reported for 7 weeks
Meningitis	o Weekly number of reported cases below the "epidemic and alert threshold" for 8 weeks

4.2 Steps of follow up investigation of an outbreak:

4.2.1 Refine the case definition

4.2.1.1 As the outbreak continues, the outbreak case definition may need to be refined

4.2.1.2 In the early stage of an outbreak investigation, the aim is to detect as many cases as possible; this requires a more sensitive case definition (e.g., a person with three or more loose stools in 24 hours).

4.2.1.3 As the outbreak evolves and more information becomes available, case definitions can be refined to be more specific using additional laboratory or epidemiologic restrictions.

4.2.1.4 These restrictions help to avoid misclassification (false positive) and are useful for hypothesis testing.

4.2.1.5 The use of subtyping methods to differentiate strains or subtypes of pathogens enables more precise and efficient outbreak detection and source tracking

4.2.1.6 Changing the case definition can have a considerable impact on the data collected and the interpretation.

4.2.1.7 For example, the early case definition of MDR Acinetobacter was "Acinetobacter nonsusceptible resistant or intermediate to all tested agents in at least 3 out of 6 antimicrobial classes, (penicillins, aminoglycosides, cephalosporins, fluoroquinolones, carbapenems, and sulbactam). Later it was changed to Acinetobacter non-susceptible resistant or intermediate to at least one agent in at least 3 out of 6 antimicrobial classes. This increased the number of MDR Acinetobacter reported.

4.2.1.8 In early case definitions of COVID-19, travel history was added to detect all possible exposed cases. Later, travel history lost importance and was then ignored.

4.2.2 Continue case finding and Surveillance

4.2.2.1 Case finding and surveillance should be continued throughout the outbreak investigation.

4.2.2.2 Methods of case finding and surveillance will vary for each outbreak but may consist of one or all of the following point-prevalence screening, admission screening, discharge screening, retrospective laboratory surveillance, prospective laboratory surveillance, self report, etc.

4.2.2.3 Record all involved patients, irrespective they have infection or colonization, caused by sensitive or resistant organisms, or meet the definition of HAI or community-related infection.

4.2.3 Review controls measures regularly

4.2.3.1 All interventions implemented during the investigation should be reviewed for necessity and monitored for compliance.

4.2.3.2 Additionally, any interventions that are difficult to maintain or are labor and resource intensive should be reviewed frequently to determine when those interventions can be discontinued. Examples of this intervention include cohort patients on a particular unit or dedicating staff to case patient care only. Another example; using specialized or advanced PPE as in case of the beginning of the

MERS-CoV outbreak. These interventions cannot be sustained over long periods of time due to disruption of facility workflow and throughput and due to cost in terms of time and resources.

4.2.4 Step 4: Consider if analytic study should be performed

4.2.4.1 Analytic studies typically should be used to test hypotheses, not generate them.

4.2.4.2 In almost all situations, generating hypotheses before designing a study will help you clarify your study objectives and ask better questions.

4.2.4.3 Studies can be time- and resource-intensive, and a hastily constructed study might not answer the correct questions.

4.2.4.4 There are two types of analytic studies that can be done: case-control and cohort studies.

4.2.4.5 If a single hospital ward is affected, a retrospective cohort study should be done

4.2.4.6 Case-control or cohort studies can be used in outbreak investigations to compare rates of infection in various populations to determine which exposures or risk factors are most likely responsible for the infection.

4.3 Epidemiology and Prevention of MDRO outbreaks.

4.3.1 Definition of Multiple drug resistant organisms (MDRO): MDROs are defined as microorganisms showing non-susceptibility to at least one agent of three or more antimicrobial classes.

4.3.2 Antimicrobial classes & Antimicrobial agents:

4.3.2.1 Antimicrobial Classes: are groups of antimicrobial agents that share a common mechanism of action or structural characteristics (e.g., Cephalosporins).

4.3.2.2 Antimicrobial Agents: are specific drugs or compounds that belong to a particular antimicrobial class and are used to treat infections (e.g., Cefepime).

4.3.3 Antimicrobial Susceptibility Testing (AST): AST results should be classified according to the guidelines of the Clinical and Laboratory Standards Institute (CLSI) to determine the susceptibility of microorganisms to specific antimicrobial agents. The classification typically falls into one of three categories:

4.3.3.1 Susceptible (S): The microorganism is likely to be inhibited by the standard dose of the antimicrobial agent when used in treatment, indicating effective therapy.

4.3.3.2 Intermediate (I): The microorganism may be inhibited by the antimicrobial agent but requires a higher dose or specific conditions (e.g., high drug concentration at the site of infection). This category serves as a buffer zone to account for variability in testing or therapeutic scenarios.

4.3.3.3 Resistant (R): The microorganism is unlikely to be inhibited by the antimicrobial agent, even at higher doses, indicating that the agent would not be effective for treatment.

4.4 **Types of MDROs**

4.4.1 **Gram positive MDROs:**

4.4.1.1 Methicillin-resistant Staphylococcus aureus (MRSA): Includes S. Aureus cultured from any specimen that tests oxacillin-resistant, cefoxitin-resistant, or methicillin-resistant by standard susceptibility testing methods

4.4.1.2 Vancomycin-resistant Enterococci (VRE): Enterococcus faecalis, Enterococcus faecium, or Enterococcus species unspecified that is resistant to vancomycin, by standard susceptibility testing methods

4.4.2 **Gram negative MDROs**:

4.4.2.1 Carbapenem-resistant Enterobacteriaceae (CRE): Carbapenem-resistant Escherichia coli, Klebsiella oxytoca, Klebsiella pneumoniae, Klebsiella aerogenes or Enterobacter spp resistant to at least one carbapenem agent OR by production of a carbapenemase (specifically, KPC, NDM, VIM, IMP, OXA-48) demonstrated using a recognized test (examples: polymerase chain reaction, metallo-β-lactamase test, modified-Hodge test, Carba-NP).

Antimicrobial class	Antimicrobial agents
Carbapenems	Imipenem, meropenem, doripenem, ertapenem, meropenem/vaborbactam, or imipenem/relebactam

4.4.2.2 MDR Acinetobacter: Any Acinetobacter spp. testing non-susceptible (resistant or intermediate) to at least 1 agent in at least 3 antimicrobial classes of the following 6 antimicrobial classes

Antimicrobial class	Antimicrobial agents
Aminoglycosides	Amikacin, Gentamicin, Tobramycin.
Carbapenems	Imipenem, Meropenem, Doripenem.
Cephalosporins	Cefepime, Ceftazidime, Cefotaxime, Ceftriaxone.
Fluoroquinolones	Ciprofloxacin, Levofloxacin.
β-Lactam combination	Piperacillin/tazobactaM
Sulbactam	Ampicillin/sulbactam

4.4.2.3 MDR Klebsiella: Klebsiella oxytoca or Klebsiella pneumoniae that testing nonsusceptible (resistant or intermediate) to at least 1 agent in 3 of following 5 antimicrobial classes

Antimicrobial class	Antimicrobial agents
Aminoglycosides	Amikacin, Gentamicin, Tobramycin.
Carbapenems	Imipenem, Meropenem, Doripenem.
Cephalosporins	Cefepime, Ceftazidime, Cefotaxime, Ceftriaxone.
Fluoroquinolones	Ciprofloxacin, Levofloxacin.
β-Lactam combination	Piperacillin/tazobactam,

4.4.2.4 MDR Pseudomonas: Any Pseudomonas aeruginosa that testing non-susceptible (resistant or intermediate) to at least 1 agent in at least 3 antimicrobial classes of the following 5 antimicrobial classes

Antimicrobial class	Antimicrobial agents
Aminoglycosides	Amikacin, Gentamicin, Tobramycin.
Carbapenems	Imipenem, Meropenem, Doripenem
Cephalosporins	Cefepime, Ceftazidime.
Fluoroquinolones	Ciprofloxacin, Levofloxacin
β-Lactam combination	Piperacillin/tazobactam

4.4.3 Extended-spectrum beta-lactamases (ESBL): are a type of β-lactamase enzyme produced by Gram-negative bacteria of the Enterobacteriaceae family that hydrolyze and inactivate a wide range of β-lactam antibiotics, mainly 3rd cephalosporins and monobactams but not carbapenems.

4.4.4 **Clostridium difficile** .A positive laboratory test result for C. Difficile toxin A and/or B, (includes molecular assays [PCR] and/or toxin assays) tested on an unformed stool specimen (must conform to the container) OR A toxin-producing C. Difficile organism detected by culture or other laboratory means performed on an unformed stool sample (must conform to the container).

4.5 Presentation by symptoms

4.5.1 **Colonization .**

4.5.1.1 The multiplication of a microorganism at a body site or sites without any overt clinical expression or detected immune reaction in the host at the time that the microorganism is isolated.

4.5.1.2 Colonization may or may not be a precursor of infection.

4.5.1.3 Colonization may be a form of carriage and is a potential source of transmission

4.5.1.4 Does not require treatment

4.5.2 **Infection**

4.5.2.1 The successful transmission of a microorganism to the host with subsequent multiplication, colonization, and invasion.

4.5.2.2 Infection may be clinical or subclinical and may not produce identifiable disease.
4.5.2.3 However, it is usually accompanied by measurable host immune response(s), such as specific antibodies or cell-mediated reactions
4.5.2.4 Requires treatment

4.6 Factors contributing to MDRO in healthcare setting
4.6.1 Selective pressure exerted by exposure to antimicrobial in the community
4.6.2 Inappropriate and uncontrolled use of antimicrobial agents in healthcare setting
4.6.2.1 Increased use of antimicrobial prophylaxis
4.6.2.2 Increased use of poly microbial antimicrobial therapy
4.6.2.3 Administration of suboptimal doses and/or for insufficient duration
4.6.2.4 Inappropriate choice of drug due to misdiagnosis, lack of microbiologic lab, and empirical treatment
4.6.2.5 Poor patient compliance
4.6.2.6 Lack of alternative appropriate antimicrobials
4.6.3 Inadequate adherence to infection control measures
4.6.4 Contact with colonized or infected patients (lack of isolation)
4.6.5 Availability of vulnerable host
4.6.5.1 Severe underlying disease
4.6.5.2 Compromised host defences such as dialysis, transplant, and oncology patients
4.6.5.3 Recent surgery
4.6.5.4 Indwelling medical devices
4.6.5.5 Transfer of the patient between institutions, specially suspected ones
4.6.5.6 Prolonged hospital stays

4.7 Prevention of MDROs arranged according to CDC Guideline
4.7.1 Structures and system administrative support
4.7.1.1 Make MDRO prevention and control an organizational patient safety priority.
4.7.1.2 Provide administrative support, and both fiscal and human resources, to prevent and control MDRO transmission within the healthcare organization.
4.7.1.3 Keep good communication and feedback to update on the progress and effectiveness of interventions
4.7.1.4 Implement systems to communicate information about reportable MDROs
4.7.1.5 Implement multidisciplinary measures to monitor and promote healthcare staff compliance
4.7.1.6 Implement systems to designate and communicate information about patients known to be colonized or infected with a targeted MDRO
4.7.1.7 Support participation of the facility or healthcare system in local, regional, and national coalitions to combat emerging or growing MDRO problems.
4.7.1.8 Human resources: trained infection control practitioners and adequate staffing level
4.7.1.9 IT measures to automate antimicrobial requests and control restriction
4.7.1.10 Provide hand hygiene and environmental cleaning products
4.7.1.11 Provide clinicians with antimicrobial susceptibility reports and analysis of current trends, updated at least annually, to guide antimicrobial prescribing practices.
4.7.1.12 Written plan for implementation
4.7.2 Education and training of healthcare workers
4.7.2.1 Provide training and education on risks and prevention of MDRO spreading during orientation and periodic educational updates for healthcare personnel.
4.7.2.2 Do the assessment and evaluation of the staff's knowledge and skills by field observation and the online Infection Control module when available
4.7.2.3 Provide clinicians with updated antimicrobial susceptibility reports and analysis of current trends, to guide antimicrobial prescription practices
4.7.2.4 Increase the frequency of MDRO educational programs for those who work in areas with high MDRO rates.
4.7.2.5 Additional review of wise utilization of antimicrobial agents

4.7.3 Judicious use of antimicrobials

4.7.3.1 Appropriate use of antimicrobials

4.7.3.1.1 Limit antimicrobial prescription

4.7.3.1.2 Use local antibiogram to effectively treat infections

4.7.3.1.3 Treat infection, not contamination

4.7.3.1.4 Treat infection, not colonization

4.7.3.1.5 Stop treatment when infection is cured or unlikely

4.7.3.1.6 Avoid excessive duration of treatment

4.7.3.1.7 Use narrow spectrum agents and restrict broad spectrum and potent antibiotics

4.7.3.2 Implement systems (e.g., computerized physician order entry, comment in microbiology susceptibility report, notification from a clinical pharmacist or unit director) to prompt clinicians to use the appropriate antimicrobial agent and regimen for the given clinical situation.

4.7.3.3 Provide clinicians with antimicrobial susceptibility reports and analysis of current trends, updated at least annually, to guide antimicrobial prescribing practices.

4.7.3.4 Monitor trends in the incidence of target MDROs in the facility over time using appropriate statistical methods to determine whether MDRO rates are decreasing and whether additional interventions are needed

4.7.3.5 Establish a baseline (e.g., incidence) for targeted MDRO isolates by reviewing results of clinical cultures

4.7.4 MDRO Surveillance

4.7.4.1 A critical component of any MDRO control program

4.7.4.1.1 Important patient safety component

4.7.4.1.2 Allows detection of newly emerging resistance pattern

4.7.4.1.3 Monitors epidemiologic trends in incidence of MDROs over time

4.7.4.1.4 Measures the effectiveness of interventions

4.7.4.2 Establish systems to ensure that clinical microbiology laboratories (in-house and outsourced) promptly notify infection control staff or a medical director/ designee when a novel resistance pattern for that facility is detected

4.7.4.3 Use standardized laboratory methods and follow published guidance for determining antimicrobial susceptibility of targeted (e.g., MRSA, VRE, MDR-ESBL) and emerging (e.g., VRSA, MDR-Acinetobacter baumannii) MDROs

4.8 Healthcare pathogen screeningScreening is the collection of specimens from specific body sites known to be associated with colonization by a specific microorganism.

Microorganism	Required specimens for screening
MRSA	o Nares, axilla, and groins
VRE	o Rectal swab or o Perianal swab
CRE	o Stool sample or o Rectal swab AND, if indicated o Urine (in the presence of a urinary catheter) o Stoma swab (patient with colostomy or ileostomy) o Wounds o Catheter exit sites
ESBL	Stool sample or o Rectal swab AND, if indicated Urine (in the presence of a urinary catheter)
Acinetobacter	o Nostrils, pharynx, and skin surface
Candida Auris	o Screen for C. auris colonization using a composite swab of the patient's bilateral axilla and groin. Available data suggest that these sites are the most common and consistent sites of colonization.

	o Although patients have been colonized with C. auris in the nose, mouth, external ear canals, urine, wounds, and rectum, these sites are usually less sensitive for colonization screening.

4.8.1 Indication of screening:

4.8.1.1 Screening is recommended in the following conditions:

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4.8.1.1.1 During an outbreak as a part of outbreak investigation and case finding

4.8.1.1.2 As part of infection control measures to manage the outbreak

4.8.1.1.3 As part of routine infection control measures, to find new cases before admission to critical care units and special papulation

4.8.1.2 Screening specimens should be taken once the antibiotic has been discontinued for at least 48 hours to avoid false negative results

4.8.1.3 Screening may not be appropriate in the following conditions:

4.8.1.3.1 Routine screening of well people admitted from the community is not recommended

4.8.1.3.2 Routine screening of staff is not recommended. If staff are epidemiologically linked to the transmission of a MDRO, review infection control practices and predisposing factors

4.8.1.3.3 If it is found incidentally that staff are colonized with MDROs, no work restrictions for these staff are required. Instead, staff should receive education on standard precautions, particularly hand hygiene

4.8 Targeted patients for screening:

Microorganism	Targeted patients for screening
MRSA	Screen all patients who are: o Transferred from another hospital o Have a history of hospitalization one month before admission o Previously infected or colonized with MRSA o Admitted to ICU and oncology unit o Scheduled for Cardiac Surgery, Orthopedic surgery, Neurosurgery and surgery with an implant. o Continuous ambulatory peritoneal dialysis o Roommates of positive patients not on precautions for more than 72 hours
VRE	o Patients who were previously VRE positive within the past 6-12 months. o Roommates exposed to VRE-positive patients.
CRE	o Roommates exposed to CRE-positive patients o Active surveillance culture before admission in specific units
ESBL	o Roommates exposed to ESBL-positive patients o Active surveillance culture for specific at-risk units such as intensive care, burn, oncology-hematology, hemodialysis and organ transplant units
Acinetobacter	o Active surveillance culture before admission in specific units
Candida Auris	Screen all patients who are: o Admitted to the critical care units and with specific risk factors to rule out Candida auris colonization. o Patients with an indwelling medical device, such as a central venous catheter, breathing aid tubes, urinary catheter, biliary catheter, or wound drain. o Any patient transferred from another healthcare facility OR long-term facility. o Roommates were exposed to C. auris-positive patients for more than 48 hours.

	○ Individuals with current multidrug-resistant gram-negative bacteria who received healthcare outside of the Kingdom of Saudi Arabia (KSA) within the last 12 months. ○ Patients transferred from a unit with current transmission within the
	healthcare facility of C. auris or recent transmission within the last 30 days. ○ Carbapenem-Resistant entero bacterales (CRE) positive patient (infected & colonized). ○ Immunocompromised patient. Others: ○ Screening is recommended in departments that are experiencing outbreaks or having an increase in the number of ongoing cases and/or colonization. NB: In all cases, in the four weeks prior to diagnosis in the index patient, the healthcare facility should look back to see if there has been an increase in detection of Candida in the same intensive care setting or ward as this may represent unrecognized transmission.

4.10 Infection control measures

4.10.1 Prevent healthcare associated infection

4.10.1.1 Implementing standard precautions, particularly hand hygiene

4.10.1.2 Implement contact precautions routinely for all patients infected with target MDROs and for patients that have been previously identified as being colonized with target MDROs (e.g., patients transferred from other units or facilities who are known to be colonized).

4.10.1.3 Use masks according to Standard Precautions when performing splash-generating procedures (e.g., wound irrigation, oral suctioning, intubation)

4.10.1.4 Implementing evidence-based best practices to prevent device-associated and procedure associated HAIs

4.10.1.5 Accurate and rapid diagnosis of infections and treatment of infectious etiology

4.10.1.6 Reduce device utilization and improve insertion and post insertion care ¬ Prevention of MDRO transmission

4.10.2 Prevention of MDRO transmission

4.10.2.1 Strict hand hygiene and monitor HCWs compliance rate

4.10.2.2 PPE: Wear gloves and gown when entering the room, removing before exiting

4.10.2.3 Active surveillance cultures: to detect asymptomatic patients

4.10.2.4 Use of isolation precautions: standard & contact for patients colonized or infected with MDRO

4.10.3 Patient placement in hospital :

4.10.3.1 All Patients with MDROs should be placed in a single room.

4.10.3.2 When single patient rooms are not available, cohort patients with the same MDRO in the same room.

4.10.3.3 When cohort cases with the same MDRO are not possible, place MDRO patients in rooms with patients who are at low risk for acquiring an MDRO and who are likely to have shorts length of stay after discussion with ICP.

4.10.4 Assign dedicated nurses and ancillary service staff to the care of MDRO patients only.

4.10.5 Stop new admissions to the unit if transmission continues despite the implementation of the increased control measures.

4.11 Enhanced environmental measures:

4.11.1 Clean and disinfect surfaces and equipment that may be contaminated with pathogens, including those that are in proximity to the case and frequently touched surfaces in the patient care setting on an extra frequent schedule compared to that for minimal touch surfaces.

4.11.2 Dedicate noncritical items to use on individual patients known to be infected or colonized with MDRO.

4.11.3 Designate cleaning equipment for contact isolation rooms.
4.11.4 Focus on cleaning and disinfection of frequently touched surfaces and equipment in the immediate vicinity of the patient.
4.11.5 Disinfect reusable medical equipment between patients

4.12 Precautions during the transportation of patients
4.12.1 Keep patient movement to a minimum if possible to prevent the transmission of MDROs.
4.12.2 Perform tests at the bedside if possible.
4.12.3 Inform the receiving department about the infectious status of the patient.
4.12.4 Follow the procedures if the transportation is unavoidable.
4.12.4.1 Give bath to the patient.
4.12.4.2 Seal all open wounds with impermeable dressings.
4.12.4.3 The patient must wear a new gown before transport.
4.12.4.4 Both patient and HCWs should perform hand hygiene before leaving from the patient's room.
4.12.4.5 Remove and discard of contaminated PPE and perform hand hygiene before transporting patients on contact precautions
4.12.5 The patient NEVER wears yellow gown or gloves.
4.12.5.1 Transport staff should NOT wear yellow gown or gloves to transport patients, except when close contact is required during transport. At least one transporter should be not wear PPE in order to help with doors, elevators, etc.
4.12.5.2 If the patient bed and /or other equipment such as an IV pole accompany the patient the patient on the transport, the bedrails and equipment should be wiped down with hospital approved disinfectant prior to the transport.
4.12.6 HCWs should wear PPE to handle the patient at the transport destination.
4.12.7 Clean the testing and procedure area with hospital approved disinfectant after MDROs patient leaves the area.
4.12.8 Do all procedures in the patient's room if applicable.
4.12.9 Do not allow sitter except if medically indicated.
4.12.10 Educate the sitter to follow infection control precautions.
4.12.11 Make sure all visitors of patients who are on contact isolation for MDROs should follow the isolation requirements. This means that visitors should use a gloves and gown when in the patient's room. A mask should also be worn if the organism is in the patient's sputum. When the visitor exits, the gown, gloves, and mask should be removed inside the room and hand washing with water and soap or alcohol-based hand cleanser should be performed. If visitors follow these requirements, there is no restriction on their movement in the hospital.
4.12.12 Make sure isolation requirements are followed whenever possible in the case of visitors who sleep in the patient's room (i.e. Parents staying with a child on isolation for MDROs).
4.12.13 Put on a clean change of clothes and perform thorough hand hygiene must be followed by the visitors prior to exiting the patient's room if gowns and gloves are not worn (i.e. When sleeping or during prolonged hospitalizations). If these isolation requirements cannot be met for any reason, then when leaving the patient's room the visitor should proceed directly out of the hospital without visiting other patients or any common-use areas
4.12.14 Reprocess ventilators used by patients with MDROs according to manufacturer recommendations.
4.12.15 Designate respiratory therapist to provide care to patients with MDROs.
4.12.16 Make sure patients with MDROs are seen last or at the end of the day if possible, including patient travelling to wound care room or physiotherapy rooms. Physical therapy/ Occupational therapy/ Speech therapy

4.13 Manage MDROs positive patient as follows
4.13.1 Start contact precautions in addition to standard precautions and place contact precautions sign on the door.
4.13.2 Practice strict hand washing.
4.13.3 Cohort non-critical items to the patient (in the patient room).
4.13.4 Minimize the amount of supplies in the patient room.

4.13.5 Use isolation cart outside the patient room.
4.13.6 Limit patient's activity outside the room for treatment or tests.
4.13.7 Make sure that same time and terminal cleaning of isolation room and equipment is per housekeeping procedures.
4.13.8 Handle/discard contaminated objects as per Standard Precautions.
4.13.9 Request Infectious Diseases consultation as needed.
4.13.10 Discharge patient if medical condition allows.
4.13.11 Discontinue isolation after prior consultation with the ICP
4.13.12 Review implementation of HAIs bundles (Surveillance MOH GDIPC Guideline).

4.14 Enhanced environmental measures:
4.14.1 Start patient-dedicated or single use disposable non-critical equipment (e.g. Blood pressure cuff, stethoscope), instruments, and devices.
4.14.2 Monitor compliance to environmental cleaning policies.
4.14.3 Monitor cleaning performance to make sure of consistent cleaning and disinfection of 50 surfaces in close proximity to the patient.
4.14.4 Obtain environmental cultures when there is epidemiological evidence than an environmental source is associated with on-going transmission of the targeted MDROs.

4.15 Clean patient's room:
4.15.1 Clean rooms everyday by the designated personnel with disposable or dedicated equipment.
4.15.2 Change the mop water after each isolation patient's room is completed.
4.15.3 Wipe mop handles with disinfectant and the mop head will be bagged and sent to the laundry.
4.15.4 Clean all equipment with hospital approved disinfectant after each use. .
4.15.5 Clean all equipment with hospital approved disinfectant after each use.
4.15.6 Do terminal cleaning of the room: This includes changing the curtains and wet disinfectant/mopping of floors, walls, bed, bedside table, telephone, and IV poles, etc. Curtains, sheets, and other durable items will be bagged and sent to the laundry.
4.15.7 Use single-use or disposable equipment for the care of patients with MDROs- whenever possible.
4.15.8 Clean when durable equipment is used, including but not limited to portable x-ray machines, ABG machines, dialysis machines, etc., the equipment with hospital approved disinfectant and/or according to manufacturer's recommendations before the equipment is used to care for another patient
4.15.9 Keep all medical items such as dressings, syringes, IV fluids, etc. To minimal in the patient room; if these items found in the patient room after diagnosis with MDROs - all should be discarded.
4.15.10 Keep linen in water-soluble bag and send to laundry as per hospital policy.

4.16 **Operation of Outbreak :** Notification Process. The outbreak level is determined using an Outbreak Classification Matrix
4.16.1 Once an outbreak is confirmed or suspected, the healthcare facility outbreak coordinator is required to fill all required an online outbreak process starting with:
4.16.1.1 Notification form in the platform within the first (48) hours of an outbreak onset.
4.16.1.2 The filled outbreak notification form for outbreak will be received by cluster, regional directorate coordinator and the GDIPC simultaneously.
4.16.2 Healthcare facility infection department should start the control measures immediately according to the outbreak management action plan (OMAP).
4.16.3 The regional outbreak coordinator is responsible to follow up with the health cluster to ensure control measures are applied by the healthcare facility outbreak team performing the outbreak investigation and follow up, according to the flowchart shown below
4.16.4 The healthcare facility must fill-up the forms within the first (72) hours and update the investigation form immediately when new cases or deaths occurs, otherwise, data will be updated once weekly
4.16.5 Meanwhile the regional directorate and GDIPC will keep following the updates, status of the outbreak and classify the level of the outbreak (A, B or C) according to the provided data.

4.16.6 In case the outbreak is type A or B, the regional directorate coordinator will work on the corrective action plan and outbreak facility assessment. Additionally, the GDIPC will make a field visit, if necessary.

4.17 Outbreak Classification Matrix- Class A

4.17.1 Responsibility: Branch of the Ministry of Health and GDIPC's responsibility, if needed.

4.17.2 Number of Cases: 9 cases and above per pathogen

4.18 Outbreak Classification Matrix- Class B

4.18.1 Responsibility: Branch of the Ministry of Health and Health cluster.

4.18.2 Number of Cases: 5-8 cases and above per pathogen

4.19 **Outbreak Classification Matrix- Class C. See appendices 7.6**

4.19.1 Responsibility :Healthcare facility and Cluster is pertaining healthcare facility are under the responsibility of the cluster, itself

4.19.2 Number of Cases: 2-4 cases and above per pathogen

4.20 Epidemiology of specific MDRO outbreaks in hospitals

4.20.1 MRSA
4.20.2 VRE
4.20.3 CRE
4.20.4 ESBL
4.20.5 MDR Pseudomonas aeruginosa
4.20.6 MDR Acinetobacter
4.20.7 Clostridium difficile

4.21 Epidemiology of specific bacterial outbreaks in hospitals

4.21.1 Mycobacterium Tuberculosis
4.21.2 Legionella Pneumophila
4.21.3 Burkholderia Cepacia
4.21.4 Salmonella Species
4.21.5 Shigella Species
4.21.6 S. Pyogenes (Group A Streptococcus)

4.22 Epidemiology of specific viral outbreaks in hospitals. See attachment 7.4

4.22.1 Respiratory viruses

4.22.1.1 SARS
4.22.1.2 SARS-CoV- 2 or (COVID-19)
4.22.1.3 MERS-CoV
4.22.1.4 Influenza Viruses A and B
4.22.1.5 Varicella Zoster
4.22.1.6 Measles
4.22.1.7 Respiratory Syncytial Virus

4.22.2 Blood-borne

4.22.2.1 Blood-borne
4.22.2.2 Hepatitis B Virus
4.22.2.3 Hepatitis C Virus
4.22.2.4 Human Immunodeficiency Virus

4.22.3 Contact viruses

4.22.3.1 Varicella Zoster virus
4.22.3.2 Herpes Simplex virus
4.22.3.3 Cytomegalovirus
4.22.3.4 Epstein Barr virus

4.22.4 GIT viruses

4.22.4.1 Rotavirus
4.22.4.2 Hepatitis A Virus

4.23 Epidemiology of specific fungal outbreaks in hospitals

4.23.1 Candida (Nosocomial/invasive candidiasis)
4.23.2 Candida Auris
4.23.3 Aspergillus Species

5. MATERIALS AND EQUIPMENT:

5.1 **Forms and Records:**
5.1.1 N/A
5.2 **Materials and Equipment**
5.2.1 N/A

6. RESPONSIBILITIES:

6.1 It is the responsibility of the OMT to implement this policy.
6.1.1 Follow up the OMAP with cluster
6.2 RHD coordinator will visit the facility as needed or as recommended by GDIPC
6.2.1 Note: GDIPC will be involved when it is necessary
6.3 Health Care Workers

7. APPENDICES:

7.1 Categories of case definition
7.2 Calculating the attack rate:
7.3 Outbreak can be declared over depends on the nature of the outbreak (type of microorganism).
7.4 Epidemiology of specific MDRO outbreaks in hospitals
7.5 Outbreak Classification Matrix- Class C.
7.6 Methods of Environmental-Surface Sampling.

8. REFERENCES:

8.1 Healthcare-Associated Outbreak Management Manual. January 2025 V. 7.2
8.2 GDIPC website (https://gdipc.sa/)
8.3 Ministry of Health of Saudi Arabia (https://www.moh.gov.sa/)
8.4 Saudi Central Board for Accreditation of Healthcare Institutions (CBAHI) Standards 3rd Edition. 1436-2015. Effective 1 January 2016.

9. APPROVALS:

	Name	Title	Signature	Date
Prepared by:	Ms. Marilou C. Magallano	IPC Practitioner		February 09, 2025
	Ms. Wadha Mohd Al Shammari	IPC Coordinator		February 09, 2025
Reviewed by:	Dr. Fahad Obeid Al Shammari	Head of PICU / Pediatrics		February 10, 2025
Reviewed by:	Dr. Sarhan Al Shammari	Head of NICU		February 10, 2025
Reviewed by:	Dr. Affif Elsid	Head of Pediatric Surgery		February 11, 2025
Reviewed by:	Dr. Mohannad Yaghmour	Gyne-OBS Head of Department		February 11, 2025
Reviewed by:	Dr. Kawther Abdou	Consultant Clinical Pathologist		February 12, 2025
Reviewed by:	Dr. Abdulgani Ibrahim	Head of OT/ ICU		February 13, 2025
Reviewed by:	Mr. Hamed Al Dafery	Head of Public Health & Waste Management		February 13, 2025
Reviewed by:	Dr. Mutlaq Al Dhafeeri	Head of Pharmacy		February 16, 2025
Reviewed by:	Mr. Metab Al Dahomishy	Head of Engineering and Housekeeping Department		February 16, 2025
Reviewed by:	Mr. Abdulaziz Al Anizy	Head of CSSD		February 17, 2025
Reviewed by:	Ms. Noora Al Anizy	Head of Laboratory		February 18, 2025
Reviewed by:	Dr. Abdullah Al Dhaferi	Head of Medical Supply		February 19, 2025
Reviewed by:	Ms. Awatif Hamoud Al Harbi	IPC Director		February 20, 2025
Reviewed by:	Mr. Sabah Turayhib Al Harbi	Nursing Director		February 23, 2025
Reviewed by:	Mr. Abdulellah Ayed Al Mutairi	QM&PS Director		February 24, 2025
Reviewed by:	Mr. Thamer Al Shamlani	Head of Administrative & Financial Department		February 25, 2025
Reviewed by:	Dr. Thamer Naguib	Medical Director		February 26, 2025
Approved by:	Mr. Fahad Hazam Al Shammari	Hospital Director & IPC Committee Chairman		February 27, 2025

Appendix 7.1 Categories of case definition

Categories of case definition:	
Case category	General features
Confirmed	Laboratory confirmation of agent
Probable	Typical clinical features of illness **AND** Partial laboratory results (confirmation pending) **OR** Epidemiologic link to a laboratory-confirmed case
Suspected	Typical clinical features of illness **AND** Missing laboratory and epidemiologic information

Appendix 7.2 Calculating the attack rate:

$$\text{Attack Rate} = \frac{\text{Number of new cases who got infected during the outbreak specified location and time interval}}{\text{Population at the same location at the start of outbreak}} \times 100$$

Appendix 7.3 Outbreak can be declared over depends on the nature of the outbreak (type of microorganism).

Outbreak	Explanation
Healthcareassociated outbreaks	o There are no new cases epidemiologically linked to the relative outbreak are identified within 14 days from the last outbreak case (the last case included in the outbreak should be either negative, discharged, or deceased) o The declaration of outbreak end must be arranged with GDIPC
Ebola outbreak	o No confirmed or probable Ebola cases are detected for a period of 42 days (i.e. twice the maximum incubation period for Ebola infections) since the death/recovery of the last confirmed case
MERS-CoV outbreak	o No confirmed MERS-CoV cases are detected for a period of 28 days (i.e. twice the maximum incubation period for MERS-CoV infections) since the death/recovery of the last confirmed case
Cholera	o No new cases reported for 7 weeks
Meningitis	o Weekly number of reported cases below the "epidemic and alert threshold" for 8 weeks

Appendix 7.4 Epidemiology of specific MDRO outbreaks in hospitals

- MRSA
- VRE
- CRE
- ESBL
- MDR Pseudomonas aeruginosa
- MDR Acinetobacter
- Clostridium difficile

MRSA	
Pathogen	• Methicillin-resistant Staphylococcus aureus (MRSA): Includes S. Aureus cultured from any specimen that tests oxacillin-resistant, cefoxitin-resistant, or methicillin-resistant by standard susceptibility testing methods. • Methicillin-sensitive Staphylococcus aureus (MSSA): S. Aureus cultured from any specimen testing intermediate or susceptible to oxacillin, cefoxitin, or methicillin by standard susceptibility testing • methods.
Burden	• Approximately 5% of patients in U.S. hospitals carry MRSA in their nose or on their skin. • Approximately 4% to 9% of all HAI are caused by MRSA • Approximately 25-50% of staphylococcus aureus causing HAI are MRSA
Risk factors	Risk factors in hospital setting: • Frequent/prolonged hospitalization • People with indwelling central line, urinary catheters, implants, prostheses, and drains

	• Immunocompromised patients (HIV/AIDS, lupus, or cancer sufferers; transplant recipients; severe asthmatics; etc.) • Surgical and non-surgical wound • Diabetics • Users of quinolone antibiotics • Elderly people • Nursing home and long-term care Risk factors in community setting: • People who are frequently in crowded places, especially with shared equipment and skin-to-skin contact • Participating in contact sports. MRSA can spread easily through cuts, scrapes, and skin-to-skin contact. • Intravenous drug users and homosexual • Prison inmates and military personnel
Hospital outbreak	• Common cause of hospital outbreaks
Symptoms & clinical picture	• The symptoms of a MRSA infection depend on the part of the body that is infected. For example, bloodstream infection is manifested as fever, shivering, and low blood pressure. • Staph skin infections cause swelling, warmth, redness, and pain, which may become abscess • It can cause severe infections including: =Bloodstream infections =Pneumonia =Surgical site infections =Sepsis =Death
Diagnosis	▯ Positive culture for MRSA. Normally, a bacterium must be cultured from blood, urine, sputum, or other body-fluid samples ▯ PCR ▯ Rapid latex agglutination test
Mode of Transmission	▯ Direct contact with contaminated hands (usually HCWs) or infected patients ▯ Direct contact with colonized patients ▯ Indirect contact with contaminated surfaces and objects
Screening	▯ In health-care settings, isolating those with MRSA from those without the infection is one method to prevent transmission. ▯ Rapid culture and sensitivity testing and molecular testing identifies carriers and reduces infection rates ▯ Swabbing sites: nares, axilla, and groins ▯ Screen the following patients: ▯ Patients transferred from another hospital ▯ Patients with history of hospitalization one month before admission ▯ Patients who are previously infected or colonized with MRSA ▯ Before admission to ICU and oncology unit ▯ Scheduled for Cardiac Surgery, Orthopedic surgery, Neurosurgery and surgery with an implant. ▯ Patients on continuous ambulatory peritoneal dialysis ▯ Roommates of positive patients not on precautions for more than 72 Hours ▯ Screening of HCWs is not recommended, unless they are epidemiologically linked to new acquisitions of MRSA
Prevention and control	Implement core prevention strategies ▯ Promote hand hygiene ▯ Implement contact precautions. Wear a gown and gloves for all interactions that may involve contact with the patient or the patient's environment. ▯ Use dedicated patient-care equipment (e.g. Blood pressure cuffs, stethoscopes), and single use disposable items (e.g. Single patient digital thermometer) whenever possible ▯ If common use of equipment for multiple patients is unavoidable, clean and disinfect such equipment before use on another patient ▯ Recognize previously colonized patients through screening and flagging. ▯ Provide education on management of MRSA patients to HCWs. Implement interventions to reduce device-associated and procedureassociated HAIs: ▯ Implement strategies for preventing CLABSI ▯ Implement strategies for preventing SSI ▯ Implement strategies for preventing bacteremia in dialysis patients Implement supplemental prevention strategies: ▯ Performance of active surveillance testing before admission to ICU and oncology unit ▯ Decolonization and chlorhexidine bath
Decolonization	▯ Decolonization for MRSA carriers who were implicated in an outbreak (intranasal mupirocin twice a day to each nare for 5 days).

Discontinue Contact isolation	• Discontinue contact isolation after three consecutive negative cultures (taken 3 days apart) from a previously positive patient (in the absence of antibiotic therapy for at least three days) • Consult IC / BMOH outbreak coordinators and treating physician
VRE	
Pathogen	• Vancomycin-resistant Enterococci (VRE): Enterococcus faecalis, Enterococcus faecium, or Enterococcus species unspecified that is resistant to vancomycin, by standard susceptibility testing methods • Enterococci are bacteria normally present in the human intestines and in the female genital tract, and are often found in the environment, like in soil and water.
Burden	• Approximately 3% of all HAI are caused by VRE • Approximately 10-20% of enterococci causing HAI are VRE
Risk factors	Risk factors in hospital setting • Frequent/prolonged hospitalization • People with indwelling central line, urinary catheters, implants, prostheses, and drains • Immunocompromised patients (cancer, transplant recipients, neutropenia, or renal dysfunction) • Diabetes mellitus • Patients undergoing surgical procedures • Patients who have been previously treated with antibiotics, including vancomycin, for long periods of time
Hospital outbreak	• Common cause of hospital outbreaks
Symptoms & clinical picture	▯ The symptoms of a VRE infection depend on the part of the body that is infected. For example, bloodstream infection is manifested as fever, shivering, and low blood pressure. ▯ It can cause severe infections including: ▯ Bloodstream infections ▯ Urinary tract infection ▯ Surgical site infections ▯ Dialysis bacteremia
Diagnosis	▯ Positive culture for VRE. Normally, a bacterium must be cultured from infected wound, blood, urine, or stool
Mode of Transmission	• Indirect contact with contaminated surfaces and objects. Items such as bedrails, stethoscopes, blood pressure cuffs are reservoirs for VRE • Direct contact with contaminated hands (usually HCWs) or infected patients • Direct contact with colonized patients • It is not spread through the air by coughing or sneezing
Screening	Screening for VRE: ▯ Patients who were previously VRE positive within the past 6-12 months. ▯ Roommates exposed to VRE-positive patients. ▯ Screening of HCWs is not recommended, unless they are epidemiologically linked to new acquisitions of VRE Sites to screen: ▯ Rectal swab or ▯ Perianal swab
Prevention and control	Implement core prevention strategies: ▯ Promote hand hygiene. Patients and their caregivers should wash their hands with soap and water or use alcohol-based hand sanitizer, particularly: ▯ After using the bathroom ▯ Before and after handling medical devices or caring for wounds ▯ Before preparing food ▯ Implement contact precautions. Wear a gown and gloves for all interactions that may involve contact with the patient or the patient's environment. ▯ Use dedicated patient-care equipment (e.g. Blood pressure cuffs, stethoscopes), and single use disposable items (e.g. Single patient digital thermometer) whenever possible ▯ If common use of equipment for multiple patients is unavoidable, clean and disinfect such equipment before use on another patient ▯ Recognize previously colonized patients through screening and flagging. ▯ Provide education on management of VRE patients to HCWs. Implement interventions to reduce device-associated and procedureassociated HAIs: ▯ Implement strategies for preventing CLABSI ▯ Implement strategies for preventing CAUTI ▯ Implement strategies for preventing SSI ▯ Implement strategies for preventing bacteremia in dialysis patients
Decolonization	• None

Discontinue Contact isolation	• Discontinue contact isolation after three consecutive negative cultures (taken 3 days apart) from a previously positive patient (in the absence of antibiotic therapy for at least three days) • Consult IC / BMOH outbreak coordinators and treating physician
CRE	
Pathogen	▯ Carbapenem-resistant Enterobacteriaceae (CRE): Any Escherichia coli, Klebsiella oxytoca, Klebsiella pneumoniae, or Enterobacter spp. Testing resistant to imipenem, meropenem, doripenem, or ertapenem by standard susceptibility testing methods OR by production of a carbapenemase demonstrated using a recognized test (e.g., PCR or Modified-Hodge test) ▯ Enterobacteriaceae are a large family of Gram-negative bacteria that includes a number of pathogens such as Klebsiella, Escherichia coli, Enterobacter, Citrobacter, Salmonella, Shigella, Proteus, Serratia and other species. ▯ These pathogens are present in the human intestinal tract and are a normal part of the gut flora.
Burden	▯ CRE is endemic in many parts of the world ▯ Approximately 5% of Enterobacteriaceae causing HAI are CRE ▯ Approximately 30% of CRE produce carbapenemases, enzymes that break down carbapenems ▯ Why are CRE considered epidemiologically important? ▯ CRE organisms are often resistant to multiple classes of antibiotics, substantially limiting treatment options. ▯ Infections caused by these organisms are associated with high mortality rates among hospitalized patients, up to 50% in some studies. ▯ Many CRE produce carbapenemases, which can be transmitted from Enterobacterales to other germs, facilitating spread of resistance. ▯ Although CRE is currently primarily associated with inpatient ▯ healthcare settings, it has the potential to spread to community settings.
Risk factors	Risk factors in hospital setting: ▯ Frequent/prolonged hospitalization ▯ People with indwelling central line, urinary catheters, and ventilator ▯ Patients who have been previously treated with antibiotics, including carbapenems, cephalosporins, fluoroquinolones, and vancomycin, for long periods of time ▯ Immunocompromised patients (cancer, transplant recipients, neutropenia, or renal dysfunction) ▯ Advanced age
Hospital outbreak	▯ Common cause of hospital outbreaks
Symptoms & clinical picture	▯ The symptoms of a CRE infection depend on the part of the body that is infected. ▯ CRE can cause infections in almost any body part, including: ▯ Urinary tract infection ▯ Bloodstream infections ▯ Ventilator-associated pneumonia ▯ Intra-abdominal abscesses ▯ Surgical site infections ▯ Dialysis bacteremia
Diagnosis	• Positive culture for CRE. • Phenotypic diagnosis requires bacterial culture and identification. • Disk diffusion or automated susceptibility testing is done to identify the carbapenem resistance phenotype. • Molecular identification is much faster (hours instead of days) and can quickly determine the type of resistance mechanism involved. The five carbapenemases most frequently identified in CRE: KPC, NDM, VIM, OXA-48-type, and IMP. However, this method simply indicates the presence of a resistance gene and may not determine the efficacy of specific antibiotics
Mode of Transmission	• Indirect contact with contaminated surfaces and objects. Sink drains and toilets are increasingly recognized as an environmental reservoir and CRE transmission source. • Direct contact with contaminated hands (usually HCWs) or infected patients
Screening	• Screening certain high-risk patients for CRE colonization is a recommended intervention. However, screening are generally reserved for carbapenemase producing-CRE, which have greater potential for spread. • Roommates exposed to CRE-positive patients • Active surveillance culture before admission in specific units • Screening of HCWs is not recommended, unless they are epidemiologically linked to new acquisitions of CRE • Specimens: ▯ Stool sample or ▯ Rectal swab

	AND, if indicated ▯ Urine (in the presence of a urinary catheter) ▯ Stoma swab (patient with colostomy or ileostomy) ▯ Wounds ▯ Catheter exit sites
Prevention and control	Implement core prevention strategies: ▯ Promote hand hygiene. Patients and their caregivers should wash their hands with soap and water or use alcohol-based hand sanitizer, particularly: ▯ After using the bathroom ▯ Before and after handling medical devices or caring for wounds ▯ Implement contact precautions. Wear a gown and gloves for all interactions that may involve contact with the patient or the patient's environment. ▯ Whenever possible, place patients currently or previously colonized or infected with CRE in a private room with a bathroom and dedicate noncritical equipment (e.g., stethoscope, blood pressure cuff) to CRE patients. ▯ If common use of equipment for multiple patients is unavoidable, clean and disinfect such equipment before use on another patient ▯ Recognize previously colonized patients through screening and flagging ▯ Provide education on management of CRE patients to HCWs. ▯ Prescribe and use antibiotics appropriately. ▯ Discontinue devices like urinary catheters as soon as no longer necessary. Implement interventions to reduce device-associated and procedureassociated HAIs: ▯ Implement strategies for preventing CAUTI ▯ Implement strategies for preventing CLABSI ▯ Implement strategies for preventing VAP ▯ Implement strategies for preventing bacteremia in dialysis patients ▯ Implement strategies for preventing SSI
Decolonization	▯ None
Discontinue contact isolation	▯ Contact isolation should continue for duration of acute care hospitalization. ▯ Only discontinue after consultation with IPC ▯ Consult IC / BMOH outbreak coordinators and treating physician
ESBL	
Pathogen	• ESBL are enzymes that confer resistance to most beta-lactam antibiotics, including penicillins, cephalosporins, and the monobactam aztreonam • They are present in Enterobacteriaceae (such as Escherichia coli and Klebsiella) and other gram negatives (such as Pseudomonas aeruginosa)
Burden	• Approximately 15-30% of Enterobacteriaceae causing HAI are ESBL
Risk factors	• Anyone can get an ESBL producing bacteria. Risk factors in hospital setting: • Patients who have been previously treated with broad spectrum antibiotics, particularly third-generation cephalosporins, fluoroquinolones, vancomycin, and quinolones • Frequent/prolonged hospitalization • ICU admission • People with indwelling central line, urinary catheters, and ventilator • Open wound or drain • Multiple comorbidity • Advanced age Risk factors in community setting: • History of repeated UTIs • Prior antibiotic exposure
Hospital outbreak	• Can cause hospital outbreaks
Symptoms & clinical picture	• The symptoms of an ESBL infection depend on the part of the body that is infected. • ESBL can cause infections, including: ⎫ Urinary tract infection (most common) ⎫ Abdominal infection and diarrhea ⎫ Wound infection ⎫ Bloodstream infections ⎫ Ventilator-associated pneumonia
Diagnosis	• Positive culture • Phenotypic diagnosis requires bacterial culture and identification. • Disk diffusion or automated susceptibility testing is done to identify resistance or decreased sensitivity to ceftazidime, cefotaxime, ceftriaxone and aztreonam • A second confirmatory test, based on the synergy between a cephalosporin (cefotaxime or ceftazidime) and a ß-lactamase inhibitor (clavulanic acid), should then be carried out. This test could be a double disk test, combination disk method or ESBL E-test
Mode of Transmission	• Indirect contact with contaminated surfaces and objects. • Direct contact with contaminated hands (of HCWs) or infected patients
Screening	• Screening certain high-risk patients for ESBL • Roommates exposed to ESBL-positive patients • Active surveillance culture for specific at-risk units such as intensive care, burn, oncology-hematology, hemodialysis and organ transplant units • Screening of HCWs is not recommended, unless they are epidemiologically linked to new acquisitions of ESBL • Specimens: ⎫ Stool sample or ⎫ Rectal swab AND, if indicated ⎫ Urine (in the presence of a urinary catheter)
Prevention and control	Implement core prevention strategies: • Promote hand hygiene. Patients and their caregivers should wash their hands with soap and water or use alcohol-based hand sanitizer, particularly:

	⎫ After using the bathroom ⎫ Before and after handling medical devices or caring for wounds • Implement contact precautions. Wear a gown and gloves for all interactions that may involve contact with the patient or the patient's environment. • Whenever possible, place patients currently or previously colonized or infected with ESBL in a private room with a bathroom and dedicate noncritical equipment (e.g., stethoscope, blood pressure cuff) to ESBL patients. • If common use of equipment for multiple patients is unavoidable, clean and disinfect such equipment before use on another patient • Recognize previously colonized patients through screening and flagging • Provide education on management of ESBL patients to HCWs. • Prescribe and use antibiotics appropriately. • Discontinue devices like urinary catheters as soon as no longer necessary. Implement interventions to reduce device-associated and procedureassociated HAIs: • Implement strategies for preventing CAUTI • Implement strategies for preventing SSI • Implement strategies for preventing CLABSI • Implement strategies for preventing VAP
Decolonization	• None
Discontinue contact isolation	• Contact isolation should continue for duration of acute care hospitalization. • Only discontinue after consultation with IPC • Consult IC / BMOH outbreak coordinators and treating physician
MDR Pseudomonas aeruginosa	
Pathogen	• Pseudomonas aeruginosa is a leading nosocomial pathogen • Pseudomonas aeruginosa lives in the environment and can be spread to people in healthcare settings when they are exposed to contaminated water or soil • MDR pseudomonas: non-susceptible (resistant or intermediate) to at least one agent in at least 3 out of 5 antimicrobial classes (penicillins, aminoglycosides, cephalosporins, fluoroquinolones, and carbapenems)
Burden	• Approximately 5-20% of Pseudomonas aeruginosa causing HAI are meeting the definition of MDRO
Risk factors	Risk factors in hospital setting: • Frequent/prolonged hospitalization • ICU admission • People with indwelling device such as ventilator, central line, and urinary catheters • Open wound or drain • Immunocompromised patients • Multiple comorbidity • Previous use of broad-spectrum antimicrobials (both antipseudomonal and non-antipseudomonal)
Hospital outbreak	• Can cause hospital outbreaks
Symptoms & clinical picture	• The symptoms of a MDR pseudomonas infection depend on the part of the body that is infected. • MDR pseudomonas can cause infections, including: ⎫ Ventilator-associated pneumonia ⎫ Bloodstream infections ⎫ Surgical site infection ⎫ Urinary tract infection ⎫ Abdominal infection
Diagnosis	• Positive culture. • Phenotypic diagnosis requires bacterial culture and identification. • Disk diffusion or automated susceptibility testing is done to identify resistance phenotype of MDR pseudomonas.
Mode of Transmission	• Indirect contact with contaminated surfaces and objects. • Direct contact with contaminated hands (usually HCWs) or infected patients • Can cause waterborne outbreaks due to exposure to contaminated water
Prevention and control	Implement core prevention strategies: • Promote hand hygiene, particularly before and after caring for wounds or touching a medical device • Implement contact precautions. Wear a gown and gloves for all interactions that may involve contact with the patient or the patient's environment. • Whenever possible, place patients currently or previously colonized or infected with MDR pseudomonas in a private room with a bathroom and dedicate noncritical equipment (e.g., stethoscope, blood pressure cuff) to MDR pseudomonas patients. • If common use of equipment for multiple patients is unavoidable, clean and disinfect such equipment before use on another patient • Recognize previously colonized patients through screening and flagging • Provide education on management to HCWs. • Precautions to prevent waterborne transmission • Water disinfection • Periodic cleaning and maintenance of showers, baths and sinks • Installing disinfection systems and filters • Avoiding the installation of other potential sources of infection such as decorative pools and fountains. Implement interventions to reduce device-associated and procedureassociated HAIs:

	• Implement strategies for preventing VAP • Implement strategies for preventing CLABSI • Implement strategies for preventing CAUTI • Implement strategies for preventing SSI
Discontinue contact isolation	▯ The patient has two consecutive negative rectal swab at least 7 days apart ▯ Consult IC / BMOH outbreak coordinators and treating physician
MDR Acinetobacter	
Pathogen	• Acinetobacter baumannii is a leading nosocomial pathogen • Acinetobacter lives in the environment and can be spread to people in healthcare settings when they are exposed to contaminated water or soil • MDR Acinetobacter: non-susceptible (resistant or intermediate) to at least one agent in at least 3 out of 6 antimicrobial classes (penicillins, aminoglycosides, cephalosporins, fluoroquinolones, carbapenems, and sulbactam)
Burden	• Approximately 40-65% of Acinetobacter causing HAI are meeting the definition of MDRO
Risk factors	Risk factors in hospital setting: • Frequent/prolonged hospitalization • ICU admission • People with indwelling device such as ventilator, central line, and urinary catheters • Open wound or drain • Immunocompromised patients • Multiple comorbidity • Previous use of broad-spectrum antimicrobials such as carbapenems and piperacillin/tazobactam
Hospital outbreak	• Can cause hospital outbreaks
Symptoms & clinical picture	• The symptoms of a MDR Acinetobacter infection depend on the part of the body that is infected. • MDR Acinetobacter can cause infections, including: ▯ Ventilator-associated pneumonia ▯ Bloodstream infections ▯ Surgical site infection ▯ Urinary tract infection
Diagnosis	• Positive culture. • Phenotypic diagnosis requires bacterial culture and identification. • Disk diffusion or automated susceptibility testing is done to identify resistance phenotype of MDR Acinetobacter
Mode of Transmission	• Indirect contact with contaminated surfaces and objects. • Direct contact with contaminated hands (usually HCWs) or infected patients
Prevention and control	Implement core prevention strategies: • Promote hand hygiene, particularly before and after caring for wounds or touching a medical device • Implement contact precautions. Wear a gown and gloves for all interactions that may involve contact with the patient or the patient's environment. • Whenever possible, place patients currently or previously colonized or infected with MDR Acinetobacter in a private room with a bathroom and dedicate noncritical equipment (e.g., stethoscope, blood pressure cuff) to MDR Acinetobacter patients. • If common use of equipment for multiple patients is unavoidable, clean and disinfect such equipment before use on another patient • Recognize previously colonized patients through screening and flagging • Provide education on management to HCWs. Implement interventions to reduce device-associated and procedureassociated HAIs: • Implement strategies for preventing VAP • Implement strategies for preventing CLABSI • Implement strategies for preventing CAUTI • Implement strategies for preventing SSI
Discontinue contact isolation	• The patient has two consecutive negative rectal swab at least 7 days apart • Consult IC / BMOH outbreak coordinators and treating physician
Clostridium difficile	
Pathogen	• Anaerobic, spore-forming Gram-positive bacilli • Present in soil and environment • Hospitals are major reservoirs ▯ Hospital toilets ▯ Metal bedpans ▯ Commodes ▯ Thermometers ▯ Floors • Spores can persist in rooms up to 40 days after infected patient is discharged • Resistant to many commonly used cleaning agents.

	• Detergent-based agents do not eliminate C. Difficile spores
Burden	• Normal flora in ~2-3% of healthy adults • The overall rate is 2-3 per 1000 admissions/year • Recurrence occurs in 15-20% of patients after discontinuation of treatment.
Risk factors	Risk factors in hospital setting: • Older age • Prolonged or multiple antimicrobial therapy • Use of acid-reducing drugs (proton-pump inhibitors or H2 blockers) • Infected roommate • Recent or prolonged hospitalization • ICU stay • Multiple, severe underlying conditions • Immunocompromised patients • Surgery of the GIT • Colon disease e.g. Inflammatory bowel disease or colorectal cancer • Tubal feeding • Previous C. Diff infection High risk antimicrobials: • 2nd generation cephalosporins • 3rd generation cephalosporins • Clindamycin • Fluoroquinolones Low risk antimicrobials: • Aminoglycosides • Beta-lactam/beta-lactamase inhibitors
Hospital outbreak	• Can cause hospital outbreak
Symptoms & clinical picture	A spectrum of C. Difficile infections (CDI), including: • Asymptomatic colonization • Diarrhea (mild to severe) and abdominal pain • Fever, loss of appetite, and nausea • Colitis +/- pseudomembranes • Toxic megacolon • Colonic perforation/peritonitis • Sepsis & acute abdomen without diarrhea
Diagnosis	• A positive laboratory test result for C. Difficile toxin A and/or B, (includes molecular assays [PCR] and/or toxin assays) tested on an unformed stool specimen (must conform to the container) OR • A toxin-producing C. Difficile organism detected by culture or other methods performed on an unformed stool sample (must conform to the container)
Categorization	CDI event categorization by prior positivity: • Incident CDI: Positive specimen obtained >8 weeks from most recent (previous) positive stool sample or first time • Recurrent CDI: Positive specimen obtained > 2 weeks but ≤8 weeks from most recent (previous) positive stool sample • Duplicate CDI: Positive specimen obtained ≤2 weeks from most recent (previous) positive stool sample (do not report) CDI event categorization by source: • Community-onset: Specimen collection (event) date is in the first 3 days of admission • Healthcare-onset: Specimen collection (event) date is after the first 3 days of admission • Community-onset healthcare -associated: Specimen collection (event) date is in the first 3 days of admission BUT within 4 weeks from last discharge
Mode of Transmission	• Indirect contact with contaminated surfaces and objects. C. Diff is shed in feces. Any surface, device, or material (such as commodes, bathtubs, and electronic rectal thermometers) that becomes contaminated with feces could serve as a reservoir for the C. Diff spores. • C. Diff spores can also be transferred to patients via the hands of HCWs who have touched a contaminated surface or item.
Prevention and control	• Promote hand hygiene, particularly After using the bathroom, before preparing food or eating, and after diapering a child or caring for an ill person. • Implement contact precautions. Wear a gown and gloves for all interactions that may involve contact with the patient or the patient's environment • Ensure adequate cleaning and disinfection of surfaces such as countertops, sinks, faucets, bathroom doorknobs, and toilets regularly using warm/hot water (see below) • Whenever possible, place patients currently or previously colonized or infected with C. Diff in a private room with a bathroom and dedicate noncritical equipment (e.g., stethoscope, blood pressure cuff) to C. Diff patients.

	• If common use of equipment for multiple patients is unavoidable, clean and disinfect such equipment before use on another patient • Recognize previously colonized patients through screening and flagging • Provide education on management to HCWs. • C diff spores are resistant to extreme environmental conditions • Elimination needs physical cleaning and disinfection • Disinfectant of choice for environmental cleaning is household bleach (5% sodium hypochlorite solution) in 1:5 dilutions (250/L) or 10,000 ppm (1%) • Some disinfectants (e.g., glutaraldehyde) normally used to reprocess gastrointestinal endoscopes need prolonged contact times to kill clostridium difficile spores
Discontinue contact isolation	• When the patient returns to his/her normal stooling pattern for minimum of 48 hours • Because C diff patients continue to shed the organism for a number of days following cessation of diarrhea, some institutions routinely continue isolation until discharge • Consult IC / BMOH outbreak coordinators and treating physician

Epidemiology of specific bacterial outbreaks in hospitals

- **Mycobacterium Tuberculosis**
- **Legionella Pneumophila**
- **Burkholderia Cepacia**
- **Salmonella Species**
- **Shigella Species**
- **S. Pyogenes (Group A Streptococcus)**

Tuberculosis (TB)	
Pathogen	• Mycobacterium Tuberculosis
Burden	• Globally, tuberculosis is a leading cause of death from a single infectious agent, with 1.4 million deaths every year • Tuberculosis affects approximately 10 million new patients every year • Globally, tuberculosis incidence is falling at about 2% per year • High-risk population groups, including household contacts of tuberculosis affected individuals, persons living with human immunodeficiency virus (HIV), persons with medical conditions that weaken the immune system, and HCWs • HCWs are at increased risk of hospital-acquired tuberculosis infection due to persistent exposure to Mycobacterium tuberculosis in healthcare settings. • Multidrug-resistant tuberculosis (MDR-TB) remains a public health crisis and a health security threat
Hospital outbreak	• Tuberculosis is a common cause of hospital outbreaks among HCWs and patients across the world
Symptoms & clinical picture	• Pulmonary tuberculosis: Continuous cough (lasting for 3 weeks or more), hemoptysis, chest pain during breathing or coughing, anorexia, fatigue, fever, night sweats and chills. • Extra pulmonary tuberculosis: site swelling, abscess, hematuria.
Diagnosis	• Positive culture for M. Tuberculosis complex • Positive microscopic examination for acid-fast bacilli when a culture has not been or cannot be obtained • Demonstration of M. Tuberculosis complex nucleic acid directly from specimens • Histology strongly suggestive of tuberculosis when there is a strong clinical probability
Mode of Transmission	• Transmission is by inhalation of airborne droplets produced by people with pulmonary or laryngeal tuberculosis, especially during coughing or sneezing. • People with extrapulmonary tuberculosis alone cannot transmit the infection to others. • People with latent tuberculosis infection are not infectious. • Bovine tuberculosis may also be transmitted from infected cattle to humans by ingestion of contaminated unpasteurized milk or milk products or by airborne droplet spread to people who work closely with cattle.
Incubation Period	• The period from infection to demonstrable primary lesion or significant tuberculin (Mantoux) reaction is between 2 and 10 weeks
Period of Infectivity	• Untreated adults and adolescents with pulmonary TB may be intermittently infectious for years. • Children under the age of 12 years are rarely infectious. • Once a person with pulmonary TB has been commenced on effective treatment, the risk of transmission declines over 2–4 weeks to negligible levels in most cases.
Prevention and control	• The WHO multimodal IPC strategy consists of a combination of interventions designed to minimize and prevent the risk of tuberculosis transmission in healthcare settings. 1. Administrative controls • Triage and isolation of people (with presumed or confirmed tuberculosis infection). Isolation and airborne precautions are indicated for cases with active pulmonary or laryngeal tuberculosis • Prompt initiation of effective treatment • Respiratory hygiene (practice of covering of the mouth and nose during coughing and sneezing) • Management of HCWs (including education and training) 2. Environmental controls

	• Ventilation systems; natural, mechanical, mixed-mode, and recirculated air through HEPA filters • Germicidal ultraviolet systems 3. Personal respiratory protection • Particulate respirators (N95 or FFP2) • Respirator fit testing
Vaccines	• The BCG is a live attenuated Mycobacterium Bovis vaccine that protects against tuberculosis • The overall protective efficacy of 50% with 56% protection against TB meningitis. • It is given as part of childhood immunization and high risk HCWs • However, BCG is not generally recommended for use in many low risk countries such as USA and UK
Legionella	
Pathogen	• Legionella Pneumophila is a Gram-negative bacterium • Legionella lives and grows in water systems at temperatures of 20 to 50 degrees Celsius (optimal 35 degrees Celsius). • Legionella can survive and grow as parasites within free-living protozoa and within biofilms which develop in water systems.
Epidemiology	• Legionnaires' disease is a severe type of pneumonia. • It is typically acquired by inhalation of contaminated water containing the Legionella pneumophila • Hospital-acquired Legionnaires' disease usually originates in hospital water systems • The overall death rate is usually within the range of 5–10%. • The death rate may be as high as 40–80% in untreated immunosuppressed patients
Hospital outbreak	• Legionella one of the most common cause of waterborne outbreaks in hospitals.
Symptoms & clinical picture	• The severe pneumonia occurs most frequently in susceptible patients • People 50 years or older • Current or former smokers • People with a chronic lung disease • People with weak immune systems, cancer, and organ failure Pneumonic form, • Incubation period of 2 to 16 days • Initially, symptoms are fever, loss of appetite, headache, malaise and lethargy. • Later symptoms are cough and may be hemoptysis • The severity of disease ranges from a mild cough to a rapidly fatal pneumonia. • Death occurs through progressive pneumonia with respiratory failure and/or shock and multi-organ failure. Non-pneumonic form (Pontiac disease) • It is an acute, self-limiting influenza-like illness usually lasting 2–5 days. • The incubation period is from a few and up to 48 hours. • The main symptoms are fever, chills, headache, malaise and muscle pain (myalgia). • No deaths are associated with this type of infection
Diagnosis	• PCR testing • Positive Legionella culture • Legionella urinary antigen test
Mode of Transmission	• Inhalation of contaminated water aerosols from shower heads, some medical equipment (i.e., respiratory devices), air conditioning cooling towers, hot tubs, hot water tanks and heaters, complex plumbing systems, hydrotherapy equipment's and/or decorative water fountains • Less commonly, people can get sick by aspiration of drinking water containing Legionella. • Rarely person to person transmission
Incubation Period	• The average is 5 to 6 days from the time of exposure to symptom onset, (range 2 to 16 days)
Period of Infectivity	• As long as the contamination source is available
Prevention and control	• Minimizing Legionella growth in complex hospital water systems and devices is key to preventing infection. • Water disinfection is generally insufficient to control the risk of infection, as the biofilm contamination can be extensive and very difficult to remove. • Education of all direct care providers and family members to minimize patient exposure to tap water • Provision of sterile water to immunocompromised patients • Organizing a program of periodic cleaning and maintenance of showers, baths and sinks • Installing disinfection systems and/or point-of-use filters on taps and shower heads in those settings • Shock treatment: heating, flushing, and shock chlorination • Avoiding the installation of other potential sources of infection such as decorative pools and fountains.
Vaccines	• None
Burkholderia	
Pathogen	• Burkholderia cepacia is Gram-negative bacteria found in soil and water
Burden	• Burkholderia has been linked to multiple healthcareassociated outbreaks. • Medical products, antiseptics, and disinfectants are the most frequent source. • In outbreak investigations, HCWs should look for contaminated object to withdraw. This would be the critical point to immediately stop new cases due to contamination.
Hospital outbreak	• Multiple outbreaks have been reported in relation to use of contaminated medical products, antiseptics, and disinfectants, mainly in immunocompromised patients

Symptoms & clinical picture	• The signs and symptoms will depend on the cause • It can produce severe lung infections in young people with cystic fibrosis, often late in the course of the disease. • If contaminated saline is administered to flush into a vein through an IV, bloodstream infections can happen: ▯ Fever ▯ Chills or shivering ▯ Clammy or sweaty skin ▯ Confusion or disorientation ▯ Shortness of breath ▯ Increased heart rate • If contaminated chlorhexidine is administered for oral care of ventilated patients, ventilator associated pneumonia can happens: ▯ Fever ▯ Purulent tracheobronchial secretions ▯ New or progressive infiltrate on chest radiograph, ▯ Leukocytosis
Diagnosis	• Culture of clinical and environmental specimens • PCR testing
Mode of Transmission	• Use of contaminated medical products, antiseptics, and disinfectants. • Person-to-person through droplet and direct/indirect contact
Incubation Period	• The average is 9 days (range between 1 and 21 days)
Period of Infectivity	• Unclear, probably during the period of the disease
Prevention and control	• Stop using any remaining contaminated products. • Immediately destroy any unused product from pharmacies, medication carts, medication preparation areas, and patient care areas. • Notify health authorities of any cases and implicated products to stop the spread in other hospitals • Other measures based on disease; droplet precautions for ventilator associated pneumonia and contact precautions and hand hygiene for bloodstream infection
Vaccines •	• None

Epidemiology of specific viral outbreaks in hospitals

Respiratory viruses

▯ SARS
▯ SARS-cov- 2 or (COVID-19)
▯ MERS-CoV
▯ Influenza Viruses A and B
▯ Varicella Zoster
▯ Measles
▯ Respiratory Syncytial Virus

Blood-borne

▯ Hepatitis B Virus
▯ Hepatitis C Virus
▯ Human Immunodeficiency Virus

Contact viruses

▯ Varicella Zoster virus
▯ Herpes Simplex virus
▯ Cytomegalovirus
▯ Epstein Barr virus

GIT viruses

▯ Rotavirus
▯ Hepatitis A Virus

Respiratory viruses

SARS	
Pathogen	• Coronavirus causing severe acute respiratory syndrome (SARS)
Epidemiology	• SARS was first reported in Asia in February 2003. The illness spread to more than two dozen countries in North America, South America, Europe, and Asia before the SARS global outbreak of 2003 was contained. • According to the WHO, a total of 8098 people worldwide became sick with SARS during the 2003 outbreak. Of these, 774 died. • Currently, there is no known SARS transmission anywhere in the world

Hospital outbreak	• Multiple hospital outbreaks have been reported in China and other countries among HCWs, their family and friends, hospital visitors, and in inpatients
Symptoms & clinical picture	• Relatively insidious onset with fever, myalgia, malaise and headache, followed a few days to 1 week later by dry cough and dyspnea. • About 10-20% of cases have diarrhea. • Symptoms of upper respiratory tract infection (rhinorrhea and sore throat) are uncommon. • About 10-20% of cases develop severe pulmonary disease that may lead to death from respiratory failure.
Diagnosis	• Symptoms & clinical picture, especially with epidemiologic link • Chest X-rays typically show scattered peripheral and lower zone opacification. • Laboratory confirmation requires at least one of the following • Detection of diagnostic levels of serum antibody to SARS-CoV • Isolation (for example, in cell culture) of SARS-CoV • Detection of SARS-CoV nucleic acid
Mode of Transmission	• Person to person, by droplet transmission, direct contact with respiratory tract secretions and possibly fomites. • Airborne transmission of SARS can occur during aerosol generating procedures, such as intubation or nebulization
Incubation Period	• The average is 2-7 days but may be as long as 10 days
Period of Infectivity	• From onset of symptoms until 10 days after resolution of fever
Prevention and control	• In hospital, place cases under airborne and contact precautions throughout the period of communicability. • Staff should also wear eye protection and footwear that can be decontaminated or disposed of and use disposable equipment for the case wherever possible. • Clean and disinfect surfaces and articles soiled with respiratory secretions or feces, using a product with antiviral activity. • Prompt detection of cases through good surveillance and contact tracing
	• Quarantine of suspected contacts for 10 days • Outside hospital, cases should be isolated at home or in some other suitable facility throughout the period of communicability.
Transport of suspected SARS patients:	Use the minimum number of Emergency Medical Staff (EMS). Wear appropriate PPE (the patient should wear a surgical mask; EMS should wear N95 masks). Notify the receiving facility prior to transfer of suspected SARS patients to facilitate preparation for appropriate Infection Control procedures and facilities
Vaccines	• None

SARS-cov-2 (COVID-19)	
Pathogen	• The virus is severe acute respiratory syndrome coronavirus 2 (SARScov-2) • The disease is called coronavirus disease of 2019 (COVID-19)
Epidemiology	• At the end of 2019, a novel coronavirus was identified as the cause of a cluster of pneumonia cases in Wuhan • It rapidly spread, resulting in an epidemic throughout China, followed by a global pandemic. • It caused the largest pandemic in human history
Hospital outbreak	• Multiple hospital outbreaks across the globe have been reported among patients and HCWs • According to MOH Regulation
Symptoms & clinical picture	• Most common symptoms: fever, cough, tiredness, and loss of taste or smell • Less common symptoms: sore throat, headache, aches and pains, diarrhea, a rash on skin, discoloration of fingers or toes, red or irritated eyes • Serious symptoms: difficulty breathing or shortness of breath, loss of speech or mobility, confusion, and chest pain
Diagnosis	**Suspected case:** One of the following • Sudden onset of at least one of the following: fever, cough, or shortness of breath • Patient with sudden onset of at least one of the following: headache, sore throat, rhinorrhea, nausea, diarrhea or loss of smell or taste. In addition (in the 14 days prior to symptom onset), had contact with a confirmed COVID-19 case OR working in or attended a healthcare facility • Any admitted adult patient with unexplained sever acute respiratory infection (SARI), either Community Acquired Pneumonia (CAP) or Hospital Acquired Pneumonia (HAP). **Confirmed Cases** • A person who meets the suspected case definition with laboratory confirmation of COVID-19 infection (PCR)
Mode of Transmission	• Person to person, by droplet transmission, direct contact with infected people through infected secretions such as saliva and respiratory secretions or their respiratory droplets, which are expelled when an infected person coughs, sneezes, talks or sings • Airborne transmission of SARS-cov-2 can occur during aerosol generating procedures
Incubation Period	• The average is 5-6 days (range 2 to 14 days)
Period of Infectivity	• Up to 10 days after symptom onset or 24 hours after resolution of fever • Up to10 days after the first positive test in asymptomatic patients

Prevention and control	**Early recognition and source control** • Encourage HCWs to have a high level of clinical suspicion. • Activation of respiratory triage • Post signage reminding symptomatic patients to alert HCWs. • Promotion of respiratory hygiene is an important preventative measure. • Suspected COVID-19 patients should be placed in an area separate from other patients, and additional Infection Prevention and Control IPC (droplet and contact) precautions promptly implemented **Application of Standard Precautions for all patients** • Universal masking of all HCWs, patients and visitors • Correct and consistent use of available PPE and appropriate hand hygiene. • Perform hand hygiene after contact with respiratory secretions. • Ensure that environmental cleaning and disinfection procedures are followed consistently and correctly. **Contact and droplet precautions for suspected COVID-19** • Place patients in adequately ventilated single rooms • In cases of severe shortage of single rooms, it is possible to cohort suspected COVID-19 patients **Airborne precautions** • For aerosol-generating procedures for suspected COVID-19 **Management of exposure** • Patients sharing the same room (any setting e.g. Ward with shared beds, open ICU, open emergency unit etc.) With a confirmed case of COVID-19 for at least 15 minutes should be monitored and tested **Precautions during transportation of patients** • There should be arrangement between the transporting facility and the receiving facility for transportation timing, personal and clinical information. • The patient should be masked with surgical mask during transportation. • The patient must be health educated about respiratory etiquette. • The driver should wear surgical mask during transportation. • Never transport suspected with confirmed COVID-19 in one vehicle. • The used vehicle should be disinfected using MOH approved disinfectant (quaternary ammonium chloride wipes or spray / freshly prepared sodium hypochlorite solution 1000 ppm). **Administrative controls** • Establishment of sustainable IPC infrastructures and activities. • Adequate staff training and specifically appropriate human behavior, and patients' care givers education. • Policies on early recognition of acute respiratory infection potentially due to COVID-19. • Access to prompt laboratory testing for identification of the etiologic agent. • Prevention of overcrowding especially in the emergency department. • Provision of dedicated waiting areas with clear signage of "Respiratory Waiting Area" for symptomatic patients and appropriate placement of hospitalized patients promoting an adequate patient-to-staff ratio. • Provision and use of regular supplies. • IPC policies and procedures for all facets of healthcare provisions with emphasis on surveillance of acute respiratory infection potentially due to COVID-19 among HCWs and the importance of seeking medical care. • Monitoring of HCW compliance with standard precautions, along with mechanisms for improvement as needed. • Environmental and engineering controls • Basic health-care facility infrastructures. • Ensuring adequate environmental ventilation. • Adequate environmental cleaning in all areas within the health-care facility. • Terminal room cleaning at the time of discharge or transfer of patients. • Physical separation of at least 1.5-2-meter distance should be maintained between each suspect patient and others. • Precautions during collection and handling of laboratory specimen • All samples collected for laboratory investigations should be regarded as potentially infectious. • HCWs who collect or transport clinical specimens should adhere rigorously to Standard Precautions to minimize the possibility of exposure to pathogens. • Ensure that HCWs who collect specimens use appropriate PPE (eye protection, surgical mask, long-sleeved gown, gloves). • The respiratory specimen should be collected under aerosol generating procedure, personnel should wear a particulate certified N95 respirator. • Ensure that all personnel who transport specimens are trained in safe handling practices and spill decontamination procedures. • Place specimens for transport in leak-proof specimen bags (secondary container) that have a separate sealable pocket for the specimen (i.e. A plastic biohazard specimen bag), with the patient's name label on the specimen container (primary container), and a clearly written laboratory request form.

	• Ensure that health-care facility laboratories adhere to appropriate biosafety practices and transport requirements according to the type of organism being handled. • Deliver all specimens by hand whenever possible. • DO NOT use pneumatic-tube systems to transport specimens. • HESN Printed lab requisitions must be sent with samples and national lab reception report and result values must be updated on HESN on their corresponding **Environmental cleaning and disinfection after a COVID-19** • In-patient rooms (housing COVID-19 patients) should be cleaned and disinfected at least daily and at the time of patient transfer or discharge • More frequent cleaning and disinfection may be indicated for hightouch surfaces and following aerosol producing procedures (e.g. Tables, hard-backed chairs, doorknobs, light switches, remotes, handles, desks, toilets, sinks) • Cleaning staff should wear disposable gloves, surgical mask and isolation gowns for all tasks in the cleaning process, including handling of waste. • Cleaning and disinfection of the environmental surfaces should be with approved MOH disinfectant e.g. Hydrogen peroxide, quaternary ammonium chloride 4th generation, freshly prepared sodium hypochlorite solution 1000 ppm with consideration to the contact time in accordance with manufacturer's instructions for environmental surface disinfection. • After patient transfer, terminal cleaning should be done using manual method and /or ultraviolet germicidal irradiation or hydrogen peroxide dry mist or vapor
Discontinuing Isolation	According to the last update Public Health Authority "COVID-19 Guidelines"
Vaccines	• Messenger RNA (mRNA) vaccine such as Pfizer-bion Tech and the Moderna vaccines • Vector vaccine such as astrazeneca and Johnson & Johnson COVID-19 vaccines • Protein subunit vaccine such as Novavax
MERS-CoV	
Pathogen	• Middle Eastern Respiratory Corona Virus (MERS-CoV)
Epidemiology	• It was first isolated in Saudi Arabia in 2012 • Currently present more than 27 countries including the KSA, UAE, Qatar, Austria, Bangladesh, Thailand, Indonesia, UK and USA. • Around 2500 cases of MERS-CoV have been reported till now with approximately 80% of reported cases have been linked to exposure in Saudi Arabia • The disease had approximately 35% fatality rate
Hospital Outbreak	• According to last update of National guideline of MERS-CoV (MERSCoV Outbreak evidence of secondary transmission within a healthcare facilities of one or more secondary cases)
Symptoms & clinical picture	• Most people with this illness present with: Fever greater than 38 C, cough, shortness of breath and breathing difficulties, body aches, runny nose, sore throat. • More severe disease in people with weakened immune systems, older people, and those with such chronic diseases as diabetes, cancer and chronic lung disease • Suspect MERS-CoV in any of the followings: ✓ Severe pneumonia (severity score ≥3 points) or ARDS (based on clinical or radiological evidence) ✓ Unexplained deterioration of a chronic condition of patients with congestive heart failure or chronic kidney disease on hemodialysis Acute febrile illness (T ≥380 C) with/without respiratory symptoms ✓ Gastrointestinal symptoms (diarrhea or vomiting), AND leukopenia (WBC≤3.5x109 /L) or thrombocytopenia (platelets < 150x109/L)
Diagnosis	**Suspected case:** • A person with any of the above mentioned signs and symptoms and has been in contact with a confirmed MERS-CoV confirmed case or is a resident of or has visited any of the MERS-CoV endemic countries. **Confirmed Cases** • A clinically compatible illness that is laboratory confirmed (positive PCR)
Mode of Transmission	• Human to human: The virus does not pass easily from person to person unless there is close contact with an ill patient suffering from an acute respiratory illness in the community or healthcare setting in the 14 days before the onset of illness • Non-Human to human: History of contact with camels or camel's products in the 14 days before the onset of illness
Incubation Period	• (Range 2 to 14 days)
Period of Infectivity	• Unknown but is likely to extend from the onset of fever until 10 days after fever resolves
Prevention and control	• Suspected and confirmed cases who are not critically ill should be placed in single rooms under standard, contact and droplet precautions. • Those who are critically ill should be placed in Airborne Infection isolation rooms (negative pressure rooms) or, if unavailable, adequately ventilated single rooms with HEPA filter placed to the side of the bed.

	• Staff should also wear PPE that includes gowns, surgical mask, eye protection and gloves. Those who are entering an airborne isolation room should wear fit-tested seal-checked N95 mask. • Symptomatic contacts should be managed as suspected cases
Vaccines	• None
Influenza Viruses A and B	
Pathogen	• Influenza A and subtyping (such as H1N1, H3N2, H7N9) • Influenza B and subtyping (such as B/Washington, B/Phuket, and B- Yamagata)
Epidemiology	• Seasonal influenza affects 5–10% of the world's population • It can cause hospital outbreaks and sometimes large pandemics
Hospital outbreak	Influenza outbreaks are frequent, with attack rates from 12% to 60% • The transmission of influenza from HCWs to patients is well described • The diagnosis is commonly missed because of substantial proportions of asymptomatic cases
Symptoms & clinical picture	• Symptoms can be mild to severe. • The most common symptoms include: a high fever, runny nose, sore throat, muscle pains, headache, coughing, and feeling tired. • These symptoms typically begin two days after exposure to the virus and most last less than a week. • Gastrointestinal symptoms, more common in in children than adults. • Complications: viral pneumonia, secondary bacterial pneumonia, sinus infections, and worsening of previous health problems such as asthma or heart failure
Diagnosis	• Symptoms & signs • Confirmation using PCR or other diagnostic tests using nasopharyngeal specimens
Mode of Transmission	• Human to human: from person to person by inhalation or ingestion of droplets containing virus from people sneezing or coughing • Non-human to human: from infected animals such as Pork or birds (usually in the community)
Incubation Period	• The average is 2 days (range 1 to 7 days)
Period of Infectivity	• The infected patient is contagious one day before onset of symptoms to about a week after symptoms • In severely ill patients and in some children, some contagious viruses may be shed for a few weeks.
Prevention and control	• Vaccination, especially among HCWs • Respiratory hygiene/cough etiquette • Clinical triage • Cohorting patients with the same diagnosis • Management of patient flow, beds and care organization • Droplet precautions and extra caution when performing aerosol- generating procedures • Proper environmental hygiene • Restrict visitor access and movement within the facility • Training and education (hand hygiene, droplet precautions, etc.) • Surveillance of nosocomial influenza and early warning
Vaccines	• It contains 4 strains; two influenza A (H1N1and H3N2) and two influenza B viruses • It should be given annually to: ▯ HCWs ▯ Age <5 years and >65 years ▯ Pregnancy ▯ Chronic lung disease as asthma and COPD ▯ Other chronic disease as CVD, cancer, neuro,..etc ▯ Residents of nursing homes and other long-term care facilities • Reduce symptoms by 40% and 60% • Reduce ICU admission and death by 30% to 60%
Varicella	
Pathogen	• Varicella Zoster Virus, a member of the herpesvirus group
Epidemiology	• Chickenpox (varicella) is a highly contagious rash illness with secondary attack rates is approximately 80% • It is transmitted from patients with either varicella or herpes zoster by direct contact or airborne spread • Once chickenpox has resolved, the virus may remain inactive in nerve cells. In about 10–20% of cases, the virus reactivates later in life, producing a disease known as shingles or herpes zoster
Hospital outbreak	• Hospital outbreaks are common among HCWs and sometimes in patients • Adult and immunocompromised patients suffering from varicella (chicken pox) are potential source of infection to HCWs.
Symptoms & clinical picture	Chickenpox (varicella): • The classic symptom of chickenpox is a pruritic rash, which progresses rapidly from macules to papules to vesicular lesions before crusting • Other typical symptoms that may begin to appear 1-2 days before rash include fever, malaise, loss of appetite and headache. • Some people who have been vaccinated against chickenpox can still get the disease. However, the symptoms are usually milder. Shingles: • Painful skin rash with blisters in a localized area that follows a dermatome • Can disseminate in immunocompromised patients
Diagnosis	• Symptoms & signs • Confirmation using PCR to detect VZV in skin lesions or positive IgG ELISA result indicates that a person has antibodies to VZV either from past varicella disease history or vaccination.
Mode of Transmission	• Varicella is highly contagious. • The virus can be spread from person to person by direct contact, inhalation of aerosols from vesicular fluid of skin lesions of acute varicella or zoster and possibly through infected respiratory secretions that also may be aerosolized
Incubation Period	• The average is 14–16 days (range, 10–21 days).

Period of Infectivity	• Patient is infectious from 1 to 2 days before the rash appears and until all lesions are crusted over (average range, 4–7 days after rash onset)
Prevention and control	• Vaccination of children and high-risk groups • Pre-employment screening of HCWs and vaccination if needed • Patients with uncomplicated chickenpox or shingles should, if possible, be nursed at home. • Chickenpox cases should be placed in isolation: Follow standard precautions plus airborne precautions, and contact precautions until lesions are dry and crusted • Contact precautions with shingles and isolation is preferable but most of the time not necessary • Post-exposure screening and vaccination • Sick leave for affected HCWs
Vaccines	• Live-attenuated vaccine given in 2 doses children 12 to 18 months of age • Varicella vaccine is 70% to 90% effective for preventing varicella and more than 95% effective for preventing severe varicella • Anyone who is not fully vaccinated, and never had chickenpox, should receive one or two doses of chickenpox vaccine • Not given during pregnancy or immunosuppression • Herpes zoster vaccine contains the same strain used in the varicella vaccine, but 14x more potent • Herpes zoster vaccine gives 50-60% protection for at least 3-4 years • VZIG (varicella immunoglobulin): for immunocompromised or pregnant within 96 hours of exposure
Measles	
Pathogen	• Measles morbillivirus
Burden	• Measles is a highly contagious serious disease. • Before widespread vaccination, major epidemics occurred approximately every 2–3 years, with 2.6 million deaths each year. • Even though a safe and cost-effective vaccine is available, in 2018, there were more than 140 000 measles deaths globally, mostly among children under the age of five. • Measles vaccination resulted in a 73% drop in measles deaths between 2000 and 2018 worldwide
Hospital outbreak	• Hospital outbreaks are common among HCWs and sometimes in patients
Symptoms & clinical picture	• Generalized maculopapular rash, starting on the head and neck. • Fever (at least 38°c if measured) present at the time of rash onset. • Cough, coryza, conjunctivitis or Koplik's spots present at the time of rash onset. • Serious complications are more common in children under the age of 5, and adults over the age of 30. • The most serious complications include blindness, encephalitis (an infection that causes brain swelling), severe diarrhea and related dehydration, ear infections, or severe respiratory infections such as pneumonia.
Diagnosis	• Detection of IgM antibody specific to the virus. • IgG seroconversion or a significant rise (four-fold or greater) in antibody level for the virus between paired sera tested in parallel where the convalescent serum was collected 10 to 14 days after the acute serum. • Isolation of measles virus by culture. • Detection of measles virus nucleic acid.
Mode of Transmission	• Measles is one of the world's most contagious diseases. • Transmitted by airborne spread and by direct contact • It is spread by coughing and sneezing, close personal contact or direct contact with infected nasal or throat secretions. • The virus remains active and contagious in the air or on infected surfaces for up to 2 hours
Incubation Period	• The average is 10 days (range, 7-18 days).
Period of Infectivity	• For public health purposes, this can usually be considered from 5 days before to 5 days after rash onset, counting the day of rash onset as day 1
Prevention and control	• MMR vaccination of children and high-risk groups • Pre-employment screening of HCWs and vaccination if needed • Patients with uncomplicated measles, if possible, be nursed at home. • Measles cases should be placed in isolation: Follow standard precautions plus airborne and contact precautions • Post-exposure screening and vaccination • Exclude HCWs without evidence of immunity from duty from day 5 after first exposure to day 21 after last exposure, regardless of the post- exposure prophylaxis given.
Vaccines	• MMR is live-attenuated vaccine against measles, mumps, and rubella (German measles). • The first dose is generally given to children around 9 months to 15 months of age, with a second dose at 15 months to 6 years of age, with at least 4 weeks between the doses. • After two doses, 97% of people are protected against measles, • The vaccine is also recommended for those who do not have evidence of immunity, those with well-controlled HIV/AIDS, and within 72 hours of exposure to measles • Measles immunoglobulin within 6 days of exposure in health care facility with work restriction
Respiratory Syncytial Virus	
Pathogen	• Respiratory Syncytial Virus (RSV)
Epidemiology	• RSV infections can be dangerous for certain pediatric patients: □ Premature infants □ Very young infants, especially those 6 months and younger □ Children younger than 2 years old with chronic lung disease or congenital heart disease □ Children with suppressed immune systems • RSV infections can be dangerous for certain adult patients: □ Older adults, especially those 65 years and older □ Adults with chronic heart or lung disease □ Adults with weakened immune systems
Hospital outbreak	• Hospital outbreaks have been reported specially in pediatric and neonatal ICUs. Also in adult hematology and bone marrow transplant
Symptoms & clinical picture	• Mild symptoms: cold-like symptoms including runny nose, sore throat, cough, and headache • Severe symptoms viral pneumonia, secondary bacterial pneumonia, sinus infections, and worsening of previous health problems such as asthma or heart failure
Diagnosis	• Symptoms & signs • Confirmation using PCR or antigen testing
Mode of Transmission	• Respiratory (droplet) route: Contact with large droplets that form when a child talks, coughs, or sneezes. • Contact with the respiratory secretions from or contaminated objects. The virus can live on surfaces for many hours and 30 minutes or more on hands

Incubation Period	• The average is 4 to 6 days (range 2 to 8 days)
Period of Infectivity	• The patient is infectious for 3 to 8 days after symptoms • In severely ill patients and in some children, some contagious viruses may be shed for a few weeks.
Prevention and control	• Respiratory hygiene/cough etiquette • Hand hygiene • Droplet precautions • Proper environmental cleaning • Restrict visitor access and movement within the facility
Vaccines	• Vaccines are available to protect older adults from severe RSV, • Vaccines for pregnant people or monoclonal antibody products are available to protect infants and young children from severe RSV

Blood-borne

Hepatitis B Virus	
Pathogen	• Hepatitis B virus
Epidemiology	• Hepatitis B is a viral infection that attacks the liver and can cause both acute and chronic disease. • WHO estimates that 296 million people were living with chronic hepatitis B infection in 2019, with 1.5 million new infections each year? • In 2019, hepatitis B resulted in an estimated 820 000 deaths, mostly from cirrhosis and hepatocellular carcinoma (primary liver cancer).
Hospital outbreak	• Hospital outbreaks are still detected in patients in long-term care facilities, dialysis units, dental clinics, and pain management clinic
Symptoms & clinical picture	• The onset is usually insidious with anorexia, abdominal discomfort, nausea, vomiting, lethargy and occasional rash and arthralgia. • It often progresses to dark urine and jaundice. • At least 50% of infections asymptomatic • Some cases present with fulminating extensive acute hepatic necrosis • Hepatitis B infection acquired in adulthood leads to chronic hepatitis in less than 5% of cases, whereas infection in infancy and early childhood leads to chronic hepatitis in about 95% of cases.
Diagnosis	• At least one of the following: ▯ HbsAg positive. ▯ Change from HBsAg negative to HBsAg positive within a 12-month period ▯ Anti-HB core IgM reactive (unless HBsAg positive more than 6 months ago and the history is readily available in laboratory information systems) ▯ Detection of hepatitis B virus (HBV) DNA
Mode of Transmission	• Many body substances and tissues (such as blood, semen and vaginal fluids) are capable of transmitting hepatitis B, via percutaneous (intravenous, intramuscular, subcutaneous or across broken skin) or per-mucosal exposure. This includes transmission through sexual contact, body piercing and tattooing. • Perinatal mother-to-infant transmission and transmission through occupational exposure to infected blood is possible.
Incubation Period	• The average is 60–90 days (range 30 to 180 days)
Period of Infectivity	• The case is potentially infective 2–3 weeks before the onset of symptoms, during the clinical disease and usually for 2–3 months after acute infection or as long as HBsAg continues to be present in blood
Prevention and control	• Vaccination of children and high risk groups • Screening of HCWs and vaccination if needed • Ensure that all blood and blood products are screened and not derived from donors at risk of infection • Adopt universal procedures for the prevention of blood-borne virus transmission in hospitals, laboratory, barber shops, acupuncture clinics, tattoo shops. • Clean equipment and surfaces potentially contaminated with blood or body fluids. • Double-gloving during exposure-prone procedure • Disposable syringes and other instruments • Consider referral to needle-stick management. • Promote condom use and safe sex practices
Vaccines	• Composition: Recombinant HBsAg • Efficacy: 95% (Range, 80%-100%) • Duration of Immunity: 20 years or more • Schedule: 3 Doses • Booster doses not routinely recommended • Given to infants and high risk groups
Hepatitis C Virus	
Pathogen	• Hepatitis C virus
Epidemiology	• The virus can cause both acute and chronic hepatitis, ranging in severity from a mild illness to a serious, lifelong illness including liver cirrhosis and cancer. • Globally, an estimated 58 million people have chronic hepatitis C virus infection, with about 1.5 million new infections occurring per year. • WHO estimated that in 2019, approximately 290 000 people died from hepatitis C, mostly from cirrhosis and hepatocellular carcinoma (primary liver cancer). • Antiviral medicines can cure more than 95% of persons with hepatitis C infection, but access to diagnosis and treatment is low.
Hospital outbreak	• Hospital outbreaks are still detected in patients in long-term care facilities, dialysis units, dental clinics, and pain management clinic
Symptoms & clinical picture	• Acute HCV infections are usually asymptomatic and most do not lead to a life-threatening disease. • Around 30% (15–45%) of infected persons spontaneously clear the virus within 6 months of infection without any treatment. • The remaining 70% (55–85%) of persons will develop chronic HCV infection. • Of those with chronic HCV infection, the risk of cirrhosis ranges from 15% to 30% within 20 years.
Diagnosis	HCV infection is diagnosed in 2 steps: • Testing for anti-HCV antibodies with a serological test identifies people who have been infected with the virus. • If the test is positive for anti-HCV antibodies, a nucleic acid test for HCV ribonucleic acid (RNA) is needed to confirm chronic infection
Mode of Transmission	• Reuse or inadequate sterilization of medical equipment, especially syringes and needles in healthcare settings • Transfusion of unscreened blood and blood products • Injecting drug use through the sharing of injection equipment
Incubation Period	• The average is 40-60 days (range 15 to 180 days)
Period of Infectivity	• From 1 week before onset of first symptoms. • Infection usually persists indefinitely without treatment. Infectivity correlates with serum HCV RNA levels

Prevention and control	• In almost all cases, there are no restrictions on work, attendance at early childhood services or school or other community activities. • Ensure that all blood and blood products are screened and not derived from donors at risk of infection • Adopt universal procedures for the prevention of blood-borne virus transmission in hospitals, laboratory, barber shops, acupuncture clinics, tattoo shops. • Clean equipment and surfaces potentially contaminated with blood or body fluids. • Double-gloving during exposure-prone procedure • Disposable syringes and other instruments • Consider referral to needle-stick management.
Vaccines	• None
Hepatitis A Virus	
Pathogen	• Hepatitis A virus
Epidemiology	• Hepatitis A is an inflammation of the liver that can cause mild to severe illness. • Almost everyone recovers fully from hepatitis A with a lifelong immunity. However, a very small proportion of people infected with hepatitis A could die from fulminant hepatitis. • The risk of hepatitis A infection is associated with a lack of safe water and poor sanitation and hygiene (such as contaminated and dirty hands)
Hospital outbreak	• A hepatitis A outbreak infrequently happened among hospital patients and HCWs, resulting from exposure to a single patient with undiagnosed HAV infection.
Symptoms & clinical picture	• Following a prodrome of fever, malaise, anorexia, nausea or abdominal discomfort, there is jaundice, elevated serum aminotransferase levels and sometimes an enlarged tender liver. • Cases are often asymptomatic • Unlike hepatitis B and C, hepatitis A does not cause chronic liver disease but it can cause debilitating symptoms and rarely fulminant hepatitis (in 0.5% of cases), which is often fatal.
Diagnosis	• Positive hepatitis A-specific IgM in serum (in the absence of recent vaccination).
Mode of Transmission	• Ingestion of contaminated food and water or through direct contact with an infectious person. • Foodborne outbreaks have been linked to an infected food handler, raw or undercooked shellfish harvested from contaminated water, and contaminated produce such as lettuce or berries
Incubation Period	• The average is 28 days (range 15–50 days)
Period of Infectivity	• Maximum infectivity is during the 1–2 weeks before and the first few days after the onset of jaundice. • Prolonged viral excretion (up to 6 months) has been documented in infants and children.
Prevention and control	• Vaccination of children and high-risk groups • Patients should stay away from work or school for at least 1 week from onset of jaundice or symptoms • The likelihood of nosocomial transmission can be reduced with proper hand hygiene, standard precautions, and routine disinfection. • In case of food hander, educate about hand hygiene and advise not to prepare or handle food for others until no longer considered infectious • The spread of hepatitis A in the community can be reduced by: = Adequate supplies of safe drinking water =Proper disposal of sewage within communities =Personal hygiene practices such as regular handwashing before meals and after going to the bathroom
Vaccines	• It is given as two shots, 6 months apart, and both shots are needed for long-term protection against hepatitis A. • The following people should be vaccinated against hepatitis A: ▯ All children aged 12–23 months ▯ All children and adolescents 2–18 years of age who have not previously received hepatitis A vaccine (catch up vaccination) ▯ People at increased risk for hepatitis A o International travelers o Those who use illegal drugs o People with occupational risk for exposure o People experiencing homelessness

Rotavirus	
Pathogen	• Rota virus
Epidemiology	• Rotavirus constitutes the principal causal agent of intra-hospital diarrhea in children • Incidence of intra-hospital gastroenteritis is 2 to 7% of hospitalized children primarily between 6 and 23 months old • Responsible for an estimated 20-50% of all hospitalizations for diarrhea among infants and children under 5 years
Hospital outbreak	• Hospital outbreak have been reported mainly in pediatric wards Outbreaks were also seen in adult wards treating • immunosuppressed patients (hematology/oncology)
Symptoms & clinical picture	• Fever, abdominal pain, and vomiting, followed by watery diarrhea that lasts for 4 to 7 days • Gastroenteritis in immunocompromised and elderly patients and may be outbreaks
Diagnosis	• Rapid detection of rotavirus antigen in stool specimens
Mode of Transmission	• The transmission is from person to person and indirectly Rotavirus can be spread by contaminated hands, objects (toys, surfaces), food, or water • The virus survives on the hands of health workers for four hours and in inanimate objects it could survive for several days.
Incubation Period	• It is usually short (1 to 2 days)
Period of Infectivity	• Infected persons shed large quantities of virus in their stool beginning 2 days before the onset of diarrhea and for up to 10 days after onset of symptoms.
	• Vaccination

Prevention and control	• Hand hygiene and environmental cleaning • Contact precautions • Single room or cohort isolation • In early childhood services or other institutional situations, ensure satisfactory facilities and practices regarding hand cleaning; nappy changing; toilet use and toilet training; preparation and handling of food; and cleaning of sleeping areas, toys and other surfaces. • Community: sanitation-based strategies and breastfeeding
Vaccines	• Live-attenuated vaccine • Given to children in 2-3 doses • Provide 74% to 87% protection against rotavirus illness of any severity • Provide 85% to 98% protection against severe rotavirus illness • Provide 40-90% reduction of rotavirus hospitalizations and 60-70% reduction of Rota-caused deaths

Epidemiology of specific fungal outbreaks in hospitals

- Candida (Nosocomial/invasive candidiasis)
- Candida Auris
- Aspergillus Species

Candida (Nosocomial / invasive candidiasis)	
Pathogen	• Candida albicans (the most prevalent pathogenic species) ▯ Candida tropicalis ▯ Candida glabrata ▯ Candida krusei ▯ Candida parapsilosis ▯ Candida lusitaniae
Epidemiology	• Candida normally lives on skin and inside the body, such as the mouth, throat, gut, and vagina, without causing problems. • Candida can cause infections if it grows out of control, penetrate into the mucosa, or enter the blood • In the recent years, the frequency of nosocomial candidiasis is increased because of newer diagnostic and therapeutic techniques. • It can cause severe illness (invasive candidiasis) among high risk patients • Invasive candidiasis is associated with increased hospital costs and inhospital all-cause mortality of approximately 30%. • These risk factors include: ▯ Critical illness with a prolonged intensive care unit stay ▯ Presence of central venous catheters and other devices ▯ Use of broad-spectrum antibiotics or total parenteral nutrition ▯ Having hematologic or solid organ malignancy, stem cell transplantation, neutropenia, or recent abdominal surgery (especially in the presence of an anastomotic leak) ▯ Pre-term infant with a very low birth weight ▯ Renal failure or hemodialysis ▯ Injection drug use
Hospital outbreak	• Hospital outbreak have been reported in admitted patients in different units, specially in: ▯ Oncology/hematology unit ▯ Hematopoietic stem cell transplantation (HSCT) ▯ Solid organ transplantation (SOT) ▯ Neonatal ICU ▯ Burns ICU
Symptoms & clinical picture	• Candida infections in the mouth and throat (thrush) or vaginal are non-invasive infections localized to one part of the body • Invasive candidiasis is a serious infection that can affect the blood, heart, brain, eyes, bones, and other parts of the body. • Candidemia (bloodstream infections) is the most common form of invasive candidiasis • Signs and symptoms of invasive candidiasis are often non-specific and include fever and chills that do not respond to antibacterial • treatment. • Candida infections in the mouth and throat (thrush) or vaginal are non-invasive infections localized to one part of the body • Invasive candidiasis is a serious infection that can affect the blood, heart, brain, eyes, bones, and other parts of the body. • Candidemia (bloodstream infections) is the most common form of invasive candidiasis • Signs and symptoms of invasive candidiasis are often non-specific and include fever and chills that do not respond to antibacterial treatment. • Other symptoms can develop if the infection spreads to other parts of the body, including endocarditis, peritonitis, meningitis, osteomyelitis, arthritis, and endophthalmitis.
Diagnosis	• For invasive candidiasis, the specimens should be collected from sterile sites; blood (candidemia), CSF (meningitis), or other sterile site

	(e.g. Pleural fluid, peritoneal fluid, joint fluid, etc). • Confirmatory laboratory evidence: ▯ Culture of blood or other body fluids ▯ PCR • Presumptive laboratory evidence ▯ Serological tests to detect antigen or antibody in serum or other body fluids (Mannan, antimannan antibody, and Candida albicans germ tube antibody, β-d-glucan)
Mode of Transmission	• Most infections arise from the endogenous flora of patients with risk factors following disruption of skin and mucosal barriers. • Less commonly, candida can be transmitted via healthcare workers' hands or contaminated medical devices.
Incubation Period	• It probably varies from patient to patient.
Period of Infectivity	• Invasive candidiasis doesn't spread directly from person to person. • However, some candida species live on skin, so it's possible that Candida can be passed from patients or healthcare workers to at risk patients • In healthcare settings, these measures are important to prevent invasive candidiasis: ⎫ Adhering to hand hygiene recommendations ⎫ Contact isolation ⎫ Following recommendations for placement and maintenance of central venous catheters ⎫ Practicing antibiotic stewardship • Some groups of patients may benefit from antifungal prophylaxis: ⎫ Some solid organ transplant recipients ⎫ High-risk ICU patients ⎫ Patients with chemotherapy-induced neutropenia ⎫ Stem cell transplant recipients with neutropenia • Setting a surveillance system for invasive candidiasis: ⎫ Track incidence of candidemia and monitor laboratory and epidemiologic trends ⎫ Identify new risk factors for candidemia ⎫ Detect changes in resistance to antifungal agents
Discontinue Contact isolation	• Discontinue Contact isolation after obtaining two negative cultures from the previous positive site one week apart
Vaccines	• None
Candida Auris	
Pathogen	• Candida Auris
Epidemiology	• Candida auris is an emerging fungus that presents a serious global health threat due to several reasons: ▯ It is becoming more common ▯ It is often multidrug-resistant ▯ It is difficult to identify with standard laboratory methods ▯ It has caused outbreaks in healthcare settings • Only three classes of antifungal drugs are available to treat severe Candida infections: azoles, echinocandins, and amphotericin B. • It can cause severe illness among patients with immunocompromising conditions or those receiving high acuity care • These risk factors include: ▯ A prolonged hospital or ICU stays. ▯ Carbapenem-Resistant Enterobacterales (CRE) positive patient (infected & colonized). ▯ Current or active outbreak in the healthcare facility. ▯ An indwelling medical device, such as a central venous catheter, urinary catheter, biliary catheter, or wound drain. ▯ An impaired immune system. ▯ Prolonged use or misuse of broad-spectrum antibiotics or antifungals drugs. ▯ Patients in critical care areas (ICU, NICU, PICU, Dialysis).
Hospital outbreak	• Hospital outbreak have been reported in admitted patients in different units
Symptoms & clinical picture	• Colonization is asymptomatic. It is generally on the skin, nares, and other external body sites. • Infection: Candida auris has caused bloodstream infections, wound infections, and ear infections. • It also has been isolated from respiratory and urine specimens, but it is unclear if it causes infections in the lung or bladder. • Suspected case: A person with a non-Candida albicans species isolated from diagnostic or screening specimens. • Confirmed case: A person with confirmatory laboratory evidence from invasive clinical specimen (blood, cerebrospinal fluid), noninvasive sites (wounds, urine, and the respiratory tract) or screening Specimens (axilla, groin, nares, rectum, or other external body sites)
Diagnosis	• Culture of blood or other body fluids

	• Candida auris is more difficult to accurately identify in the laboratory than other more common types of Candida using conventional commercial systems and can be confused with other more commonly encountered candida species. • All invasive isolates should undergo antifungal susceptibility testing. • The following aspects in regard of specimen processing must be considered: ▯ Candida auris grows on blood agar as all other Candida species but for sub-culturing, use Sabouraud's agar. ▯ Growth at 40-42 C is useful to differentiate it from many other Candida species. CHROM agar is widely used as a differentiation medium, Candida auris appear pale purple or pink colonies. ▯ Microscopically is indistinguishable from other Candida species, but it is germ tube negative budding yeast. ▯ It is commonly misidentified with other yeast (especially Candida haemulonii) in: VITEK-2 YST, API 20C, Microscan and BD phoenix yeast identification system.
Mode of Transmission	• Typically, Candida auris spreads in hospitals and other care facilities through contact with contaminated surfaces or equipment. • However, it can also spread from person to person. People with Candida may shed the fungus through their skin cells. • Candida auris is transmissible whether a patient has Candida auris infection or colonization. Thus, infection prevention & control precautions are the same for patients with Candida auris infection or colonization.
Incubation Period	• Scientists do not know how long it takes for symptoms to appear. • It probably varies from patient to patient.
Period of Infectivity	• Patients and residents in healthcare facilities often remain colonized with Candida auris for many months, perhaps indefinitely, even after acute infection (if present) has been treated and resolves
Screening	A. Screen all patients who are: • Admitted to the critical care units and with specific risk factors to rule out Candida auris colonization. • Patients with an indwelling medical device, such as a central venous catheter, breathing aid tubes, urinary catheter, biliary catheter, or wound drain. • Any patient transferred from another healthcare facility OR long-term facility. • Roommates were exposed to C. auris-positive patients for more than 48 hours. • Individuals with current multidrug-resistant gram-negative bacteria who received healthcare outside of the Kingdom of Saudi Arabia (KSA) within the last 12 months. • Patients transferred from a unit with current transmission within the healthcare facility of C. auris or recent transmission within the last 30 days. • Carbapenem-Resistant entero bacterales (CRE) positive patient infected & colonized). • Immunocompromised patient. • Additionally, screening is recommended in departments that are experiencing outbreaks or having an increase in the number of ongoing cases and/or colonization. NB: In all cases, in the four weeks prior to diagnosis in the index patient, the healthcare facility should look back to see if there has been an increase in detection of Candida in the same intensive care setting or ward as this may represent unrecognized transmission. B. Screening of healthcare workers (HCWs) and the environment: • Routine screening of healthcare workers and the environment are not recommended unless epidemiological evidence links to transmission or indicated by the infection prevention & control (IPC) team.
Prevention and control	• Screening contacts of newly identified case patients to identify Candida auris colonization. • Strict adherence to proper hand hygiene practices. • Application of contact-based precautions: ▯ Keep patients in single rooms ▯ Review the visitor's situation according to the IPC recommendation ▯ In case of limited single rooms may be cohorting with other patients with Candida auris ▯ HCWs wear gowns and gloves during patient care. ▯ Practicing regular hand hygiene • Improved adherence to bundles of care for venous and urinary catheters, as well as tracheostomy care is essential. • Enhanced environmental cleaning and disinfecting (daily and terminal cleaning) using recommended disinfectants. • Single -patient use items such as blood pressure cuffs and stethoscope should be considered, especially in outbreak situations. • If single use items not available, reusable equipment should be properly cleaned and disinfected with the recommended disinfectants post providing patient care, and shared mobile equipment (e.g., glucometers, blood pressure cuffs) should be focused on. • Limit patient transfer and if mandatory, infection prevention & control measures should be strictly applied. • Laboratory surveillance of clinical specimens should be applied to detect additional cases.

	• Specific considerations should be applied to specific healthcare department and program (dialysis and home healthcare).
Decolonization	• At this time, no specific intervention is known to reduce or eliminate Candida auris colonization. • C. auris decolonization not recommended in evidence. However, regular routine body washing, skin preparation for invasive procedures, and care bundles by using approved skin disinfectants should be implemented for all critical care patients.
Discontinue Contact isolation	• Patients in healthcare facilities often remain colonized with Candida auris for long period of time lasts for several months even after an acute infection (if present) has been treated and resolves. • It is recommended to continue contact isolation precautions for the whole duration of all inpatient healthcare stays, including those in long-term healthcare settings.
Environmental Cleaning	• Candida auris can persist on surfaces in healthcare environments. • Quaternary ammonia products that are routinely used for disinfection are not effective against Candida auris • Educate environmental cleaning staff and implement supervised cleaning. • Routine (at least daily or when required), and terminal cleaning and disinfection of patients' rooms and other areas where patients receive care (e.g., radiology, physical therapy) should be implemented applying an appropriate disinfectant that effective against Candida auris. • MOH approved disinfectants (Sodium hypochlorite 1000 ppm, Hydrogen peroxide, etc.) as high-level disinfectant s should be used with consideration of the manufacturer instructions such as for contact time. • It is preferable to use the new and evolving disinfection technologies, like ultraviolet light and hydrogen peroxide vapor/mist decontamination machines for terminal cleaning, andthey should be used only post standard cleaning. • Housekeepers performing environmental cleaning should wear the recommended PPEs described above. • Use designated cleaning equipment (e.g., mop, buckets, etc.) and disposable cleaning materials in the isolation room/unit. • Environmental sampling could be done only to support outbreak investigations.
Vaccines	• None
Aspergillus Species	
Pathogen	• Aspergillus Species • Most commonly, Aspergillus fumigatus and A. Flavus. Less common species include A. Terreus, A. Nidulans, A. Niger, and A. Versicolor.
Epidemiology	• Nosocomial aspergillosis represents a serious threat for severely immunocompromised patients • High-risk groups include individuals undergoing hematopoietic stem cell transplantation, solid organ transplantation, major surgery (especially gastrointestinal surgery), or severe burns; those with neutropenia, AIDS, neoplastic disease, immunosuppressive therapy, or advanced age; and premature babies
Hospital outbreak	• Multiple hospital outbreaks have been reported in admitted immunocompromised patients in different units such as ▯ Oncology/hematology unit ▯ Hematopoietic stem cell transplantation ▯ Solid organ transplantation ▯ Neonatal ICU ▯ Burns ICU • Sources of Aspergillus Species in hospital are; construction work, renovation activities, and contaminated or defective air supply system
Symptoms & clinical picture	• Allergic bronchopulmonary aspergillosis in people who have cystic fibrosis or asthma; coughing, shortness of breath, and wheezing • Allergic Aspergillus sinusitis; stuffiness, runny nose, headache, and reduced ability to smell • Chronic pulmonary aspergillosis in patients with other chronic lung disease; weight loss, cough, coughing up blood, fatigue, and shortness of breath • Invasive aspergillosis in immunocompromised patients: most commonly affects the lungs, but it can also spread to other parts of the body; fever, chest pain, cough, hemoptysis, and shortness of breath • Cutaneous aspergillosis can also occur if invasive aspergillosis spreads to the skin from somewhere else in the body
Diagnosis	• Microscopy: Evaluation of respiratory specimens after the application of special stains can allow for visualization of Aspergillus elements. • Galactomannan antigen detected in plasma, serum, bronchoalveolar Lavage (BAL), or cerebrospinal fluid (CSF) • Aspergillus PCR • Aspergillus species recovered by culture from sputum, BAL, bronchial brush, or aspirate
Mode of Transmission	• Inhalation of Aspergillus spores • Aspergillosis can't spread from person to person
Incubation Period	• Unclear • Incubation Period of invasive aspergillosis is estimated at 15 days
Period of Infectivity	• As long as the source of Aspergillus spores is available • Aspergillosis can't spread from person to person

Prevention and control	• Protect patients especially high-risk ones from the sources of Aspergillus spores ▯ Seal off patient care areas with adequate and impermeable barriers, and keep doors and windows closed ▯ Avoid non-emergent admissions during heavy construction periods ▯ If possible, locate high-risk patients as far as possible from areas of demolition or construction ▯ Verify that HEPA air filtration is sufficient and proper air exchange rates are maintained. ▯ Provide treatment in the patient's room if possible. ▯ Transport patients via an alternate route to avoid dust, schedule transportation during periods with minimal construction activity, and use appropriate face masks for susceptible patients ▯ Wet-clean wards thoroughly without raising dust • Surveillance of increased risk patients to early detect cases
Vaccines	• None

Appendix 7.5 Outbreak Classification Matrix- Class C.

	No.	Pathogen	Number of cases
C	1	Acinetobacter baumanni complex	2 - 4 Cases
	2	Acinetobacter baumannii	
	3	Acinetobacter baumannii MDR	
	4	Acinetobacter baumannii PDR	
	5	Acinetobacter baumannii XDR	
	6	Burkholderia cepacia	
	7	Klebsiella oxytoca	
	8	Klebsiella Pneumonia (CRKP)	
	9	Klebsiella Pneumonia (ESBL)	
	10	Klebsiella spp.	
	11	Morganella morganii	
	12	MRSA	
	13	Mycobacterium Bovis	
	14	Mycobacterium tuberculosis	
	15	Proteus mirabilis	
	16	Providencia stuartii	
	17	Pseudomonas aeruginosa	
	18	Pseudomonas spp.	
	19	Salmonella spp.	
	20	Serratia marcescens	
	21	Shigella spp.	
	22	Staphylococcus aureus	
	23	Staphylococcus epidermis	
	24	Stenotrophomonas maltophilia	
	25	Streptococcus agalactiae	
	26	Streptococcus lugdensis	
	27	Streptococcus pneumonia, meningeal	
	28	Streptococcus pneumonia, nonmeningeal	
	29	Streptococcus viridans	
	30	Enterobacter cloacae	
	31	Enterococcus faecalis	
	32	Enterococcus faecium	
	33	Other MDROs	
	34	E.coli- CRE	
	35	E.coli- ESBL	
C	36	Clostridium Botulinum	2 - 4 Cases
	37	VRE	
	38	Legionella pneumophila	
	39	Candida Auris	
	40	**Clostridium Difficile**	
	41	**Candida Albicans**	
	42	Candida Species	
	43	Candida Glabrata	
	44	Candida Parapsilosis	
	45	Candida Tropicalis	
	46	Candida Haemulonii	
	47	Aspergillus Species	
	48	Hepatitis A virus (HAV)	

49	Hepatitis B virus (HBV)
50	Hepatitis C virus (HCV)
51	Measles
52	Chickenpox
53	Influenza or Influenza-Like Illness (ILI)
54	COVID- 19

Appendix 7.6 Methods of Environmental-Surface Sampling.

Method	Suitable for appropriate surface(s)	Assay technique	Procedural notes	Points of interpretation
Sample/rinse (Moistened swab/rinse)	Non-absorbent surfaces, corners, crevices, devices, and instrument	Dilutions; qualitative or quantitative assays	Assay multiple measures areas or devices with separate swabs	Report results per measured areas or if assaying an object, per the entire sample site
Sample/rinse (Moistened sponge/rinse	Large areas and housekeeping surfaces (e.g., floors or walls)	Dilutions; qualitative or quantitative assays	Vigorously rub a sterile sponge over the surface	Report results per measured area
Sample/rinse (Moistened wipe/rinse)	Large areas and housekeeping surfaces (e.g., countertops	Dilutions; qualitative or quantitative assays	Use a sterile wipe	Report results per measured area
Direct immersion	Small items capable of being immersed	Dilutions; qualitative or quantitative assays	Use membrane filtration if rinse volume is large and anticipated microbiological concentration is low	Report results per item
Containment	Interior surfaces of containers, tubes, or bottles	Dilutions; qualitative or quantitative assays	Use membrane filtration if rinse volume is large	Evaluate both the types and numbers of microorganisms
RODAC (Replicate Organism Direct Agar Contact)	Previously cleaned and sanitized flat, non-absorbent surfaces; not suitable for irregular surfaces	Direct assay	Overgrowth occurs if used on heavily contaminated surfaces; use neutralizers in the agar if surface disinfectant residuals are present	Provides direct, quantitative results; use a minimum of 15 plates per an average hospital room

Source: *(CDC, 2019)*

Methods of Air Sampling

Method	Principle	Suitable measuring	Collection media or surface	Rate of collection (L/min)	Auxiliary equipment needed	Points to consider
Impingement in liquids	Air drawn through a small jet and directed against a liquid surface	Viable organisms, and concentration over time. Example use: sampling water aerosols to Legionella spp	Buffered gelatin, Tryptose saline, peptone, nutrient broth	12.5	Yes	Antifoaming agent may be needed. Ambient temperature and humidity will influence length of collection time
Impaction on solid surfaces	Air drawn into the sampler; particles deposited on a dry surface	Viable particles; viable organisms (on non-nutrient surfaces, limited to organisms that resist drying and spores); size measurement, and concentration over time. Example use: sampling air for Aspergillus spp., fungal spores	Dry surface, coated surfaces, and agar	28 (sieve) 30–800 (slit)	Yes	Available as sieve impactors or slit impactors. Sieve impactors can be set up to measure particle size. Slit impactors have a rotating support stage for agar plates to allow for measurement of concentration over time
Sedimentation	Particles and microorganisms settle onto surfaces via gravity	Viable particles. Example uses: sampling air for bacteria in the vicinity of and during a medical procedure; general measurements of microbial air quality	Nutrient media (agars) on plates or slides	n/a	No	Simple and inexpensive; best suited for qualitative sampling; significant airborne fungal spores are too buoyant to settle efficiently for collection using this method.
Filtration	Air drawn through a filter unit; particles trapped; 0.2 µm pore size	Viable particles; viable organisms (on non-nutrient surfaces, limited to spores and organisms that resist drying); concentration over time. Example use: air sampling for Aspergillus spp., fungal spores, and dust	Paper, cellulose, glass wool, gelatin foam, and membrane filters	1–50	Yes	Filter must be agitated first in rinse fluid to remove and disperse trapped micro-organisms; rinse fluid is
Centrifugation	Aerosols subjected to centrifugal force; particles impacted onto a solid surface	Viable particles; viable organisms)on non-nutrient surfaces, limited to spores and organisms that resist drying; (concentration over time. Example use: air sampling for Aspergillus spp., and fungal spores	Coated glass or plastic slides, and agar surfaces	40–50	Yes	Calibration is difficult and is done only by the factory; relative comparison of airborne contamination is its general use.
Electrostatic precipitation	Air drawn over an electrostatically charged surface; particles become charged	Viable particles; viable organisms (on non-nutrient surfaces, limited to spores and organisms that resist drying); concentration over time	Solid collecting surfaces (glass, and agar)	85	Yes	High volume sampling rate, but equipment is complex and must be handled carefully; not practical for use in health- care settings
Thermal precipitation	Air drawn over a thermal gradient; particles repelled from hot surfaces; settle on colder surfaces	Size measurements	Glass coverslip, and electron microscope grid	0.003–0.4	Yes	Determine particle size by direct observation; not frequently used because of complex adjustments and low sampling rates.

Source: *(CDC, 2019)*