Healthcare Associated Infections (HAIs)

Surveillance Manual

First Edition
Contributors and Collaborators

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**Message from General Director**

I am honored to present the first edition of health care associated infections surveillance manual from the general directorate of infection prevention and control at ministry of health. It is obviously known that infection control programs are essential components of any health care facility system which provide safe and healthy environment for the patients while receiving the medical care.

Approximately around 5% to 15% of the patients acquired the infections from the health care facilities, and most of these infections can be prevented by adherence to evidence based practices and care bundles for prevention of these infections.

We hope this manual will help and guide the infection control practitioners and the health care workers to understand the surveillance definitions, methodology and other related topics which will enhance the hospital performance and lead to better outcome for the patients.

**Dr. Khalid H ALAnazi**

Director General,

General directorate of Infection prevention and control,

Ministry of Health,

Saudi Arabia.
General Directorate of Infection Prevention and Control

Introduction

General Directorate of Infection Prevention and Control (GDIPC) at the Saudi Ministry of Health manages all MOH hospitals in 20 regions of Saudi Arabia regarding infection prevention and control programs. Healthcare-associated infections (HAIs) are associated with significant morbidity and mortality. Additionally, they increase the length of stay in admitted patients and consequently the cost of healthcare services. Surveillance of healthcare-associated infections provides the policy maker as well as healthcare professionals with infection rates, a critical step in HAIs prevention strategies.

Vision

GDIPC is committed to excellence and safety of healthcare services provided by the MOH hospitals across Saudi Arabia through promoting up to date infection practices including surveillance.

Mission

GDIPC is committed to provide information that contribute to the delivery of the highest quality health care, by promoting safety and reducing the risk of acquiring and transmitting infections among patients, visitors, healthcare workers and supporting staff at MOH hospitals through ongoing data collection, consolidation, and analysis, followed by the dissemination of guiding information and actions, using sound epidemiological and statistical principles.

Target audience

This manual was created to provide the necessary surveillance information for infection control practitioners (ICP), epidemiologists, biostatisticians, and any other healthcare professionals whose responsibilities include infection prevention at healthcare setting.
Objectives

This manual was created to provide the necessary surveillance information for the following objectives:

- To measure the incidence of HAIs and organisms and establish their endemic rates through using standard definitions and methods to allow benchmarking both local, regional, and international
- To investigate and control hospital clusters or outbreaks of HAI & resistant organisms among patients and personnel
- To maintain a comprehensive data system to monitor, evaluate, and implement the necessary actions to ensure a safe and healthy environment for patients, personnel, and visitors.
- To monitor antimicrobial susceptibilities and the development of new resistant strains that may pose challenge to healthcare system
- To analyze temporal trends of aggregated data to ensure patient safety and appropriate allocation of available resources
- To evaluate new products to be used to control infection throughout the hospital
- To ensure compliance with national and international regulations
- To ensure compliance with the requirements of accrediting bodies, including Saudi Central Board for Accreditation of Healthcare Institutes (CBAHI) and international agencies such as the Joint Commission International on Accreditation of Healthcare Organizations (JCI) or the Rehabilitation Accreditation Commission
- To provide data and statistical analysis for research and publications
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1. Surveillance definition

Surveillance definition:

Surveillance is a systematic method of ongoing collection, consolidation, and data analysis concerning the distribution and determinates of a given disease or event, followed by the dissemination of that information to those who can improve the outcome.

Surveillance cycle:

Surveillance cycle is not complete until data collection is translated into report and recommendations for implementation as shown in the figure below.

Difference between surveillance and clinical definitions:

Surveillance and clinical definitions are different due to different purposes, as shown below.

<table>
<thead>
<tr>
<th></th>
<th>Clinical Criteria</th>
<th>Surveillance Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Main aim</strong></td>
<td>Aim to provide diagnosis and treatment for cared patients</td>
<td>Aim to provide trend for risk assessment, prevention, and policy change</td>
</tr>
<tr>
<td><strong>Main focus</strong></td>
<td>Focus on individual patients</td>
<td>Focus on a patient population</td>
</tr>
<tr>
<td><strong>Allowance for clinical judgment</strong></td>
<td>Clinical judgment is important</td>
<td>Clinical judgment is absent or minimal</td>
</tr>
</tbody>
</table>
Objectives of HAIs surveillance:

Surveillance data can be used to serve several objectives:

- To measure the incidence of healthcare associated infections (HAI) and organisms
- To establish an endemic rate of HAIs
- To detect, investigate and control hospital clusters or outbreaks of HAI
- To monitor, evaluate, and implement the necessary preventive measures
- To work on reducing HAI using standard bundles
- To observe practices, such as hand hygiene and sterilizer performance monitoring, to promote compliance with recommendations and standards
- To monitor the occurrence of adverse outcomes to identify potential risk factors
- To prevent and control infections and occupational injuries in healthcare workers (HCWs)
- To monitor antimicrobial susceptibilities
- To analyze temporal trends of aggregated data
- To evaluate new products to be used to control infection throughout the hospital
- To detect and report notifiable diseases to the Ministry of Health (MOH) or other responsible authority
- To identify organisms and diseases of epidemiological importance, such as antibiotic-resistant organisms and tuberculosis, to prevent their spread
- To ensure compliance with national and international regulations
- To ensure compliance with accrediting agency requirements, such as the Joint Commission on Accreditation of Healthcare Organizations or the Rehabilitation Accreditation Commission
- To provide information that can be used by responsible partners within/outside the health care facilities to target performance improvement activities
- To detect a bioterrorist event or an emerging infectious disease
- To provide data to conduct a facility risk assessment for diseases, such as legionellosis or tuberculosis
Effectiveness of surveillance:

Surveillance without interventions can result in reduction of rates of infections simply due to change of the behaviors of healthcare providers.

Surveillance would be most effective if the outcome met the following criteria:

- Infections with high prevalence &/or incidence
- Infections associated with high morbidity &/or mortality
- Infections associated with long length of stay
- Infections associated with high treatment cost
- Preventable infections

Surveillance design

Surveillance design is unique and is different from survey and monitoring, as shown below:

<table>
<thead>
<tr>
<th></th>
<th>Surveillance</th>
<th>Survey</th>
<th>Monitoring</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Methods</strong></td>
<td>Making repeated standardized surveys in order to detect possible changes</td>
<td>Making a single observation to measure and record something</td>
<td>Making repeated standardized measurements to detect unacceptable standards</td>
</tr>
<tr>
<td><strong>Relation to time</strong></td>
<td>Continuous and ongoing</td>
<td>Once only</td>
<td>Continuous</td>
</tr>
<tr>
<td><strong>Relation to standards</strong></td>
<td>Usually do not differentiate between acceptable and unacceptable standards</td>
<td>NA</td>
<td>Usually have acceptable and unacceptable standards</td>
</tr>
<tr>
<td><strong>Uses</strong></td>
<td>HAI surveillance</td>
<td>Knowledge, attitude and practice (KAP) of hand hygiene in HAI prevention</td>
<td>Monitoring pressure in negative pressure isolation rooms</td>
</tr>
</tbody>
</table>
2. Establishing a surveillance system

Establishing a surveillance system requires the following steps:

1. Assess the population and identify those at greatest risk for the outcome (e.g. bloodstream infection) or process (e.g. central line insertion practices) of interest
2. Select the appropriate outcome or process to be monitored by surveillance
3. Select the appropriate surveillance methodology
4. Create a surveillance manual
5. Prepare surveillance resources
6. Assemble surveillance team & engage stakeholders
7. Train surveillance team
8. Determine observation location
9. Determine observation time period
10. Monitor for the outcome or process
11. Stick to standardized definitions during monitoring
12. Collect appropriate denominator data
13. Create and maintain database
14. Analyze surveillance data
15. Report and use surveillance information in a timely manner
1. Assessing the population to survey

Assess the population and identify those at greatest risk for the outcome (e.g. blood stream infection) or process (e.g. central line insertion practices) of interest

Indicators that can be used to assess the population to survey

- What types of patients do we serve?
- What are the most common diagnoses?
- What are our most frequently performed surgical or other invasive procedures?
- Which services or treatments are used most frequently?
- Are there services or treatments that increase the risk of infection for the patient?
- What types of patients increase liability and/or costs for the organization?
- What types of patients increase liability and/or costs for the organization?
- What types of patients with long length of stay in the organization?
- Does the organization’s strategic plan focus on particular groups of patients?
- What types of health concerns exist in the community, region, or regulatory environment?
- Which patients are at increased risk for infection or other important outcomes?

Sources of data required to assess the population to survey

- Medical records
- Financial services
- Information services
- Quality/utilization management
- Surgical database
- Administrative/management reports
- Risk management
- Community agencies
- Occupational/employee health
- Human resources records
Vulnerable patient populations who are at higher risk of infection

- Elderly
- Immunosuppressed/immunocompromised patients
- Organ or bone marrow transplant
- HIV / AIDS
- Pregnant women
- Infants and children
- Diabetics
- Alcohol/substance users
- Chronic obstructive pulmonary disease
- Congestive heart failure
- Other chronic illnesses
- Dialysis

2. Selecting the appropriate outcome or process to be monitored by surveillance

Outcome versus process

- Select the appropriate outcome or process to be monitored by surveillance
- Examples of outcomes: HAI, infection or colonization with a specific organism, pyrogenic reaction or vascular access infection in hemodialysis patients, sharps injuries, etc.
- Examples of processes: Central line insertion practices (CLIPs), surgical care processes (e.g., preoperative antimicrobial prophylaxis), medication errors, influenza vaccination rates, hepatitis B immunity rates, personnel compliance with protocols, etc.
- Examples of other events: Occurrence of reportable diseases and conditions, communicable diseases in personnel, organisms or syndromes indicative of bioterrorist events, etc.

Selecting the outcome or process should be based on:

- High prevalence &/or incidence
- High morbidity &/or mortality
- Long length of stay
- High treatment cost
- Preventable
- Satisfy customer needs / satisfaction
• Satisfy organizational mission / strategic goals
• Can be done with available resources

3. **Select Surveillance methodology**
Routine HAI surveillance in most in-patient healthcare facilities should be conducted by an infection control practitioner (ICP) in:
   1. An active
   2. Patient-based
   3. Prospective
   4. Priority-directed manner
   5. That yields risk-adjusted incidence rates

4. **Create surveillance manual for**
   • Outcome & process
   • Methodology
   • Location and durations
   • Data collection forms
   • Data analysis methods
   • Benchmarking with national and international standards
   • Reporting

5. **Prepare surveillance resources**
   • Office space
   • Computers
   • Information technology services
   • Administrative services
   • Media services
   • Folders, papers, pens, cabinets, storage media, pagers
   • Microsoft and statistical software
6. **Assemble surveillance team & engage stakeholders**
   - Hospital epidemiologist
   - Infection control practitioners (ICP)
   - Infection control coordinator
   - Data entry clerks
   - Biostatistician

7. **Train surveillance team**
   - Start with recruiting qualified persons
   - All must be formally trained in IPC to understand
   - Microbiology
   - Sterilization/ disinfection
   - Ward practice and Risk Assessment
   - Hospital type, design and management
   - Hospital scope of services
   - Surveillance and research methodology
   - Short courses, training sessions, campaigns, conferences, diploma, CIC….

8. **Determine observation location**
   - Inpatient versus outpatient
   - Intensive care units versus wards
   - Regular wards versus specialty care areas
   - Unit-based versus hospital-based

9. **Determine observation time period**
   - It should be sufficient to collect sufficient data. It could be affected by the hospital resources, hospital size, target population, health care priorities …etc.
   - The shortest unit time in surveillance is one month
10. Monitor for the outcome or process
   - Develop data collection tools for each surveillance initiative
   - Limit data collection to only what is needed for meeting the specific objective
   - Design forms considering flow of patient charts / data sources and ease of data recording / entry
   - Data collection include numerator and denominator data

11. Stick to standardized definitions during monitoring
   - Use standardized written case definitions to ensure precise surveillance
   - When available and applicable, use previously published, validated definitions
   - When historical data are used for internal comparisons or for external comparisons, ensure that the same definitions are used for outcomes and processes and that populations are at similar risk
   - If definitions are changed, be aware that such changes compromise the comparability of rates over time

12. Collect appropriate denominator data
   - Counts of the cohorts of patients at risk of acquiring HAI
   - For device-associated HAI incidence rates: record daily the total number of patients and total number of ventilator-days, central line-days, and urinary catheter-days in the patient care area(s) under surveillance
   - For SSI rates: record information on operative procedures selected for surveillance (e.g., type of procedure, date, risk factors, etc.)

13. Create and maintain database
   - Type: excel, Access, SPSS, others
   - Separate for each component
   - Names and dates
   - Safety
   - Storage
   - Manuals
14. Analyze surveillance data

- Infection rates
- Device utilization
- Standardized infection ratio
- Benchmarking

15. Report and use surveillance information in a timely manner

- Quarterly reports versus annual reports
- Consider audience
- Consider stakeholders
- Consider units that data were collected
3. **Surveillance methodology**

The patient safety surveillance modules must use the following methodology:

1. Active surveillance
2. Patient-based surveillance
3. Prospective surveillance
4. Targeted surveillance
5. Yields risk-adjusted incidence rates

- This means that the ICP shall seek out infections during a patient’s stay by screening a variety of data sources.
- Retrospective chart reviews should be used only when patients are discharged before all information can be gathered.
- Other HCW (other than ICP) may be trained to screen data sources for these infections, but the ICP must make the final determination.
- To minimize the ICP’s data collection burden, others may be trained to collect the denominator data (separate forms for device/medication-associated infections).
1. Active versus passive

1. Active surveillance

- Trained personnel, mainly ICPs, vigorously look for HAI
- Information accumulated by using a variety of data sources within and beyond the nursing ward

2. Passive surveillance

- Persons who do not have a primary surveillance role, such as ward nurses or respiratory therapists, identify and report HAI
- It is acceptable for denominator data

<table>
<thead>
<tr>
<th>Person in charge</th>
<th>Active Surveillance</th>
<th>Passive Surveillance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Data are collected by trained personnel (IPC) as part of planned surveillance</td>
<td>Data are reported by non-trained personnel as per reporting regulations</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Source of information</th>
<th>Active Surveillance</th>
<th>Passive Surveillance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Attempt to search multiple data sources</td>
<td>No attempt to search multiple data sources</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Time required</th>
<th>Active Surveillance</th>
<th>Passive Surveillance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Needs more effort and time</td>
<td>Needs less effort and time</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Missing data</th>
<th>Active Surveillance</th>
<th>Passive Surveillance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Few missing events</td>
<td>More missing events</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Example</th>
<th>Active Surveillance</th>
<th>Passive Surveillance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ICP collect CLABSI numerator data</td>
<td>Staff nurse call ICP to report a pneumonia case</td>
</tr>
</tbody>
</table>
2. Patient-based versus laboratory-based surveillance

1. Patient-based surveillance

- Count HAI, assess risk factors, and monitor patient care procedures and practices for adherence to infection control principles
- Requires ward rounds and discussion with caregivers

2. Laboratory-based surveillance

- Detection is based solely on the findings of laboratory studies of clinical specimens

<table>
<thead>
<tr>
<th></th>
<th>Patient-based Surveillance</th>
<th>laboratory-based Surveillance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case-finding</td>
<td>Data collected from multiple resources (e.g. visit patient care areas, review charts, &amp; discuss with care giver)</td>
<td>Case-finding based solely on positive lab findings</td>
</tr>
<tr>
<td>Surveillance definition</td>
<td>Can verify standard surveillance definition</td>
<td>Usually can NOT verify standard surveillance definition</td>
</tr>
<tr>
<td>Uses</td>
<td>Can monitor events, risk factors, and practices</td>
<td>Can NOT monitor risk factors and practices</td>
</tr>
<tr>
<td>Example</td>
<td>Device-associate HAI and SSI surveillance</td>
<td>LabID event detection in the MDRO/CDI</td>
</tr>
</tbody>
</table>
3. Prospective versus retrospective surveillance

1. Prospective surveillance
   - Monitor patients during their hospitalization
   - For SSIs, also monitor during the post-discharge period

2. Retrospective surveillance
   - Identify infections via chart reviews after patient discharge

<table>
<thead>
<tr>
<th></th>
<th>Prospective Surveillance</th>
<th>Retrospective Surveillance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Onset of data collection</td>
<td>Data collection starts before patient discharge</td>
<td>Data collection starts after patient discharge</td>
</tr>
<tr>
<td>Ascertainment bias</td>
<td>Less ascertainment bias</td>
<td>More ascertainment bias</td>
</tr>
<tr>
<td>Missing data</td>
<td>Few missing events as more resources are available</td>
<td>More missing events as less resources are available</td>
</tr>
<tr>
<td>Implementation</td>
<td>Easy to establish</td>
<td>May be difficult to establish</td>
</tr>
</tbody>
</table>
4. **Priority-directed versus comprehensive surveillance**

1. Priority-directed (also called targeted or focused) surveillance
   - Objectives for surveillance are defined
   - Focus is on specific events, processes, organisms, and/or patient populations

2. Comprehensive surveillance
   - Continuous monitoring of all patients for all events and/or processes
   - Highly personnel resource intensive if done manually

<table>
<thead>
<tr>
<th></th>
<th><strong>Targeted Surveillance</strong></th>
<th><strong>Comprehensive Surveillance</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Focus</strong></td>
<td>Focus on important HAI (e.g. device-associated), locations (e.g. ICUs), and population (e.g. dialysis patients)</td>
<td>Covers all HAIs in all hospital locations and populations</td>
</tr>
<tr>
<td><strong>Weight of problems</strong></td>
<td>Weight of problems is respected. Priority &amp; objective directed</td>
<td>Equal weights for different problems</td>
</tr>
<tr>
<td><strong>Annual risk assessment</strong></td>
<td>Preceded by annual risk assessment and plan</td>
<td>No need for annual risk assessment and plan</td>
</tr>
<tr>
<td><strong>Implementation</strong></td>
<td>Usually feasible &amp; less labor intensive</td>
<td>Usually unfeasible &amp; more labor intensive</td>
</tr>
<tr>
<td><strong>Effectiveness</strong></td>
<td>More cost-effective</td>
<td>Less cost-effective</td>
</tr>
</tbody>
</table>
5. **Risk-adjusted rates versus crude rates surveillance**

1. **Risk-adjusted rates**

   - Rates are controlled for variations in the distribution of major risk factors associated with an event’s occurrence
   - Such rates allow inter- and intra-facility rate comparisons
   - Common methods used for risk-adjustment in HAI surveillance
     - Stratification by location in surveillance of device associated infections
     - Stratification by surgery type in SSI surveillance
     - Stratification by risk index category in SSI surveillance
     - Stratification by birth weight group in neonatal CALBSI and VAP
     - Stratification by type of central line in CLABSI in specialty care areas
     - Standardized infection ratio

2. **Crude rates**

   - Rates assume equal distribution of risk factors for all events
   - Such rates cannot be used for inter-facility comparisons

<table>
<thead>
<tr>
<th></th>
<th><strong>Adjusted rates</strong></th>
<th><strong>Crude rate</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Risk factor assumptions</strong></td>
<td>Rates are controlled for variations in the distribution of major risk factor associated with an event’s occurrence</td>
<td>Rates assume equal distribution of risk factors for all events</td>
</tr>
<tr>
<td><strong>Credibility</strong></td>
<td>Useful for benchmarking</td>
<td>Benchmarking may be misleading</td>
</tr>
<tr>
<td><strong>Example</strong></td>
<td>SIR for SSI for patients in surgical ward</td>
<td>SSI rates in all patients in surgical ward</td>
</tr>
</tbody>
</table>
4. Surveyor competencies

Competency definition (European CDC):

- The term competency is defined as: ‘the proven ability to use knowledge, skills and personal, social and/or methodological abilities, in work or study situations and in professional and personal development.

Competency classification (European CDC):

- Core competencies are classified in areas and domains, and proposed separately for the introductory level and for the expert level.
- The levels are defined as follows:
  - Introductory level (junior specialist): newly appointed infection control and hospital hygiene staff member with little or no previous experience.
  - Expert level (senior specialist): infection control and hospital hygiene professionals who are confident and experienced; who use reasoning, critical thinking, reflection and analysis to inform his/her assessment and decision-making; and are able to develop and implement new solutions to problems.

Competency classification (APIC):

Novice ICP:

- Has very limited knowledge, skills, experience, and basis in which to have situational awareness in infection prevention and control and epidemiology.
- Must rely on rules and concepts to guide their practice and begin to develop their knowledge/skills in the core competencies.

Proficient ICP:

- Can demonstrate proficient knowledge of the core competencies through successfully achieving the CIC® credential.
- Can apply the core competencies independently and deepens their knowledge and application of the future-oriented competency domains.
- Able to use past experiences to shape future thinking about a situation.
Expert ICP:

- Consistently and reliably demonstrates professional expertise (and at times very advanced levels of mastery) in the IPC core competencies
- Shares their knowledge and skills through mentoring, research, publication, collaboration, leadership, and educating other IPs
- Able to analyze more rapidly than any other stage and guide future decisions based on experience and perceptual acuity to achieve defined outcomes

List of core competencies for infection control practitioners (European CDC)

<table>
<thead>
<tr>
<th>Area</th>
<th>Domain</th>
</tr>
</thead>
</table>
| 1. Program management                     | • Elaborating and advocating an infection control program  
                                           | • Management of an infection control program, work plan and projects                                                                 |
| 2. Quality improvement                    | • Contributing to quality management  
                                           | • Contributing to risk management  
                                           | • Performing audits of professional practices and evaluating performance  
                                           | • Infection control training of employees  
                                           | • Contributing to research                                                                                                       |
| 3. Surveillance and investigation of HAI   | • Designing a surveillance system  
                                           | • Managing (implementation, follow up, evaluation) a surveillance system  
                                           | • Identifying, investigating and managing outbreaks                                                                 |
| 4. Infection control activities            | • Elaborating infection control interventions  
                                           | • Implementing infection control healthcare procedures  
                                           | • Contributing to reducing antimicrobial resistance  
                                           | • Advising appropriate laboratory testing and use of laboratory data  
                                           | • Decontamination and sterilization of medical devices  
                                           | • Controlling environmental sources of infections                                                                                   |
Details of surveillance competencies for introductory level (European CDC)

1. Designing a surveillance System
   - Advocate HAI surveillance activities and gather the opinions of appropriate professionals in order to rank priorities and formulate objectives
   - Formulate the scope, methodology and practical organization of the HAI surveillance system based on the population served, services provided and professional involvement in order to meet the objectives
   - Select and define appropriate indicators
   - Gather specific data from the laboratory and pharmacy departments for further analysis
   - Identify national and international recommendations, regulations and standard definitions to design HAI surveillance activities, ensuring all the while the need for consistency in applying definitions
   - Support the development of the healthcare organization’s information systems (including patient and laboratory systems) to meet surveillance needs
   - Contribute to the organization of collaborative organized networks
   - Elaborate mechanisms for timely data feedback and ensure that prompt and responsive mechanisms for reporting and feedback are included in the system

2. Managing (implementation, follow up, evaluation) a surveillance system
   - Contribute to the implementation of HAI surveillance system
   - Design and develop systems for effective HAI data collection according to defined methodology
   - Participate in preparation of HAI surveillance data for analysis
   - Identify, and communicate with the healthcare organization or public health body if additional epidemiologic investigations (case-control studies, cohort studies, trials) and outbreak investigations are required
   - Contribute to the production of periodic structured reports of surveillance data
   - Regularly review the risks, needs and priorities in order to adjust surveillance targets and objectives
   - Prepare data for the periodic evaluation of the effectiveness of the HAI surveillance system
   - Ensure that reporting and feedback tools are efficiently used to communicate adequately in different contexts (scientific, professional, media, etc.)
   - Use feedback tools effectively
3. **Identifying, investigating and managing outbreaks**

- Identify clusters of HAIs (or other unusual events) through contacts with clinical units and laboratories, through alerts or through systematic analysis of microbiological laboratory testing
- Manage an outbreak of infections at healthcare organization or community level
- Carry out descriptive and analytic investigations of the outbreak
- Select appropriate methods of molecular typing and interpret microbiological results in close collaboration with clinical/reference microbiology laboratories
- Formulate and implement a suitable strategy for identifying and communicating internally and externally with concerned actors, including those in primary, hospital and long-term care
- Interpret findings and report them to relevant people by using appropriate means and seek the relevant internal and external personnel advice, including advice from the public health sector
- Use lessons learned from outbreak investigations to inform quality improvement measures
Details of surveillance competencies for expert level (European CDC)

1. Designing a surveillance System
   - Advocate HAI surveillance activities and gather the opinions of appropriate professionals in order to rank priorities and formulate objectives
   - Formulate the scope, methodology and practical organization of the HAI surveillance system based on the population served, services provided and professional involvement in order to meet the objectives
   - Select and define appropriate indicators
   - Develop functional links with the laboratory and pharmacy departments for periodically reviewing laboratory and antimicrobial consumption data
   - Identify national and international recommendations, regulations and standard definitions to design HAI surveillance activities, ensuring all the while the need for consistency in applying definitions
   - Support the development of the healthcare organization’s information systems (including patient and laboratory systems) to meet surveillance needs
   - Identify the benefits of collaborative organized networks (local, regional and national) and take steps to promote these networks
   - Elaborate mechanisms for timely data feedback and ensure that prompt and responsive mechanisms for reporting and feedback are included in the system

2. Managing (implementation, follow up, evaluation) a surveillance system
   - Implement the HAI surveillance system (pilot testing, implementation, kick off, commissioning and evaluation) according to the organization’s priorities and objectives
   - Design and develop systems for effective HAI data collection according to defined methodology
   - Analyze HAI data using appropriate epidemiological methods, measures and tests, seeking the assistance of biostatisticians and other experts when necessary
   - Identify, and communicate with, the healthcare organization or public health body if additional epidemiologic investigations (case-control studies, cohort studies, trials) and outbreak investigations are required
   - Produce periodic structured reports to interpret significant findings and learning, taking into account the target readership
   - Regularly review the risks, needs and priorities in order to adjust surveillance targets and objectives
• Periodically evaluate the effectiveness of the HAI surveillance system
• Ensure that reporting and feedback tools are efficiently used to communicate adequately in different contexts (scientific, professional, media, etc.)
• Use feedback tools effectively

3. Identifying, investigating and managing outbreaks

• Identify clusters of HAIs (or other unusual events) through contacts with clinical units and laboratories, through alerts or through systematic analysis of microbiological laboratory testing
• Manage an outbreak of infections at healthcare organization or community level
• Carry out descriptive and analytic investigations of the outbreak
• Select appropriate methods of molecular typing and interpret microbiological results in close collaboration with clinical/reference microbiology laboratories
• Formulate and implement a suitable strategy for identifying and communicating internally and externally with concerned actors, including those in primary, hospital and long-term care
• Interpret findings and report them to relevant people by using appropriate means and seek the relevant internal and external personnel advice, including advice from the public health sector
• Use lessons learned from outbreak investigations to inform quality improvement measures
5. Requirements for Health Electronic Surveillance Network (HESN)

Health electronic surveillance network (HESN):

It is an integrated national electronic surveillance system that has several domains to uniformly monitor communicable diseases, disease epidemics, immunization, and HAIs across Saudi Arabia. It allows users at different hospitals to continually and uniformly report HAIs to the GDIPC, Riyadh, Saudi Arabia.

Requirements for HESN entries:

Each hospital is eligible for participate in HESN HAIs surveillance plan if the following criteria are met:

- The hospital has a bed capacity of 100 beds or above.
- Availability of full-time microbiologist and microbiology lab or have signed documented agreement with external or referral laboratory
- Availability of dedicated surveillance coordinator
- Availability of internet services and adequate number of personal computers
- For device-associated infections:
  - The hospital should have at least one critical care unit (ICUs, CCU, NICU, etc.)
- For surgical site infections:
  - The hospital should have a standard operation room and undergoing at least one recognized surgery
- For dialysis event:
  - The hospital should have a dialysis center or unit serving hemodialysis outpatients
  - Units serving only inpatients do not meet the criteria
**HESN application:**

If the above criteria are met, the hospital should send a request to be approved by the GDIPC surveillance department. The request is filled electronically and includes the following information:

- Region
- Hospital name
- Total bed capacity
- Number of critical care units and number of beds in each one
- Surgical procedures chosen for SSI surveillance according to the protocol
- Name of the surveillance coordinators in the hospital and their contact information
- Other required information

**Creation of HESN users:**

Approved hospitals should apply for HESN user account issued by HESN for each ICP and surveillance coordinator. The HESN user account will allow them to do data entry and monitor surveillance data. Creating HESN user account require the following information:

- ICP or Coordinator name
- Mobile number
- MOH E-mail
- Hospital name and workplace
6. Surveillance roles and responsibilities

HAI surveillance process:

- Data collection
  (Based on active, patient based, prospective & targeted surveillance methodology)
- Data consolidation / data entry using HESN
- Data analysis & interpretation - benchmarking
- Data dissemination / feedback to all stakeholders *(HAI report)*
- Corrective interventions / improvement projects
Role of IC coordinator in HAI surveillance activities (Hospital level):

- **Data Collection from Critical Care Units for Device & Non Device Associated HAI**
  - Patient information, Hospital / unit admission Dates, Devices information, Clinical findings ,Laboratory & Radiology reports etc
  - Collect denominator Data  - (Patient days, CL days, Ventilator days, Urinary Catheter Days) and numerator data (EVENTS)
  - Enter new data & update existing data in HESN e.g EOS,Bundle review,HAI event UDF etc

- **Ensure implementation of Care Bundles for Devices during daily rounds**
  - (Central Line Bundle, Urinary Catheter Bundle, Ventilator Bundle)
  - Collect Bundles data & enter in HESN at least once per week

- **Data Collection from Targeted Surgical Units (targeted surgeries) for Procedure Associated HAI**
  - Patient information, hospital admission Date, Procedure Date, Procedure information, wound class, ASA score, Clinical findings ,Laboratory & Radiology reports etc
  - Enter all relevant Data in HESN

- **Ensure implementation of Surgical Bundle**
  - (Collect SSI Bundle data & enter in HESN for targeted Surgical Procedure/s)

- **Conduct Post Discharge SSI Surveillance (30/90 days)**
  - Collect operative data from surgical units, Surgical OPDs , ER etc for any SSI event using surgical operative procedure form

- **Identify HAIs using CDC - NHSN Protocols by correlating & analyzing all data collected for devices & Procedures (clinical information, culture reports, radiology findings etc)**
  - Enter identified events (CLABSI /BSI,CAUTI/UTI,VAP/VAE/Pneumonia, & SSI) in HESN by using relevant UDFs

- **Review Data Quality Dashboards in HESN WebPortal & Fix errors**
  - (Daily Check HESN webportal for data errors - contact HESN support for unresolved issues)

- **Send Surveillance Validation Report to Regional Coordinators**
  - (On or before 5th of every month using GDIPC Surveillance Validation form)
Role of regional coordinators in HAI surveillance activities (Regional level):

Data Quality Monitoring
(Review data quality dashboard in HESN Webportal (At least weekly)

Follow up with hospitals to correct all identified errors
Send Weekly Data Quality Monitoring Tracker to alert ICPs - (Use attached template)

Data Review Using HESN Webportal
Review denominator data, Numerator data, Bundle compliance data & Patients Under Surveillance to ensure completeness and accuracy of data

Surveillance Data Validation Reports Tracking
( Follow up with hospitals for timely submission of Monthly validation reports

Surveillance Data Validation
( Review and compare Manual and HESN data received from hospitals to ensure data is valid

Use Automated Surveillance Validation Tool (SVT)
( check if difference is within 5% margin of difference

Fill GOOGLE FORM for SVT of each hospital and send to GDIPC
(On or before the 10th day of the each month

Analyse HAI data using HESN webportal and generate HAI report
(at least Biannual)

Share HAI report with all stakeholders
(GDIPC, Regional Leaders, Hospital directors etc)

Follow up with hospitals with high infection rates
(Based on analysis of cumulative data in each quarter e.g Jan - Mar 2021) - Ask for Corrective Action Plan

Conduct and supervise online HAI Surveillance Training for all hospitals
(Cover all Surveillance Modules at least once per year)
Role of GDIPC in HAI surveillance activities (GDIPC - MOH level):

<table>
<thead>
<tr>
<th>Role of GDIPC in HAI surveillance activities (GDIPC - MOH level)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Regional Data Quality Monitoring</strong></td>
</tr>
<tr>
<td>(Review data quality dashborads in HESN Webportal (At least weekly))</td>
</tr>
<tr>
<td><strong>Follow up with Regional Coordinators for data Quality Issues</strong></td>
</tr>
<tr>
<td>(At least monthly to alert regional coordinators)</td>
</tr>
<tr>
<td><strong>Regional Data Review Using HESN Webportal</strong></td>
</tr>
<tr>
<td>Review denominator data, Numerator data, Bundle compliance data &amp; Patients Under Surveillance to ensure completeness and accuracy of data</td>
</tr>
<tr>
<td><strong>Surveillance Data Validation Reports Tracking</strong></td>
</tr>
<tr>
<td>(Follow up with regions for on time submission of Monthly validation reports)</td>
</tr>
<tr>
<td><strong>Surveillance Monthly Evaluation (SME)</strong></td>
</tr>
<tr>
<td>(Review Regional SVTs &amp; Generate Surveillance Monthly Evaluation report)</td>
</tr>
<tr>
<td><strong>Share Surveillance Monthly Evaluation Report with all stakeholders</strong></td>
</tr>
<tr>
<td>(GDIPC Leaders, Regional leaders, Regional Surveillance Coordinators etc)</td>
</tr>
<tr>
<td><strong>Analyse HAI data using HESN webportal and generate HAI report</strong></td>
</tr>
<tr>
<td>(Bi annually, Annually)</td>
</tr>
<tr>
<td><strong>Share Annual HAI Report with all stakeholders</strong></td>
</tr>
<tr>
<td>(GDIPC Leaders, Regional Leaders, Regional Surveillance Coordinators etc)</td>
</tr>
<tr>
<td><strong>Follow up with Regions with high infection rates</strong></td>
</tr>
<tr>
<td>(Based on analysis of cumulative data in each quarter e.g Jan - Mar 2021) - Review Corrective Action Plans</td>
</tr>
<tr>
<td><strong>Conduct online HAI Surveillance Training for all Regions</strong></td>
</tr>
<tr>
<td>(To cover all Surveillance Modules at least once per year)</td>
</tr>
</tbody>
</table>

MOH Surveillance Manual

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7. Surveillance plan and risk assessment

Infection control risk assessment:

Infection control risk assessment is a coordinated activity to identify the risks for acquiring and transmitting infections based on the patient population served, the types of services provided, and the analysis of surveillance data.

Purpose of infection control risk assessment:

1. Evaluation of potential risk for infections, contamination and exposures
   - Based on known risk, historical data and reports in literature
2. Evaluation of harm
   - Life threatening, loss of function, loss of community trust, loss of organization good will, financial threat, legal and/or regulatory issues
3. Evaluation of organization’s preparedness
   - To eliminate or mitigate the harm or risk of harm

Components of infection control risk assessment:

1. **Probability of occurrence of the event/condition**: based on known risks, historical data & reports in literature

<table>
<thead>
<tr>
<th>Rate</th>
<th>Probability of occurrence</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Never</td>
<td>No possibility to occur</td>
</tr>
<tr>
<td>1</td>
<td>Rare</td>
<td>Risk is not expected to occur</td>
</tr>
<tr>
<td>2</td>
<td>Maybe</td>
<td>Occur infrequently but remain a possibility, few times per year or per activity</td>
</tr>
<tr>
<td>3</td>
<td>Likely</td>
<td>Risk is not a persistent issue, once several times per year month or per activity</td>
</tr>
<tr>
<td>4</td>
<td>Expected</td>
<td>Occur frequently, pose a constant threat once or several times per day</td>
</tr>
</tbody>
</table>
2. Impact of the event/condition at different levels

- Threat to life and or health
- Disruption of services
- Loss of function
- Prolonged length of stay
- Financial impact
- Legal issues
- Regulatory/accrediting/organizational issues

<table>
<thead>
<tr>
<th>Rate</th>
<th>Consequence of occurrence</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Minimal clinical</td>
<td>No real risk or harm</td>
</tr>
<tr>
<td>2</td>
<td>Moderate clinical</td>
<td>Minimal real risk or harm</td>
</tr>
<tr>
<td>3</td>
<td>Permanent harm</td>
<td>Prolonged length of stay</td>
</tr>
<tr>
<td>4</td>
<td>Serious Loss</td>
<td>Permanent injury</td>
</tr>
<tr>
<td>5</td>
<td>Life threatening</td>
<td>May cause death</td>
</tr>
</tbody>
</table>
3. Current preparedness of the system

- Status of current plans and implementation
- Training status
- Availability of backup systems
- Community/Public Health resources

<table>
<thead>
<tr>
<th>Rate</th>
<th>Preparedness level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Solid</td>
<td>Risk would be avoided if plan of actions took place</td>
</tr>
<tr>
<td>2</td>
<td>Good</td>
<td>Consequences are minimized by the plan of actions</td>
</tr>
<tr>
<td>3</td>
<td>Fair</td>
<td>Plan of actions needs to be modified ASAP</td>
</tr>
<tr>
<td>4</td>
<td>Poor</td>
<td>Plan of action not enough</td>
</tr>
<tr>
<td>5</td>
<td>None</td>
<td>No plan of Action</td>
</tr>
</tbody>
</table>
Example of infection control risk assessment:

<table>
<thead>
<tr>
<th>Event or Condition</th>
<th>What is probability of event/condition occurring?</th>
<th>What is potential impact of event/condition on patients and staff?</th>
<th>What is organization’s preparedness to deal with this event/condition?</th>
<th>Numerical risk level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level</td>
<td>Expected</td>
<td>Likely</td>
<td>Maybe</td>
<td>Rare</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>C-diff infection</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CABG SSI</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Multiply the ratings for each risk in the area of probability, impact and current systems
  - C-diff infection risk: 4x3x3=36
  - CABG SSI risk: 4x4x4=64

- Sort the total score in descending order
- Determine a cut off value below which no action is necessary
- Review with organization for acceptance of priorities
8. Point prevalence survey

Point prevalence survey (PPS) of healthcare-associated infections (HAIs):

- PPS is a count of the number of patients with a particular condition (in this case a HAIs) at a particular time (in this case one day), as a proportion of the total number of patients who are hospitalized at that particular time.

- PPS only counts the condition if present at the time (on the day) of the survey, but does not count if it is present at other times during the patient stay in the hospital.

Objectives of PPS:

- To estimate the overall burden of HAIs
- To describe specific types of HAIs and their causative organisms and associated antimicrobial use
- To set priorities for future surveillance as regards types of HAIs and the units surveyed
- To describe geographic variations in the above outcomes
- To increase the surveillance skills of ICPs
- Data for post-graduate students and publications

Duration/date of PPS:

- One day
- Choose a day with no much staff leaves
- Avoid days with more scheduled procedures/admissions than usual (?Sunday)
- The total period for data collection for all wards of a single hospital should not exceed one week.
**Steps of PPS:**

1. Creating data collection form
2. Training of ICPs on PPS methodology
3. Training of ICPs on HAI definitions
4. Data collection during the day of the PPS and afterwards if needed
5. Data validation by reviewing positive cases with ID physicians
6. Data entry of validated cases
7. Analysis and report writing

**Patients’ selection criteria in PPS:**

- Inpatients of any age are eligible for inclusion as long as he/she is admitted to the ward/unit before or at 8 a.m. and not discharged from the ward at the time of the survey
- Patients in outpatient clinics, emergency departments (<1 day), same day surgery, and outpatient dialysis patients are excluded

**Outcome of PPS:**

- The outcome is active HAI infections
- HAI infections: Infections that met NHSN surveillance definition criteria, with onset ≥3 days from admission
- Active infections: Infections that met NHSN surveillance definition criteria, with
  - Signs or symptoms of infection present on the survey date or
  - Antimicrobial therapy for an HAI is still being given on the survey date
- Note that all types of HAI infections should be included not only the ones that we regularly do surveillance for as CLABSI or CAUTI
### Types of HAIs included in PPS:

<table>
<thead>
<tr>
<th>Category</th>
<th>Types</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pneumonia</strong></td>
<td>□ VAP □ PVAP of VAE □ Other HAI pneumonia □ CAP</td>
</tr>
<tr>
<td><strong>Blood stream infection</strong></td>
<td>□ CLABSI □ Secondary BSI □ Dialysis □ Others</td>
</tr>
<tr>
<td><strong>Urinary tract infection</strong></td>
<td>□ CAUTI □ Others</td>
</tr>
<tr>
<td><strong>Surgical site infection</strong></td>
<td>□ Superficial □ Deep □ Organ Surgery: .....................................</td>
</tr>
<tr>
<td><strong>Lower respiratory system infection, other than pneumonia</strong></td>
<td>....................................................................................................</td>
</tr>
<tr>
<td><strong>Gastrointestinal system infection</strong></td>
<td>□ Clostridium difficile Infection □ Intra-abdominal infection □ ..........</td>
</tr>
<tr>
<td><strong>Skin and soft tissue infection</strong></td>
<td>□ Burn □ Decubitus ulcer □ Skin/wound □ Breast □ ...........................</td>
</tr>
<tr>
<td><strong>Reproductive tract infection</strong></td>
<td>....................................................................................................</td>
</tr>
<tr>
<td><strong>Bone and joint infection</strong></td>
<td>....................................................................................................</td>
</tr>
<tr>
<td><strong>Central nervous system infection</strong></td>
<td>....................................................................................................</td>
</tr>
<tr>
<td><strong>Cardiovascular system infection</strong></td>
<td>....................................................................................................</td>
</tr>
<tr>
<td><strong>Upper respiratory tract infection (URI)</strong></td>
<td>....................................................................................................</td>
</tr>
<tr>
<td><strong>Eye, ENT, or mouth infection other than URI</strong></td>
<td>....................................................................................................</td>
</tr>
<tr>
<td><strong>Others</strong></td>
<td>....................................................................................................</td>
</tr>
</tbody>
</table>
Exceptions of the ≥3 days rule in HAI:

- Onset ≤2 days BUT the patient was readmitted after discharge within the last 2 days
- Onset ≤2 days BUT the patient was transferred from another hospital
- Onset ≤2 days BUT the patient has *Clostridium difficile* infection where specimen was collected within 4 weeks from last discharge (community-onset healthcare-associated CDI)
- Onset ≤2 days BUT the patient has surgical site infection occurring after 30/90 days from a relevant surgery

Recurrent HAIs in PPS:

- They are collected in PPS as long as meeting the definition of active infection

Missing data at the date of PPS:

- We should not go prospectively after them
- We should go retrospectively for up to 7 days from the date if he survey
- Results of tests/examinations that are not yet available on the survey date should neither be completed after the survey date nor taken into account when establishing whether the case definition criteria are fulfilled.
- This will probably cause some actual cases of HAI to be discarded, but this can be seen as compensation for the (potentially long) retrospective period preceding the start of the treatment when no more signs or symptoms are present on the survey date.
Surveillance is planned based on location and duration

**Types of patient care hospital locations**

I- **Inpatient locations**: Locations serving patients whose date of admission to the healthcare facility and the date of discharge are different calendar days.

1. **Intensive care units (ICU)**: A nursing care area that provides intensive observation, diagnosis, and therapeutic procedures for adults (Adult ICU), children (Pediatric ICU, PICU), or neonates (Neonatal ICU, NICU) who are critically ill. The critical care could be surgical, medical, trauma, respiratory, neurologic...etc. An ICU excludes nursing areas that provide step-down, intermediate care or telemetry only.

2. **Specialty care area (SCA)**: Hospital location which includes one of the types below: Bone marrow transplant, solid organ transplant, inpatient acute dialysis, hematology/oncology

3. **Other inpatient**: including any inpatient locations which is not ICU or SCA e.g. inpatient medical, surgical, or other wards, step down units, or operating rooms (OR). OR may include an operating room, C-Section room, interventional radiology room or a cardiac catheterization lab, or Post Anesthesia Care Unit

II- **Outpatient locations**: Locations serving patients whose date of admission to the healthcare facility and the date of discharge are the same calendar day. These may include any outpatient clinic, Outpatient Emergency Department, or same day surgery and its 24-hour observation area

**Non-patient care locations**

- Community locations: e.g. Home care
- Non-patient care hospital locations: e.g. Laboratory or laundry.
Location is mapped according to acuity level and type of service

80% rule for determining the acuity level of the unit

- The acuity level of unit is determined by the type of care served in that unit.
- That is, if at least 80% of patients are of the same acuity level (for example 80% acute care and 20% non-acute care), that unit is mapped as that acuity level (for example acute care unit). The choice will be based on the list of acuity levels of hospital locations (shown below)
- If the 80% rule does not hold, try splitting the unit into 2 virtual locations. The use of virtual locations is recommended only for units that are geographically split by patient service or those in which beds are designated by service (for example neurology patients are housed in beds 1 thru 10 and the neurosurgery patients are housed in beds 11 thru 20).
- If the 80% rule and virtual locations do not hold, map the unit as mixed acuity unit (comprised of patients with varying levels of acuity)

List of acuity levels of hospital locations:

- Adult critical care units
- Pediatric critical care units
- Neonatal critical care units
- Specialty care areas (SCA)/oncology
- Adult wards
- Pediatric wards
- Neonatal wards
- Step down units
- Mixed acuity units
- Operating rooms
- Chronic care
- Long term acute care
- Rehabilitation
- Outpatient (acute) locations
- Clinic (non-acute) settings
Operating Rooms (OR)

- A patient care area that meets the American Institute of Architects (AIA) criteria for an operating room. This may include an operating room, C-Section room, interventional radiology room, or a cardiac catheterization lab.

- Could be inpatient or outpatient

80% rule for determining the type of unit

- The type of unit is determined by the kind of patients cared for in that unit.

- That is, if at least 80% of patients are of a certain type (for example patients with trauma), that unit is mapped as that type of these patients (for example trauma ICU).

- If the 80% rule does not hold, try splitting the unit into 2 virtual locations. The use of virtual locations is recommended only for units that are geographically split by patient service or those in which beds are designated by service (for example neurology patients are housed in beds 1 thru 10 and the neurosurgery patients are housed in beds 11 thru 20).

- If the 80% rule and virtual locations do not hold, you have two scenarios:
  - When a unit houses roughly equal populations (for example 50/50 or 60/40 of medical and surgical patients), that unit is mapped as combined patient unit (for example medical/ surgical ICU).
  - When a unit houses mixed populations but one of them >60% (for example 70% medical and 30% surgical), that unit is mapped as that type of the patient majority (for example medical ICU).
### Locations involved in surveillance

<table>
<thead>
<tr>
<th>Locations</th>
<th>Adult ICU</th>
<th>Pediatric ICU</th>
<th>Neonatal ICU</th>
<th>SCA*</th>
<th>Other wards*</th>
<th>Out-patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLABSI &amp; bundle</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>VAP &amp; bundle</td>
<td>Yes**</td>
<td>Yes</td>
<td>Yes</td>
<td>Pediatric only</td>
<td>Pediatric only</td>
<td>No</td>
</tr>
<tr>
<td>VAE &amp; bundle</td>
<td>Yes</td>
<td>Yes***</td>
<td>Yes***</td>
<td>Adult only</td>
<td>Adult only</td>
<td>No</td>
</tr>
<tr>
<td>CAUTI &amp; bundle</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>DE &amp; bundle</td>
<td>No</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>SSI &amp; bundle</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>MDRO &amp; bundle</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

*In the future ** off plan only for internal benchmarking *** will be implemented in 2021

### Surveillance duration:

- The least time period to do surveillance is one month (to allow for denominator collection)
- Usually one quarter (3 months) are enough to give evidence about the rates of infection
- In bigger units, shorter duration can be tried and in smaller units longer duration can be tried
10. Healthcare-associated infection (HAI)

Infection definition:

- The successful transmission of a microorganism to the host with subsequent multiplication, colonization, and invasion.
- Infection may be clinical or subclinical and may not produce identifiable disease.
- However, it is usually accompanied by measurable host response(s), either through the appearance of specific antibodies or through cell-mediated reaction(s) (e.g., positive tuberculin test results).

Colonization definition:

- The multiplication of a microorganism at a body site or sites without any clinical signs and symptoms or detected immune reaction in the host at the time that the microorganism is isolated.
- Colonization may or may not be a precursor of infection.
- Colonization may be a form of carriage and is a potential source of transmission.

Timelines for Infection and Disease

<table>
<thead>
<tr>
<th>Infection status</th>
<th>Latent period: time interval from exposure to infection to infectiousness</th>
<th>Infectious period: time during which the host is infectious</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disease status</td>
<td>Incubation period: time from exposure to infection to the development of symptomatic disease</td>
<td>Symptomatic period: period in which symptoms of the disease are present.</td>
</tr>
</tbody>
</table>
Mode of transmission of infection:

- It is the method of transfer by which the organism moves from host to susceptible individual
- Transmission could be direct or indirect

1- Direct transmission (person-to-person):

- Droplet contact: coughing or sneezing (1 meter)
- Direct physical contact to infected person secretions, blood, stool/urine (This method includes sexual contact)
- Trans-placental infection

2- Indirect transmission (person-environment-person):

- Airborne transmission - if the microorganism can remain in the air for long periods (TB, varicella, measles)
- Indirect contact - usually by touching soil contamination or a contaminated surface
- Fecal-oral transmission - usually from contaminated food or water sources
- Vector borne transmission - carried by insects or other animals
- Inoculation (devices)
**HAI definition:**

- A localized or systemic condition resulting from an adverse reaction to the presence of an infectious agent(s) or its toxin(s)
- Not present or incubating on admission to the facility
- An infection is considered HAI if the date of event of the NHSN site-specific infection criterion occurs on or after the 3rd calendar day of admission to an inpatient location where day of admission is calendar day 1
- Infections occurring in newborns with date of event on hospital day 1 or day 2 are considered POA. Those with date of event on day 3 or later are HAI. This includes infections acquired through placenta (for example but not limited to herpes simplex, toxoplasmosis, rubella, cytomegalovirus, or syphilis) or as a result from passage through the birth canal.
- Reactivation of a latent infection (for example but not limited to herpes, shingles, syphilis, or tuberculosis) is not considered to be an HAI

**HAI classification:**

- Device-associated infections
- Procedure-associated

**Device-associated infections:**

- Central line associated blood stream infection (CLABSI)
- Catheter associated urinary tract infection (CAUTI)
- Ventilator associated pneumonia (VAP)
- Ventilator associated events (VAE)
- Dialysis events surveillance (DE)

**Procedure-associated:**

- Surgical Site Infection (SSI)
**Surveillance versus clinical definitions**

Surveillance definition is different from clinical definition and can not be unified

<table>
<thead>
<tr>
<th></th>
<th>Clinical Criteria</th>
<th>Surveillance Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Use</strong></td>
<td>Clinical care</td>
<td>Surveillance</td>
</tr>
<tr>
<td><strong>Focus</strong></td>
<td>Detection of infection in individual patients</td>
<td>Detection of infection in patient population</td>
</tr>
<tr>
<td><strong>Purpose</strong></td>
<td>To provide diagnosis and treatment for cared patients</td>
<td>To provide trend for risk assessment, prevention, and policy change</td>
</tr>
<tr>
<td><strong>Clinical judgment</strong></td>
<td>Important and is part of diagnosis</td>
<td>Absent and discouraged</td>
</tr>
</tbody>
</table>
11. Infection pathogens

HAIs are caused by bacterial, fungal, and viral pathogens. The focus here will be on bacterial and fungal pathogens.

**Difference between Gram-Positive and Gram-Negative Bacteria**

<table>
<thead>
<tr>
<th></th>
<th>Gram-positive bacteria</th>
<th>Gram-negative bacteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gram stain</td>
<td>Appear as purple-colored when examined under the microscope</td>
<td>Appear as pink-colored when examined under the microscope</td>
</tr>
<tr>
<td>Cell wall</td>
<td>Composed of thick layers peptidoglycan</td>
<td>Composed of thin layers of peptidoglycan</td>
</tr>
<tr>
<td>Toxins</td>
<td>Produce exotoxins</td>
<td>Produce endotoxins</td>
</tr>
<tr>
<td>Examples pathogenic</td>
<td><strong>Pathogenic:</strong> Staphylococcus aureus</td>
<td><strong>Pathogenic:</strong> Acinetobacter spp.</td>
</tr>
<tr>
<td></td>
<td>• Methicillin sensitive staphylococcus aureus</td>
<td>• Bacteroides spp.</td>
</tr>
<tr>
<td></td>
<td>• Enterococcus spp.</td>
<td>• Citrobacter spp.</td>
</tr>
<tr>
<td></td>
<td>• Clostridium</td>
<td>• Enterobacter spp.</td>
</tr>
<tr>
<td></td>
<td>• Streptococcus pneumoniae</td>
<td>• Escherichia coli</td>
</tr>
<tr>
<td></td>
<td>• Streptococcus spp.</td>
<td>• Fusobacterium spp.</td>
</tr>
<tr>
<td></td>
<td><strong>Commensals:</strong> Coagulase negative staphylococci</td>
<td>• Haemophilus spp.</td>
</tr>
<tr>
<td></td>
<td>• Streptococcus viridans</td>
<td>• Klebsiella spp.</td>
</tr>
<tr>
<td></td>
<td>• Diphtheroids</td>
<td>• Legionella spp.</td>
</tr>
<tr>
<td></td>
<td>• Corynebacterium spp.</td>
<td>• Peptostreptococcus spp.</td>
</tr>
<tr>
<td></td>
<td>• Bacillus spp.</td>
<td>• Prevotella spp.</td>
</tr>
<tr>
<td></td>
<td>• Propionibacterium spp.</td>
<td>• Proteus spp.</td>
</tr>
<tr>
<td></td>
<td>• Aerococcus spp.</td>
<td>• Providencia</td>
</tr>
<tr>
<td></td>
<td>• Micrococcus spp.</td>
<td>• Pseudomonas aeruginosa</td>
</tr>
<tr>
<td></td>
<td>• Rhodococcus</td>
<td>• Serratia spp.</td>
</tr>
<tr>
<td></td>
<td><strong>Commensals:</strong> Coagulase negative staphylococci</td>
<td>• Stenotrophomonas maltophilia</td>
</tr>
<tr>
<td></td>
<td>• Streptococcus viridans</td>
<td>• Veillonella spp.</td>
</tr>
</tbody>
</table>
Most frequent bacterial pathogens causing HAI

The listed pathogens cause more than 97% of all HAI events

The pathogens were sorted in descending order according to frequency in causing HAI in NHSN reports

1- Escherichia coli
2- Staphylococcus aureus
3- Klebsiella (pneumoniae/oxytoca)
4- Pseudomonas aeruginosa
5- Enterococcus faecalis
6- Coagulase-negative staphylococci
7- Enterobacter
8- Enterococcus faecium
9- Proteus
10- Candida albicans
11- Other Enterococcus spp.
12- Bacteriodes
13- Viridans group streptococci
14- Other Candida spp.
15- Candida glabrata
16- Serratia
17- Citrobacter
18- Acinetobacter
19- Morganella
20- Group B streptococcus
21- Stenotrophomonas maltophilia
22- Yeast
23- Lactobacillus
24- Corynebacterium
25- Other Staphylococcus spp.
26- Gram-negative bacillus
27- Propionibacterium acnes
28- Diphtheroids
29- Providencia stuartii
30- Gram-positive coccus
31- Alpha-hemolytic streptococcus
32- Haemophilus influenzae
33- Streptococcus
34- Clostridium
35- Streptococcus pneumoniae
36- Peptostreptococcus
37- Clostridium perfringens
38- Prevotella
39- Streptococcus pyogenes
40- Prevotella bivia
41- Beta-hemolytic streptococcus
42- Finegoldia magna
43- Corynebacterium striatum
44- Gram-positive bacillus
45- Rothia mucilaginosa
46- Propionibacterium
c7- Bacillus
48- Burkholderia cepacia
49- Streptococcus, group C
50- Actinomyces
51- Clostridium ramosum
52- Anaerobe
53- Streptococcus, group G
54- Hafnia alvei
55- Pseudomonas putida
56- Pseudomonas fluorescens
57- Pseudomonas
Commensal organisms

All of the outer surfaces of the human body are covered with agents that normally do not harm and may, in fact, be beneficial. Those commensal organisms on the skin help to break down dying skin cells or to destroy debris secreted by the many minute glands and pores that open on the skin. Many of the organisms in the intestinal tract break down complex waste products into simple substances, and others help in the manufacture of chemical compounds that are essential to human life.

Skin commensals organisms (short list)

- Diphtheroids [Corynebacterium spp]
- Bacillus spp.
- Propionibacterium spp.
- Coagulase-negative Staphylococci [including S. epidermidis]
- Viridans group streptococci
- Aerococcus spp.
- Micrococcus spp.
- Rhodococcus
Intestinal pathogens (MBI pathogens short list)

- Bacteroides spp.
- Candida spp.
- Clostridium spp.
- Enterococcus spp.
- Fusobacterium spp.
- Peptostreptococcus spp.
- Prevotella spp.
- Veillonella spp.
- Enterobacteriaceae

Enterobacteriaceae (short list)

Enterobacteriaceae are a large family of different types of gram-negative, facultatively anaerobic, rod-shaped bacteria that do not form endospores. They include some of the normal inhabitants of the small and large gastrointestinal tracts (as their name said). They are common causes of HAIs and include

- Citrobacter
- Enterobacter
- Escherichia
- Klebsiella
- Proteus
- Providencia
- Salmonella
- Serratia
- Shigella
- Yersinia
Fungal pathogens (short list)

They can cause HAIs especially in immunocompromised or hospitalized patients with serious underlying diseases. They include the following groups:

1- Yeast
   - Candida:
     ✓ C. albicans
     ✓ C. glabrata
     ✓ C. parapsilosis
     ✓ C. tropicalis
     ✓ C. krusei
     ✓ C. auris
   - Cryptococcus:
     ✓ C. neoformans
     ✓ C. gattii
   - Other yeast:
     ✓ Pneumocystis
     ✓ Saccharomyces
     ✓ Trichosporon

2- Molds:
   - Aspergillus:
     ✓ A. fumigatus
     ✓ A. flavus
     ✓ A. niger
     ✓ A. terreus
• Mucorales:
  ✓ M. Rhizopus
  ✓ M. Mucor

• Other molds:
  ✓ Fusarium spp.
  ✓ Scedosporium spp.

**Dimorphic fungi (endemic mycoses):**
Specific fungal pathogens typically causing community-associated infections cannot be used to meet any HAI definition:

• Blastomyces
• Histoplasma
• Coccidioides
• Paracoccidioides
• Cryptococcus
• Pneumocystis.

**Viral pathogens (short list)**

• Influenza virus
• Respiratory syncytial virus
• Adenovirus
• Parainfluenza virus
• Rhinovirus
• Human metapneumovirus
• Coronavirus
12. Surveillance of device-associated HAI

Device-associated infections:

Device-associated infection is an infection in a patient with a device (e.g., ventilator, central line or foleys catheter) that was in place more than 2 calendar days before onset of infection.

- The date of device-associated HAI event is the date the first element used to meet the infection criterion occurs for the first time within the seven-day infection window period.
- If the device-associated HAI develops within 2 calendar days of discharge from a location with discharge day considered day 1, it is attributed to the discharging location.

Common Criteria for device-associated infections:

The common criteria shown below are applicable for surveillance of device-associated HAI with exception of VAE. Additionally, these criteria are not applicable to SSI and MDRO (LabID Events). The criteria included the following:

1. Infection Window Period for HAI:
   - It is the 7-days during which all site-specific infection criteria must be met.
   - It includes the day the first positive diagnostic test that is an element of the site-specific infection criterion, was obtained, the 3 calendar days before and the 3 calendar days after.

2. Date of HAI event:
   - It is the date the first element used to meet an NHSN site-specific infection criterion occurs for the first time within the seven-day infection window period.

3. Present on admission (POA):
   - An infection is considered POA if the date of event of the infection criterion occurs during:
     - Two calendar days before day of admission
     - First day of admission (day 1)
     - Day after admission (day 2)
   - Exceptions: SSI, LabID, CDI & MRSA bacteremia may occur after patient’s discharge from facility and be present upon readmission.
4. Healthcare-associated infection (HAI):
   - An infection is considered HAI if the date of event of the infection on or after the third day of admission of the patient considering the day of admission as day 1.
   - HAI is a localized or systemic condition resulting from an adverse reaction to the presence of an infectious agent(s) or its toxin(s) not present or incubating on admission to the facility.

5. Transfer Rule:
   - If all elements of an HAI were present within 2 calendar days of transfer from one inpatient location to another in the same facility (i.e., on the day of transfer or the next day), the HAI is attributed to the transferring location.
   - If all elements of an HAI were present within 2 calendar days of transfer from one inpatient facility to another, the HAI is attributed to the transferring facility.
   - However, infections cannot be attributed to a location where patients are not housed overnight (like an OR or ED). In this situation, the infection should be attributed to the next inpatient location.

6. Multiple Transfer:
   - If the patient has been transferred to more than one location on the date of an infection, or the day before, attribute the infection to the first location in which the patient was housed the day before the infection's date of event.

7. Repeat Infection Timeframe (RIT):
   - It is a 14-day timeframe during which no new infections of the same type are reported.
   - The date of event is Day 1 of the 14-day RIT.
   - Additional pathogens recovered during the RIT from the same type of infection are added to the event.
   - The RIT applies during a patient's single admission, including the day of discharge and the day after, keeping with the Transfer Rule.
   - An RIT does not carry over from one admission to another even if readmission is to the same facility.
8. Device removal and reinsertion:

- If a device (central line, urinary catheter or ventilator) was removed and reinserted before a full calendar day, then continue the day count.
- Therefore, if the patient is without a device (central line, urinary catheter or ventilator) for at least one full calendar day (NOT to be read as 24 hours), then start a new day count.

9. Secondary BSI Attribution Period:

- It is the period in which a positive blood culture must be collected to be considered as a secondary bloodstream infection to a primary site infection.
- This period includes the Infection Window Period combined with RIT.
- In case of device associated HAI: It is 14-17 days in length depending upon the date of event.
- In case of SSI: 17-day period that includes the date of SSI event, 3 days prior and 13 days after.

10. Pathogen Assignment Guidance:

- Additional pathogens recovered during the RIT from the same type of infection or during the secondary BSI attribution period are added to the event.
- Exception: Pathogens excluded from specific infection definitions (e.g., yeast in UTI, Enterococcus spp. in PNEU) are also excluded as pathogens for BSIs secondary to that type of infection.
- Secondary BSI pathogens may be assigned to more than one infection source at the same time.

11. Microbiologic testing:

- Organisms identified from a specimen by a culture or non-culture based microbiologic testing method is acceptable to meet the HAI definition.
- However, for the purpose of meeting the HAI definition culture or non-culture based microbiologic testing method must be performed for purposes of clinical diagnosis or treatment (e.g., not Active Surveillance Culture/Testing (ASC/AST)).
12. Excluded organisms:

- Specific fungal pathogens typically causing community-associated infections cannot be used to meet any HAI definition:
  - Blastomyces
  - Histoplasma
  - Coccidioides
  - Paracoccidioides
  - Cryptococcus
  - Pneumocystis.
12.1 Central line associated blood stream infection (CLABSI)

CLABSI:
- CLABSI is a primary bloodstream infection (BSI) in a patient who had a central line or umbilical catheter.
- The central line or umbilical catheter has to be in place for >2 days and in place at the date of event or the day before.
- Primary BSI is a laboratory-confirmed bloodstream infection (LCBI) that is not secondary to an infection meeting CDC/NHSN criteria at another body site.

Surveillance settings:
Surveillance can be done in any inpatient location where denominator data can be collected, this includes
- ICUs
- NICUs
- SCA
- Other inpatient locations
- Inpatients receiving dialysis are included in any CLABSI surveillance in the location in which they are housed, regardless of whether or not the central line is the only central line and only accessed for dialysis.

Surveillance methodology
- Active
- Patient based
- Prospective
- Priority-directed targeted
- Yield risk-adjusted incidence rates

Date of event (DOE):
It is the date when the FIRST element used to meet the CLABSI criterion occurs for the first time within the 7-day infection window period.
**Central line:**

It is an intravascular catheter that terminates at or close to the heart or in one of the great vessels which is used for infusion, withdrawal of blood, or hemodynamic monitoring. The following are considered great vessels for the purpose of CLABSI surveillance:

- Aorta.
- Pulmonary artery.
- Superior vena cava.
- Inferior vena cava.
- Brachiocephalic veins.
- Internal jugular veins.
- Subclavian veins.
- External iliac veins.
- Common iliac veins.
- Femoral veins.
- In neonates, the umbilical artery/vein.

**Notes about central line:**

- Neither the insertion site nor the type of device may be used to determine if a line qualifies as a central line.
- The device must terminate in one of the great vessels or in or near the heart, and be used for one of the purposes outlined above, to qualify as a central line.
- An introducer is considered an intravascular catheter, and depending on the location of its tip and use, may be a central line.
- Pacemaker wires and other non-lumened devices inserted into central blood vessels or the heart are not considered central lines, because fluids are not infused, pushed, nor withdrawn through such devices.
- The following devices are not considered central lines:
  - Extracorporeal membrane oxygenation (ECMO).
  - Femoral arterial catheters.
  - Intra-aortic balloon pump (IABP) devices.
  - Hemodialysis reliable outflow (HeRO) dialysis catheters.
✓ Impella heart devices.

- Infusion: The introduction of a solution through a blood vessel via a catheter lumen. This may include continuous infusions such as nutritional fluids or medications, or it may include intermittent infusions such as flushes, IV antimicrobial administration, or blood transfusion or hemodialysis.

**Types of central lines:**

- Temporary central line: A non-tunneled, non-implanted catheter.
- Permanent central line: Includes
  ✓ Tunneled catheters, including certain dialysis catheters.
  ✓ Implanted catheters (including ports).
- Umbilical catheter: A central vascular device inserted through the umbilical artery or vein in a neonate.

**Counting central line days**

- If a patient has more than one temporary central line on a given day, this is counted only as one central line day.
- If a patient has both a temporary and a permanent central line on the same day, the day is counted as one temporary central line day.
- If an infant has both an umbilical catheter and a non-umbilical central line, count as an umbilical catheter day only.

**Central line removal and reinsertion:**

- If central line was removed and reinserted before a full calendar day without a central line, then continue the day count.
- Therefore, if the patient is without a central line for at least one full calendar day (NOT to be read as 24 hours), then start a new day count.

<table>
<thead>
<tr>
<th>Hospital days</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central line days</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>Removal (4)</td>
<td>Re-insertion (5)</td>
<td>6</td>
<td>7</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hospital days</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central line days</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>Removal (4)</td>
<td>---</td>
<td>Re-insertion (1)</td>
<td>2</td>
</tr>
</tbody>
</table>
Location of attribution:

- The inpatient location where the patient was assigned on the date of the LCBI event, which is further defined as the date when the first element used to meet the LCBI criterion occurred.
- OR/Post Anesthesia Care Unit/Recovery Room/dialysis unit/ERs cannot be considered a location of attribution for BSI.

Transfer Rule:

- If the date of event for a CLABSI is the day of transfer or discharge, or the next day, the CLABSI is attributed to the transferring location.
- Receiving facilities should share information about such HAIs with the transferring facility to enable reporting.
- Example:
  - Patient with a central line in place in the SICU is transferred to the surgical ward. The day after transfer is the date of event for an LCBI. This is reported as a CLABSI for the SICU.
  - Patient with a central line in place is transferred from the medical ward to the coronary care ICU (CCU). An LCBI date of event is on day four in the CCU. The central line is still in place. This is reported as a CLABSI for the CCU because the date of event was not the date of transfer from the medical ward, or the next day.

Multiple Transfers:

- If the patient has been transferred to more than one location on the date of CLABSI, or the day before, attribute the CLABSI to the first location in which the patient was housed the day before the CLABSI’s date of event.

<table>
<thead>
<tr>
<th>Date</th>
<th>3/22</th>
<th>3/23</th>
<th>3/24</th>
</tr>
</thead>
<tbody>
<tr>
<td>Locations</td>
<td>Unit A</td>
<td>Unit A</td>
<td>Unit C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Unit B</td>
<td>Unit D</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Unit C</td>
<td></td>
</tr>
</tbody>
</table>

- CLABSI is attributed to Unit A since Unit A was the first location in which the patient was housed the day before the date of event.
### Laboratory-confirmed bloodstream infection (LCBI-1)

<table>
<thead>
<tr>
<th>Patient of <strong>any age</strong> has a <strong>recognized pathogen</strong> identified from <strong>one or more</strong> blood specimens by culture or non-culture based microbiologic testing method which is performed for purposes of clinical diagnosis or treatment.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AND</strong></td>
</tr>
<tr>
<td>Organism(s) identified in blood is not related to an infection at another site.</td>
</tr>
</tbody>
</table>

### Laboratory-confirmed bloodstream infection (LCBI-2)

<table>
<thead>
<tr>
<th>Patient of <strong>any age</strong> has at least one of the following <strong>signs or symptoms</strong>: fever (&gt;38.0°C), chills, or hypotension.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AND</strong></td>
</tr>
<tr>
<td>The same common <strong>commensal</strong> is identified from <strong>two or more</strong> blood specimens drawn on separate occasions, by culture or non-culture based microbiologic testing method which is performed for purposes of clinical diagnosis or treatment. Criterion elements must occur within the Infection Window Period</td>
</tr>
<tr>
<td><strong>AND</strong></td>
</tr>
<tr>
<td>Organism(s) identified from blood is not related to an infection at another site.</td>
</tr>
</tbody>
</table>

### Laboratory-confirmed bloodstream infection (LCBI-3)

<table>
<thead>
<tr>
<th>Patient ≤ 1 year of age has at least one of the following <strong>signs or symptoms</strong>: fever (&gt;38.0°C), hypothermia (&lt;36.0°C), apnea, or bradycardia.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AND</strong></td>
</tr>
<tr>
<td>The same common <strong>commensal</strong> is identified from <strong>two or more</strong> blood specimens drawn on separate occasions, by culture or non-culture based microbiologic testing method which is performed for purposes of clinical diagnosis or treatment. Criterion elements must occur within the Infection Window Period</td>
</tr>
<tr>
<td><strong>AND</strong></td>
</tr>
<tr>
<td>Organism(s) identified from blood is not related to an infection at another site.</td>
</tr>
</tbody>
</table>
**Infection Window Period:**
It is the 7-day time period which includes the collection date of the positive blood, the 3 calendar days before and the 3 calendar days after.

**Repeat Infection time frame (RIT)**
- It is 14-day timeframe during which no new CLABSI of the same type are reported. The date of event is Day 1 of the 14-day RIT.
- Note that only primary BSIs create a BSI RIT. Secondary BSIs do not create a BSI RIT.

**Skin commensals organisms**
It is applicable for LCBI-2 and LCBI-3. They include
- Diphtheroids [Corynebacterium spp]
- Bacillus spp.
- Propionibacterium spp.
- Coagulase-negative Staphylococci [including S. epidermidis]
- Viridans group streptococci
- Aerococcus spp.
- Micrococcus spp.
- Rhodococcus

**Matching organisms:**
- If genus and species are identified in both specimens, they must be the same.
  - Example: Pseudomonas aeruginosa and Pseudomonas aeruginosa
- If one organism is less definitively identified than the other, the lesser identified organism must be identified at least to the genus level and at that level the organisms must be the same.
  - Example: Pseudomonas species and Pseudomonas aeruginosa.
  - Exception-1: Staphylococcus and coagulase negative/positive Staphylococcus
Exception-2: Streptococcus species and Streptococcus viridans

- The matching common commensals represent a single element; therefore, the collection date of the first common commensal is the date of the first diagnostic test used to determine the Infection Window Period (IWP).

Examples on matching/non-matching organisms

<table>
<thead>
<tr>
<th>First culture</th>
<th>Second culture</th>
<th>Sameness</th>
<th>Report as...</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coagulase positive Staphylococci</td>
<td>S. aureus</td>
<td>Different (look at exception above)</td>
<td>S. aureus</td>
</tr>
<tr>
<td><em>S. epidermidis</em></td>
<td>Coagulase-negative staphylococci</td>
<td><em>Same (staph epidermidis is part of Coagulase-negative staphylococci)</em></td>
<td><em>S. epidermidis</em></td>
</tr>
<tr>
<td><em>Enterococcus spp.</em></td>
<td><em>E. faecium</em></td>
<td><em>Same (genus and species levels)</em></td>
<td><em>E. faecium</em></td>
</tr>
<tr>
<td><em>Bacillus spp.</em></td>
<td><em>B. cereus</em></td>
<td><em>Same (genus and species levels)</em></td>
<td><em>B. cereus</em></td>
</tr>
<tr>
<td><em>S. salivarius</em></td>
<td>Strep viridans</td>
<td><em>Same (just synonymous names)</em></td>
<td><em>S. salivarius</em></td>
</tr>
</tbody>
</table>

Secondary BSI:

- It is BSI meeting the LCBI criteria BUT is secondary to infection at another site in the body.

- One of the following scenarios must be met:

  ✓ **Scenario 1**: At least one organism from the blood specimen matches an organism identified from the site-specific specimen that is used as an element to meet the NHSN site-specific infection criterion AND the blood specimen is collected during the secondary BSI attribution period (infection window period + repeat infection timeframe).

  OR
**Scenario 2:** An organism identified in the blood specimen is an element that is used to meet the NHSN site-specific infection criterion, and therefore is collected during the site-specific infection window period.

**Scenarios of secondary BSI:**

<table>
<thead>
<tr>
<th>Scenario 1</th>
<th>Scenario 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood specimen must contain at least one matching organism of the site-specific specimen</td>
<td>Blood specimen must be an element of the site-specific criterion*</td>
</tr>
<tr>
<td>And is collected in the secondary BSI attribution period</td>
<td>And is collected during the site-specific infection’s infection window period</td>
</tr>
<tr>
<td>And an organism identified from the site-specific infection is used as an element to meet the site-specific infection criterion</td>
<td>And an organism identified in the blood specimen is an element that is used to meet the site-specific infection criterion</td>
</tr>
</tbody>
</table>

**Examples of scenarios of secondary BSI:**

<table>
<thead>
<tr>
<th>Scenario 1</th>
<th>Scenario 2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SSI (SI or DI or OS)</strong></td>
<td><strong>IAB criterion 3b</strong></td>
</tr>
<tr>
<td>• Positive wound</td>
<td>• Fever, nausea or abdominal pain, positive blood specimen during IWP and CT scan showing infection in abdominal cavity</td>
</tr>
<tr>
<td>• Matching positive blood during BSI attribution period</td>
<td></td>
</tr>
<tr>
<td><strong>SUTI</strong></td>
<td><strong>PNU 2 or 3 (one criterion during IWP)</strong></td>
</tr>
<tr>
<td>• Positive urine during IWP</td>
<td>• Infiltrate on chest imaging test, fever, new onset of cough and organism identified from blood specimen during IWP.</td>
</tr>
<tr>
<td>• Matching positive blood during BSI attribution period.</td>
<td></td>
</tr>
<tr>
<td>PNU 2 or 3 or PVAP</td>
<td>PNU 2 or 3 (Two criteria during IWP)</td>
</tr>
<tr>
<td>-------------------</td>
<td>-------------------------------------</td>
</tr>
<tr>
<td>• Positive respiratory specimen during IWP</td>
<td>• Infiltrate on chest imaging test, fever, new onset of cough and organism identified from <strong>blood</strong> and <strong>BAL</strong> specimens during IWP</td>
</tr>
<tr>
<td>• Matching positive blood during BSI attribution period</td>
<td></td>
</tr>
</tbody>
</table>

- **PNU 2 or 3** or **PVAP**
- **PNU 2 or 3** (Two criteria during IWP)
Mucosal Barrier Injury (MBI):

- The mucosal barrier injury (MBI) LCBI meet the need for more specific BSI definition in oncology patients.
- In this population, CLABSI rates are inflated by misclassification of BSI resulting from translocation of intestinal organisms.
- These BSIs are not impacted by CLABSI prevention measures and not associated with the central line.
- Mucosal Barrier Injury Laboratory-Confirmed Bloodstream Infection (MBI-LCBI)
  - Patient who meets LCBI criteria with at least one blood specimen showing intestinal organisms
  - AND
  - Patient meets at least one of the following:
    - Grade III or IV gastrointestinal graft versus host disease in allogeneic hematopoietic stem cell transplant recipient
    - Is neutropenic

**LCBI criterion**

**Organism:**
- instead of common pathogen >> intestinal organism
- Instead of commensal>>viridans group streptococci

**Type of patient:**
- Grade III or IV gastrointestinal graft versus host disease in allogeneic hematopoietic stem cell transplant recipient
- Neutropenic

**MBI-LCBI**
MBI-LCBI-1

Patient of any age meets criterion 1 for LCBI with at least one blood specimen identified by a culture or non-culture based microbiologic testing method, with ONLY intestinal organisms from the MBI-LCBI organisms list.

And

patient meets at least one of the following:
1. Is an allogeneic hematopoietic stem cell transplant recipient within the past year with one of the following documented during same hospitalization as positive blood specimen:
   a. Grade III or IV gastrointestinal graft versus host disease [GI GVHD]
   b. ≥1 liter diarrhea in a 24-hour period (or ≥20 mL/kg in a 24-hour period for patients <18 years of age) with onset on or within 7 calendar days before the date the positive blood specimen was collected.
2. Is neutropenic, defined as at least two separate days with values of absolute neutrophil count (ANC) or total white blood cell count (WBC) <500 cells/mm³ within a 7-day time period which includes the date the positive blood specimen was collected (Day 1), the 3 calendar days before and the 3 calendar days after

MBI-LCBI-2

Patient of any age meets criterion 2 for LCBI with at least two blood specimens identified by a culture or non-culture based microbiologic testing method, with only viridans group streptococci but no other organisms.

And

And patient meets at least one of the following
1. Is an allogeneic hematopoietic stem cell transplant recipient within the past year with one of the following documented during same hospitalization as positive blood specimen:
   a. Grade III or IV gastrointestinal graft versus host disease [GI GVHD]
   b. ≥1 liter diarrhea in a 24-hour period (or ≥20 mL/kg in a 24-hour period for patients <18 years of age) with onset on or within 7 calendar days before the date the positive blood specimen was collected.
2. Is neutropenic, defined as at least two separate days with values of absolute neutrophil count (ANC) or total white blood cell count (WBC) <500 cells/mm³ within a 7-day time period which includes the date the positive blood specimen was collected (Day 1), the 3 calendar days before and the 3 calendar days after
MBI-LCBI-3

Patient ≤1 year of age meets criterion 3 for LCBI with at least two blood specimens identified by a culture or non-culture based microbiologic testing method, with only viridans group streptococci but no other organisms.  

And

And patient meets at least one of the following
1. Is an allogeneic hematopoietic stem cell transplant recipient within the past year with one of the following documented during same hospitalization as positive blood specimen:
   a. Grade III or IV gastrointestinal graft versus host disease [GI GVHD]
   b. ≥20 mL/kg diarrhea in a 24-hour period with onset on or within 7 calendar days before the date the first positive blood specimen is collected.
2. Is neutropenic, defined as at least two separate days with values of absolute neutrophil count (ANC) or total white blood cell count (WBC) <500 cells/mm3 within a 7-day time period which includes the date the positive blood specimen was collected (Day 1), the 3 calendar days before and the 3 calendar days after

Intestinal pathogens (MBI pathogens short list)

- Bacteroides spp.
- Candida spp.
- Clostridium spp.
- Enterococcus spp.
- Fusobacterium spp.
- Peptostreptococcus spp.
- Prevotella spp.
- Veillonella spp.
- Enterobacteriaceae
Enterobacteriaceae (short list)

- Citrobacter
- Enterobacter
- Escherichia
- Klebsiella
- Proteus
- Providencia
- Salmonella
- Serratia
- Shigella
- Yersinia

Collection of denominator data for CLABSI

1. **Manual, daily:** patient days and central line days should be collected at the same time, every day, for each location performing surveillance to ensure that different collection methods don’t result in device days being > patient days.

2. **Manual, weekly:** patient days and central line days should be collected at the same time on the same designated day, once per week. The idea is to reduce staff time spent collecting surveillance data, once weekly collection of denominator data is good for:
   - For locations with 75 or more device days per month
   - For locations other than specialty care areas/oncology and NICUs
   - It was shown that the use of Friday and Saturday generate the least accurate estimates, so avoid them
   - If the day designated for the collection of data is missed, collect the data on the next available day instead

3. **Electronic sources:**
   - When patient days and central line days are available from electronic databases, these sources may be used as long as the counts are not substantially different (+/- 5%) from those collected manually.
### Analysis of CLABSI

<table>
<thead>
<tr>
<th>Measure</th>
<th>Calculation</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CLABSI Rates</strong></td>
<td>The number of CLABSIs for a location / The number of central line days for that location X1000</td>
<td>Location specific measure</td>
</tr>
<tr>
<td><strong>MBI-LCBI Rates</strong></td>
<td>The number of MBI-LCBIs for a location / The number of central line days for that location X1000</td>
<td>Location specific measure</td>
</tr>
<tr>
<td><strong>CLABSI SIR</strong></td>
<td>The number of observed CLABSIs / The number of predicted CLABSIs</td>
<td>Both location specific and summarized measure</td>
</tr>
<tr>
<td><strong>MBI-LCBI SIR</strong></td>
<td>The number of observed MBI-LCBIs / The number of predicted MBI-LCBIs</td>
<td>Both location specific and summarized measure</td>
</tr>
<tr>
<td><strong>Central line DUR</strong></td>
<td>The number of central line days for a location / The number of patient days for that location</td>
<td>Location specific measure</td>
</tr>
<tr>
<td><strong>Central Line SUR</strong></td>
<td>The number of observed central line days / The number of predicted central line days</td>
<td>Both location specific and summarized measure</td>
</tr>
</tbody>
</table>

SIR, Standardized Infection Ratio; DUR, Device Utilization Ratio; SUR, Standardized Utilization Ratio
12.2 Catheter Associated Urinary Tract Infection (CAUTI)

CAUTI:

- CAUTI is defined as symptomatic urinary tract infection (SUTI) or asymptomatic bacteremic UTI (ABUTI) in a patient who had an indwelling urinary catheter
- Indwelling urinary catheter has to be in place for >2 days and in place at the date of event or the day before.

Surveillance settings:
Surveillance can be done in any inpatient location where denominator data can be collected, this includes
- ICUs
- SCA
- Other inpatient locations
- NICUs (may participate, but only off plan)

Surveillance methodology
- Active
- Patient based
- Prospective
- Priority-directed targeted
- Yield risk-adjusted incidence rates

Date of event (DOE):
It is the date when the FIRST element used to meet the CAUTI criterion occurs for the first time within the 7-day infection window period.

Indwelling urinary catheter:
- Indwelling catheter: A drainage tube that is inserted into the urinary bladder through the urethra, is left in place, and is connected to a drainage bag (including leg bags).
- These devices are also called Foley’s catheters.
• Condom or straight in-and-out catheters are not included nor are nephrostomy tubes, ileoconduits, or suprapubic catheters unless a Foley’s catheter is also present.
• Indwelling urethral catheters that are used for intermittent or continuous irrigation are included in CAUTI surveillance.

**Urinary catheter removal and reinsertion:**

• If indwelling urinary catheter was removed and reinserted before a full calendar day, then continue the day count.
• Therefore, if the patient is without a urinary catheter for at least one full calendar day (NOT to be read as 24 hours), then start a new day count.

<table>
<thead>
<tr>
<th>Hospital days</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urinary catheter days</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>Removal (4)</td>
<td>Re-insertion (5)</td>
<td>6</td>
<td>7</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hospital days</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urinary catheter days</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>Removal (4)</td>
<td>---</td>
<td>Re-insertion (1)</td>
<td>2</td>
</tr>
</tbody>
</table>

**Repeat Infection time frame (RIT)**

• It is 14-day timeframe during which no new CAUTI of the same type are reported.
• The date of event is Day 1 of the 14-day RIT.

**Location of attribution:**

• The inpatient location where the patient was assigned on the date of the CAUTI event, which is further defined as the date when the first element used to meet the CAUTI criterion occurred.
• OR/Post Anesthesia Care Unit/Recovery Room/dialysis unit /ERs cannot be considered a location of attribution for CAUTI
**Transfer Rule:**

- If the date of event for a CAUTI is the day of transfer or discharge, or the next day, the CAUTI is attributed to the transferring location.
- Receiving facilities should share information about such HAIs with the transferring facility to enable reporting.
- Example:
  - Patient in the SICU with a Foley's catheter, which has been in place for 5 days, is transferred to a surgical ward.
  - The next day is determined to be the date of event for a CAUTI.
  - This is reported as a CAUTI for the SICU

**Multiple Transfers:**

- If the patient has been transferred to more than one location on the date of CAUTI, or the day before, attribute the CAUTI to the first location in which the patient was housed the day before the CAUTI's date of event.

<table>
<thead>
<tr>
<th>Date</th>
<th>3/22</th>
<th>3/23</th>
<th>3/24</th>
</tr>
</thead>
<tbody>
<tr>
<td>Locations</td>
<td>Unit A</td>
<td>Unit A</td>
<td>Unit C</td>
</tr>
<tr>
<td></td>
<td>Unit B</td>
<td>Unit D</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Unit C</td>
<td>CAUTI was diagnosed</td>
<td></td>
</tr>
</tbody>
</table>

- CAUTI is attributed to Unit (A) Since Unit (A) was the first location in which the patient was housed the day before the date of event.
1. Symptomatic UTI (SUTI-1a)

<table>
<thead>
<tr>
<th>Patient must meet 1, 2, and 3 below:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Patient of any age had an indwelling urinary catheter that had been in place for &gt; 2 days on the date of event AND was either:</td>
</tr>
<tr>
<td>• Present for any portion of the calendar day on the date of event OR</td>
</tr>
<tr>
<td>• Removed the day before the date of event</td>
</tr>
<tr>
<td>2. Patient has at least one of the following signs or symptoms:</td>
</tr>
<tr>
<td>• Fever (&gt;38.0°C)</td>
</tr>
<tr>
<td>• Suprapubic pain or tenderness</td>
</tr>
<tr>
<td>• Costovertebral angle pain or tenderness</td>
</tr>
<tr>
<td>• Urinary urgency (only if catheter is not in place)</td>
</tr>
<tr>
<td>• Urinary frequency (only if catheter is not in place)</td>
</tr>
<tr>
<td>• Dysuria (only if catheter is not in place)</td>
</tr>
<tr>
<td>3. Patient has a urine culture with no more than two species of organisms identified, at least one of which is a bacterium ≥10⁵ CFU/m.</td>
</tr>
</tbody>
</table>
2. **Symptomatic UTI (SUTI-2)**

**Patient must meet 1, 2, and 3 below:**

1. Patient is ≤1 year and had an indwelling urinary catheter that had been in place for > 2 days on the date of event AND was either:
   - Present for any portion of the calendar day on the date of event OR
   - Removed the day before the date of event

2. Patient has at least one of the following signs or symptoms:
   - fever (>38.0°C)
   - hypothermia (<36.0°C)
   - apnea*
   - bradycardia*
   - lethargy*
   - vomiting*
   - suprapubic tenderness* (*With no other recognized cause)

3. Patient has a urine culture with no more than two species of organisms identified, at least one of which is a bacterium ≥10⁵ CFU/m.

3. **Asymptomatic bacteremic urinary tract infection (ABUTI)**

**Patient must meet 1, 2, and 3 below:**

1. Patient of any age with an indwelling urinary catheter has no signs or symptoms of SUTI 1 or 2 according to age

   Note: Patients > 65 years of age may have a fever and still meet the ABUTI criterion BUT the indwelling urinary catheter needs to be in place > 2 calendar days on the date of event

2. Patient has a urine culture with no more than two species of organisms identified, at least one of which is a bacterium ≥10⁵ CFU/m

3. Patient has organism identified from blood specimen with at least one matching bacterium to the bacterium identified in the urine specimen, or meets LCBI criterion 2 (without fever) and matching common commensal(s) in the urine.

Note: All elements of the ABUTI criterion must occur during the Infection Window Period
Comments about CAUTI definition

- The following excluded organisms cannot be used to meet the UTI definition:
  - Any Candida species as well as a report of “yeast” that is not otherwise specified
  - mold
  - dimorphic fungi
  - parasites

- “Mixed flora” cannot be reported as a pathogen to meet the CAUTI Criteria.
- An acceptable urine specimen may include these organisms as long as one bacterium of greater than or equal to 100,000 CFU/ml is also present. Additionally, these non-bacterial organisms identified from blood cannot be deemed secondary to a UTI since they are excluded as organisms in the UTI definition.
- Suprapubic tenderness whether elicited by palpation (tenderness-sign) or provided as a subjective complaint of suprapubic pain (pain-symptom), documentation of either found in the medical record is acceptable as a part of SUTI criterion if documented in the medical record during the Infection Window Period.
- Lower abdominal pain or bladder or pelvic discomfort are examples of symptoms that can be used as suprapubic tenderness. Generalized “abdominal pain” in the medical record is not to be interpreted as suprapubic tenderness as there are many causes of abdominal pain and this symptom is too general.
- Left or right lower back or flank pain are examples of symptoms that can be used as costovertebral angle pain or tenderness. Generalized "low back pain" is not to be interpreted as costovertebral angle pain or tenderness.
- Fever and hypothermia are non-specific symptoms of infection and cannot be excluded from CAUTI determination because they are clinically deemed due to another recognized cause.
Collection of denominator data for CAUTI

4. **Manual, daily**: patient days and urinary catheter days should be collected at the same time, every day, for each location performing surveillance to ensure that different collection methods don’t result in device days being > patient days.

5. **Manual, weekly**: patient days and urinary catheter days should be collected at the same time on the same designated day, once per week. The idea is to reduce staff time spent collecting surveillance data, once weekly collection of denominator data is good for
   - For locations with 75 or more device days per month
   - For locations other than specialty care areas/oncology and NICUs
   - It was shown that the use of Saturday or Sunday generate the least accurate estimates, so avoid them
   - If the day designated for the collection of data is missed, collect the data on the next available day instead

6. **Electronic sources**:
   - When patient days and urinary catheter days are available from electronic databases, these sources may be used as long as the counts are not substantially different (+/- 5%) from those collected manually.
## Analysis of CAUTI

<table>
<thead>
<tr>
<th>Measure</th>
<th>Calculation</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAUTI Rates</td>
<td>The number of CAUTIs for a location X1000 The number of urinary catheter days for that location</td>
<td>Location specific measure</td>
</tr>
<tr>
<td>CAUTI SIR</td>
<td>The number of observed CAUTIs The number of predicted CAUTIs</td>
<td>Both location specific and summarized measure</td>
</tr>
<tr>
<td>Urinary catheter DUR</td>
<td>The number of urinary catheter days for a location The number of patient days for that location</td>
<td>Location specific measure</td>
</tr>
<tr>
<td>Urinary catheter SUR</td>
<td>The number of observed urinary catheter days The number of predicted urinary catheter days</td>
<td>Both location specific and summarized measure</td>
</tr>
</tbody>
</table>

SIR, Standardized Infection Ratio; DUR, Device Utilization Ratio; SUR, Standardized Utilization Ratio
12.3 Ventilator Associated Pneumonia (VAP)

**VAP:**

- VAP is a pneumonia (PNEU) identified by using a combination of radiologic, clinical and laboratory criteria that occurs in a patient who was ventilated.
- The ventilator has to be in place for >2 days and in place at the date of event or the day before.
- Healthcare-associated pneumonia can be characterized by its onset: early or late, early onset pneumonia occurs during the first four days of hospitalization.

**Surveillance settings:**

- VAP surveillance can be done in any inpatient location where denominator data can be collected.
- However, due to replacement of VAP by VAE, VAP surveillance can be done in any inpatient pediatric locations such as, pediatric ICUs and SCA, step-down units, wards.
- VAP surveillance can still be done in adult and neonatal locations as off plan surveillance for mechanically-ventilated patients

**Surveillance methodology**

- Active
- Patient based
- Prospective
- Priority-directed targeted
- Yield risk-adjusted incidence rates

**Date of event (DOE):**

It is the date when the FIRST element used to meet the VAP criterion occurs for the first time within the 7-day infection window period.
**Ventilator:**
- Any device used to support, assist or control respiration (inclusive of the weaning period) through the application of positive pressure to the airway when delivered via an artificial airway, specifically an oral/nasal endotracheal or tracheostomy tube.
- Note: Ventilation and lung expansion devices that deliver positive pressure to the airway (for example: CPAP, Bipap, bi-level, IPPB and PEEP) via non-invasive means (for example: nasal prongs, nasal mask, full face mask, total mask, etc.) are not considered ventilators unless positive pressure is delivered via an artificial airway (oral/nasal endotracheal or tracheostomy tube).

**Ventilator removal and reinsertion:**
- If ventilator was removed and reinserted before a full calendar day, then continue the day count.
- Therefore, if the patient is without a ventilator for at least one full calendar day (NOT to be read as 24 hours), then start a new day count.

<table>
<thead>
<tr>
<th>Hospital days</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ventilator days</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>Extubated (4)</td>
<td>Re-intubated (5)</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>Ventilator episodes</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hospital days</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ventilator days</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>Extubated (4)</td>
<td>---</td>
<td>Re-intubated (1)</td>
<td>2</td>
</tr>
<tr>
<td>Ventilator episodes</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>---</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

**Repeat Infection time frame (RIT)**
- It is 14-day timeframe during which no new VAP of the same type are reported. The date of event is day 1 of the 14-day RIT.
Location of attribution:

- The inpatient location where the patient was assigned on the date of the VAP event, which is further defined as the date when the first element used to meet the VAP criterion occurred.
- OR/Post Anesthesia Care Unit/Recovery Room/dialysis unit /ERs cannot be considered a location of attribution for VAP.

Transfer Rule:

- If the date of event for a VAP is the day of transfer or discharge, or the next day, the VAP is attributed to the transferring location.
- Receiving facilities should share information about such HAIs with the transferring facility to enable reporting.
- Example:
  - ✓ Patient in the SICU with a ventilator, which has been in place for 5 days, is transferred to a surgical ward.
  - ✓ The next day is determined to be the date of event for a VAP.
  - ✓ This is reported as a VAP for the SICU

Multiple Transfers:

- If the patient has been transferred to more than one location on the date of VAP, or the day before, attribute the VAP to the first location in which the patient was housed the day before the VAP’s date of event.

<table>
<thead>
<tr>
<th>Date</th>
<th>3/22</th>
<th>3/23</th>
<th>3/24</th>
</tr>
</thead>
<tbody>
<tr>
<td>Locations</td>
<td>Unit A</td>
<td>Unit A</td>
<td>Unit C</td>
</tr>
<tr>
<td></td>
<td>Unit B</td>
<td>Unit C</td>
<td>Unit D</td>
</tr>
<tr>
<td></td>
<td>Unit C</td>
<td>Unit D</td>
<td>VAP was diagnosed</td>
</tr>
</tbody>
</table>

- VAP is attributed to Unit A since Unit A was the first location in which the patient was housed the day before the date of event.
Pneumonia (PNEU):
Can be diagnosed using one of three criteria

- Clinically defined pneumonia (PNU1)
- Pneumonia with specific laboratory findings (PNU2)
  ✓ Common bacterial or filamentous fungal pathogens
  ✓ Viral, legionella and other bacterial pneumonias
- Pneumonia in immunocompromised patients (PNU3)

<table>
<thead>
<tr>
<th></th>
<th>PNEU1</th>
<th>PNEU2</th>
<th>PNEU3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Imaging Test Evidence</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Signs/Symptoms</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Laboratory</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Immuno-compromised patients</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>
1. Clinically Defined Pneumonia (PNU1)

<table>
<thead>
<tr>
<th>Imaging Test Evidence</th>
<th>Signs/Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two or more serial chest imaging test results with at least one of the following: New and persistent or Progressive and persistent • Infiltrate • Consolidation • Cavitation • Pneumatoceles, in infants ≤1-year-old</td>
<td>For any patient, at least one of the following: • Fever (&gt;38.0°C or &gt;100.4°F) • Leukopenia (≤4000 WBC/mm³) or leukocytosis (&gt;12,000 WBC/mm³) • For adults &gt;70 years old, altered mental status with no other recognized cause AND at least two of the following: • New onset of purulent sputum or change in character of sputum, or increased respiratory secretions, or increased suctioning requirements • New onset or worsening cough, or dyspnea, or tachypnea • Rales or bronchial breath sounds • Worsening gas exchange (for example: O₂ desaturations (for example: PaO₂/FiO₂ &lt;240), increased oxygen requirements, or increased ventilator demand)</td>
</tr>
</tbody>
</table>

Note: In patients without underlying pulmonary or cardiac disease (for example: respiratory distress syndrome, bronchopulmonary dysplasia, pulmonary edema, or chronic obstructive pulmonary disease), one definitive imaging test result is acceptable.

Alternate Criteria, for infants < 1-year-old:
Worsening gas exchange (for example: O₂ desaturations [for example pulse oximetry <94%], increased oxygen requirements, or increased ventilator demand) AND at least three of the following: • Temperature instability • Leukopenia (≤4000 WBC/mm³) or leukocytosis (≥15,000 WBC/mm³) and left shift (>10% band forms) • New onset of purulent sputum or change in character of sputum, or increased respiratory secretions or increased suctioning requirements • Apnea, tachypnea, nasal flaring with retraction of chest wall or nasal flaring with grunting • Wheezing, rales, or rhonchi • Cough • Bradycardia (<100 beats/min) or tachycardia (>170 beats/min)

Alternate Criteria, for child >1-year-old or ≤12 years old: At least three of the following:
Fever (>38.0°C or >100.4°F) or hypothermia (<36.0°C or <96.8°F) • Leukopenia (≤4000 WBC/mm³) or leukocytosis (≥15,000 WBC/mm³) • New onset of purulent sputum or change in character of sputum, or increased respiratory secretions, or increased suctioning requirements • New onset or worsening cough, or dyspnea, apnea, or tachypnea. • Rales or bronchial breath sounds • Worsening gas exchange (for example: O₂ desaturations [for example pulse oximetry <94%], increased oxygen requirements, or increased ventilator demand)
2. Pneumonia with Common Bacterial or Filamentous Fungal Pathogens and Specific Laboratory Findings (PNU2)

<table>
<thead>
<tr>
<th>Imaging Test Evidence</th>
<th>Signs/Symptoms</th>
<th>Laboratory</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two or more serial chest imaging test results with at least one of the following: New and persistent or Progressive and persistent • Infiltrate • Consolidation • Cavitation • Pneumatoceles, in infants ≤1-year-old</td>
<td>At least one of the following: • Fever (&gt;38.0°C or &gt;100.4°F) • Leukopenia (≤4000 WBC/mm³) or leukocytosis (&gt;12,000 WBC/mm³) • For adults &gt;70 years old, altered mental status with no other recognized cause AND at least one of the following: • New onset of purulent sputum or change in character of sputum, or increased respiratory secretions, or increased suctioning requirements • New onset or worsening cough, or dyspnea or tachypnea • Rales or bronchial breath sounds • Worsening gas exchange (for example: O₂ desaturations [for example: PaO₂/FiO₂ &lt;240], increased oxygen requirements, or increased ventilator demand)</td>
<td>At least one of the following: • Organism identified from blood • Organism identified from pleural fluid • Positive quantitative culture or corresponding semiquantitative culture result from minimally-contaminated LRT specimen (specifically, BAL, protected specimen brushing or endotracheal aspirate) • ≥5% BAL-obtained cells contain intracellular bacteria on direct microscopic exam (for example: Gram’s stain) • Positive quantitative culture or corresponding semiquantitative culture result of lung tissue • Histopathologic exam shows at least one of the following evidences of pneumonia: • Abscess formation or foci of consolidation with intense PMN accumulation in bronchioles and alveoli • Evidence of lung parenchyma invasion by fungal hyphae or pseudohyphae</td>
</tr>
</tbody>
</table>

Note: In patients without underlying pulmonary or cardiac disease (for example: respiratory distress syndrome, bronchopulmonary dysplasia, pulmonary edema, or chronic obstructive pulmonary disease), one definitive chest imaging test result is acceptable.
3. Pneumonia with viral, legionella, and other bacterial pneumonias with definitive laboratory findings (PNU2)

<table>
<thead>
<tr>
<th>Imaging Test Evidence</th>
<th>Signs/Symptoms</th>
<th>Laboratory</th>
</tr>
</thead>
</table>
| Two or more serial chest imaging test results with at least one of the following: New and persistent or Progressive and persistent  
• Infiltrate  
• Consolidation  
• Cavitation  
• Pneumatoceles, in infants ≤1-year-old | At least one of the following:  
• Fever (>38.0°C or >100.4°F)  
• Leukopenia (≤4000 WBC/mm³) or leukocytosis (>12,000 WBC/mm³)  
• For adults >70 years old, altered mental status with no other recognized cause | At least one of the following:  
• Virus, Bordetella, Legionella, Chlamydia or Mycoplasma identified from respiratory secretions or tissue by a culture or non-culture based microbiologic testing method which is performed for purposes of clinical diagnosis or treatment (for example: not Active Surveillance Culture/Testing (ASC/AST)).  
• Fourfold rise in paired sera (IgG) for pathogen (for example: influenza viruses, Chlamydia)  
• Fourfold rise in Legionella pneumophila serogroup 1 antibody titer to ≥1:128 in paired acute and convalescent sera by indirect IFA.  
• Detection of L. pneumophila serogroup 1 antigens in urine by RIA or EIA |

Note: In patients **without** underlying pulmonary or cardiac disease (for example: respiratory distress syndrome, bronchopulmonary dysplasia, pulmonary edema, or chronic obstructive pulmonary disease), one definitive chest imaging test result is acceptable.
### 4. Pneumonia in Immunocompromised Patients (PNU3)

<table>
<thead>
<tr>
<th>Imaging Test Evidence</th>
<th>Signs/Symptoms</th>
<th>Laboratory</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two or more serial chest imaging test results with at least one of the following:</td>
<td>Patient who is immune-compromised has</td>
<td>At least one of the following:</td>
</tr>
<tr>
<td>New and persistent or Progressive and persistent</td>
<td></td>
<td>• Identification of matching Candida spp. from blood and one of the following: sputum, endotracheal aspirate, BAL or protected specimen brushing.</td>
</tr>
<tr>
<td>• Infiltrate</td>
<td></td>
<td>• Evidence of fungi (excluding Candida and yeast not otherwise specified) from minimally-contaminated LRT specimen (specifically BAL, protected specimen brushing or endotracheal aspirate) from one of the following:</td>
</tr>
<tr>
<td>• Consolidation</td>
<td></td>
<td>✓ Direct microscopic exam</td>
</tr>
<tr>
<td>• Cavitation</td>
<td></td>
<td>✓ Positive culture of fungi</td>
</tr>
<tr>
<td>• Pneumatoceles, in infants ≤1-year-old</td>
<td></td>
<td>✓ Non-culture diagnostic laboratory test</td>
</tr>
<tr>
<td>Note: In patients without underlying pulmonary or cardiac disease (for example: respiratory distress syndrome, bronchopulmonary dysplasia, pulmonary edema, or chronic obstructive pulmonary disease), one definitive chest imaging test result is acceptable.</td>
<td></td>
<td>OR</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Any of the following from: LABORATORY CRITERIA DEFINED UNDER PNU2</td>
</tr>
</tbody>
</table>

**Abbreviations used in the PNU laboratory criteria:**
- BAL—Broncho alveolar lavage
- EIA—Enzyme immunoassay
- IFA—Immunofluorescent antibody
- LRT—Lower respiratory tract
- PMN—Polymorphonuclear leukocyte
- RIA—Radioimmunoassay
General comments applicable to all pneumonia specific site criteria:

1. Physician’s diagnosis of pneumonia alone is not an acceptable criterion for POA (present on admission) or HAI (healthcare-associated) pneumonia.
2. Although specific criteria are included for infants and children and immunocompromised patients, all patients may meet any of the other pneumonia site-specific criteria.
3. Pneumonia due to gross aspiration (for example, in the setting of intubation in the field, emergency department, or operating room) that meets the PNEU/VAP definition with a date of event during the HAI timeframe is considered healthcare associated (HAI).
4. Multiple episodes of healthcare-associated pneumonia may occur in critically ill patients with lengthy hospital stays.
5. Excluded organisms that cannot be used to meet the PNEU/VAP definition are as follows:
   - “Normal respiratory flora,” “normal oral flora,” “mixed respiratory flora,” “mixed oral flora,” “altered oral flora” or other similar results indicating isolation of commensal flora of the oral cavity or upper respiratory tract.
   - The following organisms unless identified from lung tissue or pleural fluid (where specimen was obtained during thoracentesis or initial placement of chest tube and NOT from an indwelling chest tube):
     - Any Candida species as well as a report of “yeast” that is not otherwise specified
     - Any coagulase-negative Staphylococcus species
     - Any Enterococcus species
6. Coagulase-negative Staphylococcus species, Enterococcus species and Candida species or yeast not otherwise specified that are identified from blood cannot be deemed secondary to a PNEU, unless the organism was also identified from pleural fluid (where specimen was obtained during thoracentesis or initial placement of chest tube and NOT from an indwelling chest tube) or lung tissue. This applies when meeting PNU2 or when meeting PNU3 with the laboratory findings found in PNU2.
7. Following genera are typically causes of community-associated infections and are rarely or are not known to be causes of healthcare-associated infections, they are also excluded, and cannot be used to meet any NHSN definition: Blastomyces, Histoplasma, Coccidioides, Paracoccidioides, Cryptococcus and Pneumocystis.

8. A specimen that is not obtained through an artificial airway (specifically endotracheal tube or tracheostomy) from a ventilated patient is not considered minimally contaminated and is not eligible for use in meeting the laboratory criteria for PNU2.

9. Purulent sputum is defined as secretions from the lungs, bronchi, or trachea that contain >25 neutrophils and <10 squamous epithelial cells per low power field (x100).

10. Change in the character of sputum refers to the color, consistency, odor and quantity.

11. Tachypnea is defined as respiratory rate >25 breaths per minute in adults.

12. Tachypnea is defined as respiratory rate >75 breaths per minute in premature infants born at <37 weeks’ gestation and until the 40th week;

13. Tachypnea is defined as respiratory rate >60 breaths per minute in patients <2 months old; >50 breaths per minute in patients 2-12 months old; and >30 breaths per minute in children >1-year-old.

14. Rales may be described as “crackles”.

15. This measure of arterial oxygenation is defined as the ratio of the arterial tension (PaO2) to the inspiratory fraction of oxygen (FiO2).

**Immunocompromised patients in VAP surveillance include only:**

- Those with neutropenia defined as absolute neutrophil count or total white blood cell count (WBC) <500/mm3
- Those with leukemia, lymphoma or who are HIV positive with CD4 count <200
- Those who have undergone splenectomy
- Those who have a history of solid organ or hematopoietic stem cell transplant
- Those on cytotoxic chemotherapy
- Those on enteral or parenteral administered steroids (excludes inhaled and topical steroids) daily for >2 weeks on the date of event
General comments chest imaging:

- To help confirm difficult cases, multiple imaging test results spanning over several calendar days must be considered when determining if there is imaging test evidence of pneumonia.
- Pneumonia may have rapid onset and progression, but does not resolve quickly. Imaging test evidence of pneumonia will persist. Rapid imaging resolution suggests that the patient does not have pneumonia, but rather a non-infectious process such as atelectasis or congestive heart failure.
- In non-ventilated patients, the diagnosis of healthcare-associated pneumonia may be quite clear on the basis of signs, symptoms and a single definitive chest imaging test result. Therefore, in a patient without underlying pulmonary or cardiac disease and when there is only one imaging test available, if it is an eligible finding, the imaging test evidence requirement can be met.
- In patients without underlying disease if more than one imaging test is available serial imaging test results must also be evaluated and demonstrate persistence.
- In patients with underlying disease, serial chest imaging test results must be examined to help separate infectious from non-infectious pulmonary processes. In patients with pulmonary or cardiac disease (for example: interstitial lung disease or congestive heart failure), the diagnosis of pneumonia may be particularly difficult. For example: Pulmonary edema from decompensated congestive heart failure may simulate the presentation of pneumonia.
- Note that there are many ways of describing the imaging appearance of pneumonia. Examples include, but are not limited to, “air-space disease”, “focal opacification”, “patchy areas of increased density”. Although perhaps not specifically delineated as pneumonia by the radiologist, in the appropriate clinical setting these alternative descriptive wordings should be seriously considered as potentially positive findings. If provided and the findings are not documented as attributed to another issue (for example: pulmonary edema, chronic lung disease) they are eligible for meeting imaging test evidence of pneumonia.
Reporting Instructions:
- There is a hierarchy of specific categories within the major site pneumonia. If the patient meets criteria for more than one specific site during the infection window period or the RIT, report only one:
  - If a patient meets criteria for both PNU1 and PNU2, report PNU2.
  - If a patient meets criteria for both PNU2 and PNU3, report PNU3.
  - If a patient meets criteria for both PNU1 and PNU3, report PNU3.

Threshold values for cultured specimens used in the diagnosis of pneumonia

<table>
<thead>
<tr>
<th>Specimen collection/technique</th>
<th>Values*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Lung tissue *</td>
<td>≥10⁴ CFU/g tissue</td>
</tr>
<tr>
<td>2. Bronchoscopically (B) obtained specimens</td>
<td></td>
</tr>
<tr>
<td>• Broncho alveolar lavage (B-BAL)</td>
<td>≥10⁴ CFU/ml</td>
</tr>
<tr>
<td>• Protected BAL (B-PBAL)</td>
<td>≥10⁴ CFU/ml</td>
</tr>
<tr>
<td>• Protected specimen brushing (B-PSB)</td>
<td>≥10³ CFU/ml</td>
</tr>
<tr>
<td>3. Non bronchoscopically (NB) obtained (blind) specimens</td>
<td></td>
</tr>
<tr>
<td>• NB-BAL</td>
<td>≥10⁴ CFU/ml</td>
</tr>
<tr>
<td>• NB-PSB</td>
<td>≥10³ CFU/ml</td>
</tr>
<tr>
<td>4. Endotracheal aspirate (ETA)</td>
<td>≥ 10⁵ CFU/ml</td>
</tr>
</tbody>
</table>

- CFU = colony forming units
- Consult with your laboratory to determine if reported semi-quantitative results match the quantitative thresholds. In the absence of additional information available from your laboratory, a semi-quantitative result of “moderate” or “heavy” or “many” or “numerous” growth, or 2+, 3+ or 4+ growth is considered to correspond.
- *Open-lung biopsy specimens and immediate post-mortem specimens obtained by transthoracic or trans bronchial biopsy.
Collection of denominator data for VAP

1. **Manual, daily:**
   - Patient days and ventilator days should be collected at the same time, every day, for each location performing surveillance to ensure that differing collection methods don’t inadvertently result in device days being > patient days.

2. **Electronic sources:**
   - When patient days and ventilator days are available from electronic databases, these sources may be used as long as the counts are not substantially different (+/- 5%) from those collected manually.

### Analysis of VAP

<table>
<thead>
<tr>
<th>Measure</th>
<th>Calculation</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>VAP Rates</strong></td>
<td>The number of VAPs for a location</td>
<td>Location specific measure</td>
</tr>
<tr>
<td></td>
<td>X1000 The number of ventilator days for that location</td>
<td></td>
</tr>
<tr>
<td><strong>VAP SIR</strong></td>
<td>The number of observed VAPs</td>
<td>Both location specific and summarized measure</td>
</tr>
<tr>
<td></td>
<td>The number of predicted VAPs</td>
<td></td>
</tr>
<tr>
<td><strong>Ventilator DUR</strong></td>
<td>The number of ventilator days for a location</td>
<td>Location specific measure</td>
</tr>
<tr>
<td></td>
<td>The number of patient days for that location</td>
<td></td>
</tr>
<tr>
<td><strong>Ventilator SUR</strong></td>
<td>The number of observed ventilator days</td>
<td>Both location specific and summarized measure</td>
</tr>
<tr>
<td></td>
<td>The number of predicted ventilator days</td>
<td></td>
</tr>
</tbody>
</table>

SIR, Standardized Infection Ratio; DUR, Device Utilization Ratio; SUR, Standardized Utilization Ratio
12.4 Ventilator-Associated Events (VAE)

VAE:

- VAE events are identified by using a combination of objective criteria: deterioration in respiratory status after a period of stability or improvement on the ventilator, evidence of infection or inflammation, and laboratory evidence of respiratory infection.
- Ventilator is defined as a device to assist or control respiration continuously, inclusive of the weaning period, through a tracheostomy or by endotracheal intubation. The ventilator has to be in place for >2 days.
- The VAE definition algorithm is for use in surveillance; it is not a clinical definition algorithm and is not intended for use in the clinical management of patients.
- Three tiers of VAE definitions - hierarchical
  - Ventilator-Associated Condition (VAC)
  - Infection-related Ventilator-Associated Complications (IVAC)
  - Possible Ventilator-Associated Pneumonia (PVAP)

Surveillance settings:

- VAE surveillance can be done in any inpatient location where denominator data can be collected.
- Currently it is implemented in adult ICUs and SCA, step-down units, wards.
- This chapter refer to adult VAE. Pediatric and neonatal VAE will be discussed in a separate chapter and will be implemented in 2021.

Surveillance methodology:

- Active
- Patient based
- Prospective
- Priority-directed targeted
- Yield risk-adjusted incidence rates
Ventilator:
- Any device used to support, assist or control respiration (inclusive of the weaning period) through the application of positive pressure to the airway when delivered via an artificial airway, specifically an oral/nasal endotracheal or tracheostomy tube.
- Lung expansion devices such as intermittent positive-pressure breathing (IPPB); nasal positive end-expiratory pressure (nasal PEEP); and continuous nasal positive airway pressure (CPAP, hypoCPAP) are not considered ventilators unless delivered via tracheostomy or endotracheal intubation (e.g., ET-CPAP).
- Patients on Airway Pressure Release Ventilation (APRV) or related modes of mechanical ventilation (e.g., BiLevel, Bi Vent, BiPhasic, PCV+, DuoPAP) are INCLUDED in VAE protocol, but the VAE period of stability or improvement on the ventilator and the period of worsening oxygenation should be determined by changes in FiO2 only, since changes in PEEP may not be applicable to APRV.

Ventilator removal and reinsertion:
- If ventilator was removed and reinserted before a full calendar day without a ventilator, then continue the day count.
- Therefore, if the patient is without a ventilator for at least one full calendar day (NOT to be read as 24 hours), then start a new day count.
- **Episode of mechanical ventilation:** the period of days during which the patient was mechanically ventilated for some portion of each consecutive day.

<table>
<thead>
<tr>
<th>Hospital days</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ventilator days</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>Extubated (4)</td>
<td>Re-intubated (5)</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>Ventilator episodes</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hospital days</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ventilator days</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>Extubated (4)</td>
<td>---</td>
<td>Re-intubated (1)</td>
<td>2</td>
</tr>
<tr>
<td>Ventilator episodes</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>---</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>
Date of event (DOE):
- The date of onset of worsening oxygenation
- This is defined as the first calendar day of the required ≥ 2-day period of worsening oxygenation following a ≥ 2-day period of stability or improvement on the ventilator.

Infection Window Period:
- It is usually a 5-day period and includes the 2 days before, the day of, and the 2 days after the VAE event date (i.e., the first day of worsening oxygenation, the day of VAE onset).
- However, it could be shorter if VAE occurs early in the course of mechanical ventilation (cannot include the first 2 days on ventilator)
- The earliest day on which VAE criteria can be fulfilled is day 4 of mechanical ventilation (where the day of intubation and initiation of mechanical ventilation is day 1)
- The earliest date of event for VAE (the date of onset of worsening oxygenation) is day 3 of mechanical ventilation

<table>
<thead>
<tr>
<th>Ventilator days</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
<th>16</th>
</tr>
</thead>
<tbody>
<tr>
<td>VAE day</td>
<td>-3</td>
<td>-2</td>
<td>-1</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Oxygenation</td>
<td>Stable/improve</td>
<td>Stable/improve</td>
<td>Stable/improve</td>
<td>Worsen</td>
<td>Worsen</td>
<td>Worsen</td>
<td>Worsen</td>
</tr>
<tr>
<td>DOE</td>
<td>Day2 before</td>
<td>Day1 before</td>
<td>DOE</td>
<td>Day1 after</td>
<td>Day2 after</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Window</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ventilator days</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>VAE day</td>
<td>-3</td>
<td>-2</td>
<td>-1</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Oxygenation</td>
<td>Stable/improve</td>
<td>Stable/improve</td>
<td>Stable/improve</td>
<td>Worsen</td>
<td>Worsen</td>
<td>Worsen</td>
<td>Worsen</td>
</tr>
<tr>
<td>DOE</td>
<td>Day2 before</td>
<td>Day1 before</td>
<td>DOE</td>
<td>Day1 after</td>
<td>Day2 after</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Window</td>
<td>Cannot include</td>
<td>Cannot include</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>
Location of attribution:

- The inpatient location where the patient was assigned on the date of the VAE event, which is further defined as date of onset of worsening oxygenation.
- OR/Post Anesthesia Care Unit/Recovery Room/dialysis unit/ERs cannot be considered a location of attribution for VAE.

Transfer Rule:

- If a VAE develops on the day of transfer or the day following transfer from one inpatient location to another in the same facility or to a new facility (where the day of transfer is day 1), the event is attributed to the transferring location.
- Example:
  - Patient on a ventilator in the SICU who has had improving oxygenation for 3 days is transferred to the MICU, still on the ventilator.
  - On the day of transfer, after the patient has arrived in the MICU, the patient experiences an acute decompensation, requiring an increase of 0.30 (30 points) in FiO2 that persists during the following calendar day.
  - VAC criteria are met on calendar day 2 in the MICU.
  - Because the onset of worsening oxygenation occurred on the day of transfer to the MICU, the VAC event is attributed to the SICU.

Multiple Transfers:

- If the patient has been transferred to more than one location on the date of VAE, or the day before, attribute the VAE to the first location in which the patient was housed the day before the date of event.

<table>
<thead>
<tr>
<th>Date</th>
<th>3/22</th>
<th>3/23</th>
<th>3/24</th>
</tr>
</thead>
<tbody>
<tr>
<td>Locations</td>
<td>Unit A</td>
<td>Unit A</td>
<td>Unit C</td>
</tr>
<tr>
<td></td>
<td>Unit B</td>
<td>Unit D</td>
<td>VAE was diagnosed</td>
</tr>
</tbody>
</table>

- VAE is attributed to Unit A since Unit A was the first location in which the patient was housed the day before the date of event.
Repeat Infection time frame (RIT)

- A new VAE cannot be identified or reported until a 14-day period has elapsed after the day of onset of worsening oxygenation (the event date, day 1).
- However, the period of stability can be diagnosed during the defined 14 days

Secondary BSIs:

- Secondary BSIs may be reported for PVAP events but NOT reported for VAC or IVAC events provided that:
  - The organism identified from blood specimen matches an organism identified from an appropriate respiratory specimen (respiratory secretions, pleural fluid and lung tissue).
  - Collection times: respiratory specimen have been collected during the 5-day infection window and the positive blood specimen collected during the 14-day event period starting by the date of event
  - In cases where PVAP is met with only the histopathology criterion and there is a positive blood specimen a secondary BSI is not reported
  - Do not limit reporting to just those organisms isolated in culture. For example, influenza A identified by PCR in respiratory specimen and culture of blood specimen, a secondary BSI is reported

Measurements of oxygen requirement

- **Fraction of Inspired Oxygen** (FiO2) is oxygen concentration (%) is typically maintained below 0.5 even with ventilation, to avoid oxygen toxicity. Natural air includes 20.9% oxygen, which is equivalent to FiO2 of 0.21.
- **Positive end-expiratory pressure** (PEEP) is the pressure in the lungs above atmospheric pressure applied by a ventilator. A small amount of applied PEEP (0 to 5 cmH2O) is used in most mechanically ventilated patients to mitigate end-expiratory alveolar collapse
Daily minimum PEEP

- The lowest value of PEEP during a calendar day that is set on the ventilator and maintained for at least 1 hour.
- In the event that ventilator settings are monitored and recorded less frequently than once per hour or where there is no value that is documented to have been maintained for at least one hour, the daily minimum PEEP is simply the lowest value of PEEP set on the ventilator during the calendar day.
- EXAMPLE: The patient is intubated and the PEEP is set at the following values through the remainder of the calendar day:

<table>
<thead>
<tr>
<th>Time-1</th>
<th>6:00 PM</th>
<th>7:00 PM</th>
<th>8:00 PM</th>
<th>9:00 PM</th>
<th>10:00 PM</th>
<th>11:00 PM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value-1</td>
<td>10</td>
<td>8</td>
<td>5</td>
<td>5</td>
<td>8</td>
<td>8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Time-2</th>
<th>6:00 PM</th>
<th>7:00 PM</th>
<th>8:00 PM</th>
<th>9:00 PM</th>
<th>10:00 PM</th>
<th>11:00 PM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value-2</td>
<td>8</td>
<td>5</td>
<td>8</td>
<td>5</td>
<td>8</td>
<td>8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Time-3</th>
<th>12:00 AM</th>
<th>4:00 AM</th>
<th>8:00 AM</th>
<th>12:00 PM</th>
<th>4:00 PM</th>
<th>8:00 PM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value-3</td>
<td>5</td>
<td>8</td>
<td>5</td>
<td>8</td>
<td>8</td>
<td>10</td>
</tr>
</tbody>
</table>

- In the first example, the daily minimum PEEP for the purposes of VAE surveillance is 5 cmH2O. It was the lowest value that is maintained for one hour.
- In the second example, the daily minimum PEEP for the purposes of VAE surveillance is 8 cmH2O. The value 5 cmH2O cannot be used as it was not maintained for one hour.
- In the third example, the daily minimum PEEP is 5 cmH2O. PEEP settings are being monitored and recorded every 4 hours; therefore, the lowest recorded PEEP setting for the calendar day is the value used in VAE surveillance.
**Daily minimum FiO2**

- The lowest value of FiO2 during a calendar day that is set on the ventilator and maintained for at least 1 hour
- In the event that ventilator settings are monitored and recorded less frequently than once per hour or where there is no value that has been maintained for at least one hour, the daily minimum FiO2 is simply the lowest value of FiO2 set on the ventilator during the calendar day.
- **EXAMPLE:** The patient is intubated and the FiO2 is set at the following values through the remainder of the calendar day:

<table>
<thead>
<tr>
<th>Time-1</th>
<th>6:00 PM</th>
<th>7:00 PM</th>
<th>8:00 PM</th>
<th>9:00 PM</th>
<th>10:00 PM</th>
<th>11:00 PM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value-1</td>
<td>1.0</td>
<td>0.8</td>
<td>0.5</td>
<td>0.5</td>
<td>0.8</td>
<td>0.8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Time-2</th>
<th>6:00 PM</th>
<th>7:00 PM</th>
<th>8:00 PM</th>
<th>9:00 PM</th>
<th>10:00 PM</th>
<th>11:00 PM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value-2</td>
<td>0.8</td>
<td>0.8</td>
<td>0.5</td>
<td>0.8</td>
<td>0.5</td>
<td>0.8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Time-3</th>
<th>2:00 PM</th>
<th>4:00 PM</th>
<th>6:00 PM</th>
<th>8:00 PM</th>
<th>10:00 PM</th>
<th>12:00 AM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value-3</td>
<td>1.00</td>
<td>0.60</td>
<td>0.40</td>
<td>0.50</td>
<td>0.55</td>
<td>0.60</td>
</tr>
</tbody>
</table>

- In the first example, the daily minimum FiO2 for the purposes of VAE surveillance is 0.5. It was the lowest value that is maintained for one hour
- In the second example, the daily minimum FiO2 for the purposes of VAE surveillance is 0.8. The value 0.5 cannot be used as it was not maintained for one hour
- In the third example, the daily minimum FiO2 is 0.40. FiO2 settings are being monitored and recorded every 2 hours; therefore, the lowest recorded FiO2 setting for the calendar day is the value used in VAE surveillance.
Layers of VAE events

- **Ventilator-Associated Condition (VAC):** After a period of stability or improvement on the ventilator sustained for ≥ 2 calendar days, the patient has **one** the following indicators of worsening oxygenation that sustained for ≥ 2 calendar days;
  - Increase in daily minimum FiO2 values of ≥ 0.20 points or
  - Increase in daily minimum PEEP values of ≥ 3 cm H2O

- **Infection-related Ventilator-Associated Complication (IVAC):** After meeting the criteria of VAC, the patient meets the following **two** criteria;
  - Temperature > 38 °C or < 36°C, OR white blood cell count ≥ 12,000 cells/mm3 or ≤ 4,000 cells/mm3
  - A new antimicrobial agent(s) is started, and is continued for ≥ 4 calendar days

- **Possible Ventilator-Associated Pneumonia (PVAP):** After meeting the criteria of VAC or IVAC, the patient meets **one** of the following criteria;
  - **Criterion 1:** Positive culture of respiratory specimens without requirement for purulent respiratory secretions.
  - **Criterion 2:** Purulent respiratory secretions plus organism identified from defined respiratory specimens.
  - **Criterion 3:** One of the following positive tests: Organism identified from pleural fluid, Lung histopathology, Legionella detection, or viral detection.
1. **Ventilator-Associated Condition (VAC)**

After a period of stability or improvement on the ventilator sustained for ≥ 2 calendar days, the patient has **one** the following indicators of worsening oxygenation;

- Increase in daily minimum FiO2 values of ≥ 0.20 points or
- Increase in daily minimum PEEP values of ≥ 3 cm H2O

**EXAMPLE:** In the example below, the baseline period is defined by mechanical ventilation (MV) days 1 through 4 (shaded in light gray), and the period of worsening oxygenation by MV days 5 and 6 (shaded in darker gray), where the daily minimum PEEP is ≥ 3 cmH2O greater than the daily minimum PEEP of the first day in the baseline period. Note that there is no VAC on MV day 3, because PEEP values 0-5 cmH2O are considered equivalent for the purposes of this surveillance.

<table>
<thead>
<tr>
<th>Ventilator day</th>
<th>Daily minimum PEEP (cmH2O)</th>
<th>Daily minimum FiO2 (%)</th>
<th>VAE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>50%</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>50%</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td>50%</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>8</td>
<td>50%</td>
<td>VAC</td>
</tr>
<tr>
<td>6</td>
<td>8</td>
<td>50%</td>
<td></td>
</tr>
</tbody>
</table>

**EXAMPLE:** In the example below, the baseline period is defined by mechanical ventilation (MV) days 3 and 4 (shaded in light gray), and the period of worsening oxygenation by MV days 5 and 6 (shaded in darker gray), where the daily minimum FiO2 is ≥ 0.20 (20 points) over the daily minimum FiO2 of the first day in the baseline period.

<table>
<thead>
<tr>
<th>Ventilator day</th>
<th>Daily minimum PEEP (cmH2O)</th>
<th>Daily minimum FiO2 (%)</th>
<th>VAE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>8</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>6</td>
<td>50%</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>5</td>
<td>40%</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td>40%</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>6</td>
<td>70%</td>
<td>VAC</td>
</tr>
<tr>
<td>6</td>
<td>6</td>
<td>70%</td>
<td></td>
</tr>
</tbody>
</table>
EXAMPLE: In the example below, there is no VAC, because the FiO2 on MV day 4 is higher than the FiO2 on MV day 3 (and therefore not stable or decreasing) – even though the FiO2 on MV days 3 and 4 meets the 20-point threshold when compared with the daily minimum FiO2 on MV days 5 and 6.

<table>
<thead>
<tr>
<th>Ventilator day</th>
<th>Daily minimum PEEP (cmH2O)</th>
<th>Daily minimum FIO2 (%)</th>
<th>VAE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>8</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>6</td>
<td>50%</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>5</td>
<td>35%</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td>40%</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>6</td>
<td>70%</td>
<td>No event</td>
</tr>
<tr>
<td>6</td>
<td>6</td>
<td>70%</td>
<td></td>
</tr>
</tbody>
</table>
2. Infection-related Ventilator-Associated Complication (IVAC):

After meeting the criteria of VAC, the patient meets the following two criteria:

- Temperature > 38 °C or < 36°C, OR white blood cell count ≥ 12,000 cells/mm³ or ≤ 4,000 cells/mm³
- A new antimicrobial agent(s) is started, and is continued for ≥ 4 calendar days

New antimicrobial agent:

- Any agent initiated on or after the third calendar day of mechanical ventilation AND in the VAE Window Period
- The agent is considered new for the purposes of this definition if it was NOT given to the patient during the 2-days before the window
- Qualifying Antimicrobial Day (QAD): day on which the patient was administered an antimicrobial agent that was determined to be “new” within the VAE Window Period
- Four consecutive QADs are needed to meet the IVAC antimicrobial criterion
- The requirement for 4 consecutive QADs can be met with 4 days of therapy with the same antimicrobial (with a gap of no more than 1 calendar day between administrations of that antimicrobial) or it can be met with 4 days of therapy with multiple antimicrobial agents, as long as each antimicrobial was started within the VAE Window Period.

Routes of administration of new antimicrobial agent

<table>
<thead>
<tr>
<th>Route of Administration</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intravenous</td>
<td>An intravascular route that begins with a vein.</td>
</tr>
<tr>
<td>Intramuscular</td>
<td>A route that begins within a muscle</td>
</tr>
<tr>
<td>Digestive Tract</td>
<td>A route that begins anywhere in the digestive tract extending from the mouth through rectum.</td>
</tr>
<tr>
<td>Respiratory Tract</td>
<td>A route that begins within the respiratory tract, including the oropharynx and nasopharynx.</td>
</tr>
</tbody>
</table>
Qualifying Antimicrobial Day (QAD):

<table>
<thead>
<tr>
<th>Ventilator days</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oxygenation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stable/improve</td>
<td>Stable/improve</td>
<td>Worsen</td>
<td>Worsen</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Antimicrobial agent</td>
<td>Ceftriaxone</td>
<td>Ceftriaxone</td>
<td>Ceftriaxone</td>
<td>Meropenem</td>
<td>Meropenem</td>
<td>Meropenem</td>
<td>Meropenem</td>
</tr>
<tr>
<td>QAD</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

- Meropenem is a new start while ceftriaxone is not as it was given to the patient the day before the 5-day period (infection window period).
- The number of QAD is 4

<table>
<thead>
<tr>
<th>Ventilator days</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oxygenation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stable/improve</td>
<td>Stable/improve</td>
<td>Worsen</td>
<td>Worsen</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Antimicrobial agent</td>
<td>Ceftriaxone</td>
<td>Ceftriaxone</td>
<td>Ceftriaxone</td>
<td>Meropenem</td>
<td>Imipenem</td>
<td>Piperacillin/Tazobactam</td>
<td>Piperacillin/Tazobactam</td>
</tr>
<tr>
<td>QAD</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

- Meropenem, Imipenem and Piperacillin/Tazobactam are new start while ceftriaxone is not as it was given to the patient the day before the 5-day period.
- The number of QAD is 4

<table>
<thead>
<tr>
<th>Ventilator days</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oxygenation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stable/improve</td>
<td>Stable/improve</td>
<td>Worsen</td>
<td>Worsen</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Antimicrobial agent</td>
<td></td>
<td></td>
<td></td>
<td>Levofloxacin</td>
<td>Levofloxacin</td>
<td>Levofloxacin</td>
<td>Levofloxacin</td>
</tr>
<tr>
<td>QAD</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

- Because there is a gap of no more than 1 calendar day between days of levofloxacin administration, the requirement for 4 consecutive QADs is met.
- The number of QAD is 5

<table>
<thead>
<tr>
<th>Ventilator days</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oxygenation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stable/improve</td>
<td>Stable/improve</td>
<td>Worsen</td>
<td>Worsen</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Antimicrobial agent</td>
<td></td>
<td></td>
<td></td>
<td>Vancomycin</td>
<td>Vancomycin</td>
<td></td>
<td></td>
</tr>
<tr>
<td>QAD</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Because there is a gap of more than 1 calendar day between days of vancomycin administration, the requirement for 4 consecutive QADs is not met.
- The number of QAD is 0
3. Possible Ventilator-Associated Pneumonia (PVAP):  

After meeting the criteria of VAC or IVAC, the patient meets one of the following criteria:

**Criterion 1:** Positive culture of one of the following specimens, meeting quantitative or semi-quantitative thresholds, without requirement for purulent respiratory secretions:

- Endotracheal aspirate, \( \geq 105 \text{ CFU/ml} \) or corresponding semi-quantitative result
- Bronchoalveolar lavage, \( \geq 104 \text{ CFU/ml} \) or corresponding semi-quantitative result
- Lung tissue, \( \geq 104 \text{ CFU/g} \) or corresponding semi-quantitative result
- Protected specimen brush, \( \geq 103 \text{ CFU/ml} \) or corresponding semi-quantitative result

**Criterion 2:** Purulent respiratory secretions PLUS organism identified from one of the following specimens (to include qualitative culture, or quantitative/semi-quantitative culture without sufficient growth to meet criterion #1):

- Sputum
- Endotracheal aspirate
- Bronchoalveolar lavage
- Lung tissue
- Protected specimen brush

**Criterion 3:** One of the following positive tests:

- Organism identified from pleural fluid (where specimen was obtained during thoracentesis or initial placement of chest tube and NOT from an indwelling chest tube)
- Lung histopathology, defined as: 1) abscess formation or foci of consolidation with intense neutrophil accumulation in bronchioles and alveoli; 2) evidence of lung parenchyma invasion by fungi (hyphae, pseudohyphae or yeast forms); 3) evidence of infection with the viral pathogens listed below based on results of immunohistochemical assays, cytology, or microscopy performed on lung tissue
- Diagnostic test for Legionella species
- Diagnostic test on respiratory secretions for influenza virus, respiratory syncytial virus, adenovirus, parainfluenza virus, rhinovirus, human metapneumovirus, coronavirus

**Criterion 1-PVAP:** Threshold values for cultured specimens used in the diagnosis of pneumonia

<table>
<thead>
<tr>
<th>Specimen collection/technique</th>
<th>Values*</th>
</tr>
</thead>
<tbody>
<tr>
<td>5. Lung tissue</td>
<td>( \geq 10^4 ) CFU/g tissue</td>
</tr>
<tr>
<td>6. Bronchoscopically (B) obtained specimens</td>
<td></td>
</tr>
<tr>
<td>• Broncho alveolar lavage (B-BAL)</td>
<td>( \geq 10^4 ) CFU/ml</td>
</tr>
<tr>
<td>• Protected BAL (B-PBAL)</td>
<td>( \geq 10^4 ) CFU/ml</td>
</tr>
<tr>
<td>• Protected specimen brushing (B-PSB)</td>
<td>( \geq 10^3 ) CFU/ml</td>
</tr>
<tr>
<td>7. Non bronchoscopically (NB) obtained (blind)specimens</td>
<td></td>
</tr>
<tr>
<td>• NB-BAL</td>
<td>( \geq 10^4 ) CFU/ml</td>
</tr>
<tr>
<td>• NB-PSB</td>
<td>( \geq 10^3 ) CFU/ml</td>
</tr>
<tr>
<td>8. Endotracheal aspirate (ETA)</td>
<td>( \geq 10^5 ) CFU/ml</td>
</tr>
</tbody>
</table>
Collection of denominator data for VAE

1. **Manual, daily:**
   - patient days and ventilator days should be collected at the same time, every day, for each location performing surveillance to ensure that different collection methods don’t result in device days being > patient days.

2. **Electronic sources:**
   - When patient days and ventilator days are available from electronic databases, these sources may be used as long as the counts are not substantially different (+/- 5%) from those collected manually.

### Analysis of VAE

<table>
<thead>
<tr>
<th>Measure</th>
<th>Calculation</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>VAE Rates</td>
<td>The number of VAES for a location / The number of ventilator days for that location x 1000</td>
<td>Location specific measure</td>
</tr>
<tr>
<td>VAE Rates</td>
<td>The number of VAES for a location / The number of ventilator episodes for that location x 100</td>
<td>Location specific measure</td>
</tr>
<tr>
<td>VAE SIR</td>
<td>The number of observed VAES / The number of predicted VAES</td>
<td>Both location specific and summarized measure</td>
</tr>
<tr>
<td>Ventilator DUR</td>
<td>The number of ventilator days for a location / The number of patient days for that location</td>
<td>Location specific measure</td>
</tr>
<tr>
<td>Ventilator SUR</td>
<td>The number of observed ventilator days / The number of predicted ventilator days</td>
<td>Both location specific and summarized measure</td>
</tr>
</tbody>
</table>

SIR, Standardized Infection Ratio; DUR, Device Utilization Ratio; SUR, Standardized Utilization Ratio
12.5 Pediatric VAE

Pediatric VAE:

- Ped VAE is identified by deterioration in respiratory status after a period of stability or improvement on the ventilator
- Ped VAE definition algorithm is for use in surveillance; it is not a clinical definition algorithm and is not intended for use in the clinical management of patients

Surveillance settings:

- Ped VAE surveillance is implemented in neonatal and pediatric locations including ICUs and SCA, step-down units, wards

Baseline period of stability or improvement:

- The baseline period of stability or improvement on the ventilator is defined as the 2 calendar days immediately preceding the first day of deterioration in respiratory status as evidenced by increased daily minimum
  - Fraction of inspired oxygen (FiO2) OR
  - Mean Airway Pressure (MAP)

Surveillance methodology: Similar to adult VAE
Date of event: Similar to adult VAE
Infection Window Period: Not applicable
Ventilator: Similar to adult VAE
Episode of mechanical ventilation: Similar to adult VAE
Location of attribution: Similar to adult VAE
Secondary BSI: It is not reported or attributable to a Ped VAE which is not a clinical diagnosis (clinical data required to diagnose IVAC and PVAP as in adult VAE are not collected or reported in Ped VAE surveillance).
Daily minimum FiO2

- Similar to adult VAE, the lowest value of FiO2 during a calendar day that is set on the ventilator and maintained for at least 1 hour.
- In the event that ventilator settings are monitored and recorded less frequently than once per hour or where there is no value that has been maintained for at least one hour, the daily minimum FiO2 is simply the lowest value of FiO2 set on the ventilator during the calendar day.
- In units tracking FiO2 every 30 minutes, 3 consecutive recordings of FiO2 at a certain level would be needed to meet the required > 1 hour minimum duration.
- EXAMPLE: The patient is intubated and the FiO2 is set at the following values through the remainder of the calendar day:

<table>
<thead>
<tr>
<th>Time-1</th>
<th>6:00 PM</th>
<th>7:00 PM</th>
<th>8:00 PM</th>
<th>9:00 PM</th>
<th>10:00 PM</th>
<th>11:00 PM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value-1</td>
<td>1.0</td>
<td>0.8</td>
<td>0.5</td>
<td>0.5</td>
<td>0.8</td>
<td>0.8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Time-2</th>
<th>6:00 PM</th>
<th>7:00 PM</th>
<th>8:00 PM</th>
<th>9:00 PM</th>
<th>10:00 PM</th>
<th>11:00 PM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value-2</td>
<td>0.8</td>
<td>0.8</td>
<td>0.5</td>
<td>0.8</td>
<td>0.5</td>
<td>0.8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Time-3</th>
<th>2:00 PM</th>
<th>4:00 PM</th>
<th>6:00 PM</th>
<th>8:00 PM</th>
<th>10:00 PM</th>
<th>12:00 AM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value-3</td>
<td>1.00</td>
<td>0.60</td>
<td>0.40</td>
<td>0.50</td>
<td>0.55</td>
<td>0.60</td>
</tr>
</tbody>
</table>

- In the first example, the daily minimum FiO2 for the purposes of VAE surveillance is 0.5. It was the lowest value that is maintained for one hour.
- In the second example, the daily minimum FiO2 for the purposes of VAE surveillance is 0.8. The value 0.5 cannot be used as it was not maintained for one hour.
- In the third example, the daily minimum FiO2 is 0.40. FiO2 settings are being monitored and recorded every 2 hours; therefore, the lowest recorded FiO2 setting for the calendar day is the value used in VAE surveillance.
Mean Airway Pressure (MAP)

- MAP: the average pressure exerted on the airway and lungs from the beginning of inspiration until the beginning of the next inspiration.
- MAP is determined by peak end-expiratory pressure (PEEP), peak inspiratory pressure (PIP), inspiratory time and frequency
- A sustained increase in the daily minimum MAP of ≥ 4 cmH2O following a period of stability or improvement on the ventilator

Daily minimum MAP:

- The daily minimum MAP is the lowest value documented during a calendar day (the value does not need to be maintained for > 1 hour)
- EXAMPLE: The patient (<30 days old) is intubated and MAP values through the remainder of the calendar day are as follows:

<table>
<thead>
<tr>
<th>Time-1</th>
<th>6:00 PM</th>
<th>7:00 PM</th>
<th>8:00 PM</th>
<th>9:00 PM</th>
<th>10:00 PM</th>
<th>11:00 PM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value-1</td>
<td>12</td>
<td>11</td>
<td>9</td>
<td>9</td>
<td>11</td>
<td>11</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Time-2</th>
<th>6:00 PM</th>
<th>7:00 PM</th>
<th>8:00 PM</th>
<th>9:00 PM</th>
<th>10:00 PM</th>
<th>11:00 PM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value-2</td>
<td>12</td>
<td>12</td>
<td>10</td>
<td>12</td>
<td>10</td>
<td>12</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Time-3</th>
<th>1:00 AM</th>
<th>4:00 AM</th>
<th>8:00 AM</th>
<th>12:00 PM</th>
<th>4:00 PM</th>
<th>8:00 PM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value-3</td>
<td>9</td>
<td>11</td>
<td>9</td>
<td>11</td>
<td>11</td>
<td>12</td>
</tr>
</tbody>
</table>

- In the first example, the daily minimum MAP for the purposes of Ped VAE surveillance is 9 cmH2O (absolute lowest value).
- In the second example, the daily minimum MAP is 10 cmH2O (absolute lowest value).
- In the third example, the daily minimum MAP is 9 cmH2O (absolute lowest value).
Worsening of oxygenation

After a period of stability or improvement on the ventilator, the patient has at least one of the following indicators of worsening oxygenation:

- Increase in daily minimum FiO2 of ≥ 0.25 (25 points) over the daily minimum FiO2 of the first day in the baseline period, sustained for ≥ 2 calendar days.
- Increase in daily minimum MAP values of ≥ 4 cmH2O over the daily minimum MAP of the first day in the baseline period, sustained for ≥ 2 calendar days.
  - For patients <30 days old, daily minimum MAP values 0-8 cm H2O are considered equal to 8 cmH2O for the purposes of surveillance.
  - For patients ≥30 days old, daily minimum MAP values 0-10 cmH2O are considered equal to 10 cmH2O for the purposes of surveillance.

Diagnosis of Ped VAE events:

**EXAMPLE:** In the example below, in a patient < 30 days old, the baseline period is defined by mechanical ventilation (MV) days 1 through 4 (shaded in light gray), and the period of worsening oxygenation by MV days 5 and 6 (shaded in darker gray), where the daily minimum MAP is ≥ 4 cmH2O greater than the daily minimum MAP during the baseline period (keeping in mind that daily minimum MAP values 0-8 cmH2O in a patient <30 days should be considered to be equal to 8 cmH2O for the purposes of surveillance.

<table>
<thead>
<tr>
<th>Ventilator day</th>
<th>Daily minimum MAP (cmH2O)</th>
<th>Daily minimum FIO2 (%)</th>
<th>VAE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>7 (8)</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>7 (8)</td>
<td>50%</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>8</td>
<td>50%</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>8</td>
<td>50%</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>12</td>
<td>50%</td>
<td>Ped VAE</td>
</tr>
<tr>
<td>6</td>
<td>12</td>
<td>50%</td>
<td></td>
</tr>
</tbody>
</table>
EXAMPLE: In the example below, the baseline period is defined by mechanical ventilation (MV) days 3 and 4 (shaded in light gray), and the period of worsening oxygenation by MV days 5 and 6 (shaded in darker gray), where the daily minimum FiO2 is ≥ 0.25 (25 points) over the daily minimum FiO2 during the baseline period.

<table>
<thead>
<tr>
<th>Ventilator day</th>
<th>Daily minimum MAP (cmH2O)</th>
<th>Daily minimum FiO2 (%)</th>
<th>VAE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>12</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>11</td>
<td>50%</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>9</td>
<td>40%</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>9</td>
<td>40%</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>11</td>
<td>70%</td>
<td>Ped VAE</td>
</tr>
<tr>
<td>6</td>
<td>11</td>
<td>70%</td>
<td></td>
</tr>
</tbody>
</table>

EXAMPLE: In the example below, there is no PedVAE, because the FiO2 on MV day 4 is higher than the FiO2 on MV day 3 (and therefore not stable or decreasing) – even though the FiO2 on MV days 3 and 4 meets the 25-point threshold when compared with the daily minimum FiO2 on MV days 5 and 6.

<table>
<thead>
<tr>
<th>Ventilator day</th>
<th>Daily minimum MAP (cmH2O)</th>
<th>Daily minimum FiO2 (%)</th>
<th>VAE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>12</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>11</td>
<td>50%</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>9</td>
<td>35%</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>9</td>
<td>40%</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>11</td>
<td>70%</td>
<td>No event</td>
</tr>
<tr>
<td>6</td>
<td>11</td>
<td>70%</td>
<td></td>
</tr>
</tbody>
</table>
Collection of denominator data for Ped VAE

3. **Manual, daily:**
   - patient days and ventilator days should be collected at the same time, every day, for each location performing surveillance to ensure that different collection methods don’t result in device days being > patient days.

4. **Electronic sources:**
   - When patient days and ventilator days are available from electronic databases, these sources may be used as long as the counts are not substantially different (+/- 5%) from those collected manually.

### Analysis of Ped VAE

<table>
<thead>
<tr>
<th>Measure</th>
<th>Calculation</th>
<th>Application</th>
</tr>
</thead>
</table>
| Ped VAE Rates | \[
|               | \frac{\text{The number of Ped VAEs for a location}}{\text{The number of ventilator days for that location}} \times 1000 \] | Location specific measure    |
| Ped VAE Rates | \[
|               | \frac{\text{The number of Ped VAEs for a location}}{\text{The number of ventilator episodes for that location}} \times 100 \] | Location specific measure    |
| Ventilator DUR| \[
|               | \frac{\text{The number of ventilator days for a location}}{\text{The number of patient days for that location}} \] | Location specific measure    |

DUR, Device Utilization Ratio
12.6 Dialysis Events (DE)

Dialysis Event (DE):

DE could be one or more of the following types:

- **In-unit IV antimicrobial start**: Include all IV antimicrobial starts, not just those with vancomycin or for a vascular access problem.

- **Positive blood culture**: Include all patients with a positive blood culture even if they did not have an associated hospitalization or in-unit IV antimicrobial start. Include blood cultures taken as an outpatient or within 1 day after a hospital admission. Access-associated bacteremia is a positive blood culture with source identified as the vascular access site or unknown.

- **Pus, redness, or increased swelling at the vascular access site**: Pus is always reportable. Report redness or swelling if it is greater than expected and suspicious for infection.

**Surveillance settings:**

- Surveillance occurs in outpatient hemodialysis centers.
- These centers may be attached to or affiliated with a hospital, but should serve hemodialysis outpatients.
- Inpatient dialysis is not included in this module

**Eligibility of patients:**

- Maintenance hemodialysis outpatients.
- Transient Patient: patients transferred from another facility and received in-center hemodialysis at our location on the first two working days of the month.

**Non-eligibility of patients:**

- If the reverse happens, our patient was transferred to another facility we do not count him/her in our denominator unless he/she received in-center hemodialysis at our location on the first two working days of the month
- Non-hemodialysis (peritoneal dialysis) patients and inpatients are excluded
Surveillance methodology

- Active
- Patient based
- Prospective
- Priority-directed targeted
- Yield risk-adjusted incidence rates
  ✓ Rates are controlled for variations in the distribution of major risk factors associated with an event’s occurrence (e.g. type of event and type of access)
  ✓ Such rates allow inter- and intra-facility rate comparisons

Date of event (DOE):

It is the date when the FIRST element used to meet the DE criterion occurs

<table>
<thead>
<tr>
<th>Event Type</th>
<th>Date of Event Criterion</th>
</tr>
</thead>
<tbody>
<tr>
<td>IV antimicrobial start</td>
<td>Date of first outpatient dose of an antimicrobial course</td>
</tr>
<tr>
<td>Positive blood culture</td>
<td>Date of specimen collection</td>
</tr>
<tr>
<td>Pus, redness, or increased swelling at the vascular access site</td>
<td>Date of onset of symptoms</td>
</tr>
<tr>
<td>Combination</td>
<td>Earliest date of the three types</td>
</tr>
</tbody>
</table>

Vascular access:

Hemodialysis vascular access types, in order of increasing risk of infection, include:

1. Arteriovenous fistulas created from the patient’s own blood vessels
2. Arteriovenous grafts often constructed from synthetic materials
3. Tunneled central lines
4. Non-tunneled central lines
5. Post access device
Arterio-venous fistula
A surgically created direct connection between an artery and a vein to provide vascular access

Arterio-venous graft
A surgically created connection between an artery and a vein using implanted synthetic tubing for the purpose to provide a permanent vascular access

Temporary central line
A central venous catheter that travels directly from the skin entry site to a vein and terminates close to the heart or one of the great vessels, typically intended for short term use.

Permanent central line
A central venous catheter that travels a distance under the skin from the point of insertion before terminating at or close to the heart or one of the great vessels (e.g., Hickman® or Broviac® catheters).

Port access device
A fully implantable access device e.g., Lifesite
21 day rule:

- 21 or more days must exist between two dialysis events of the same type for the second occurrence to be reported as a separate dialysis event.
- The 21 day rule applies across calendar months.
- If fewer than 21 days have passed since the last reported event of the same type, the subsequent event is not reported.

**IV antimicrobial start**

From the end of one (reported) IV antimicrobial course to the beginning of a second IV antimicrobial start.

**Positive blood culture**

From date of first (reported) culture to date of second culture.

**Local infection**

From onset of first (reported) episode to the onset of a second episode.
1- IV antimicrobial start

- Report all starts of intravenous (IV) antibiotics or antifungals administered in an outpatient setting, regardless of the reason for administration (i.e., include IV antimicrobial starts unrelated to vascular access problems) and regardless of the duration of treatment.
- A start is defined as a single outpatient dose or first outpatient dose of a course.
- Report outpatient starts that are continuations of inpatient treatment or another outpatient dialysis facility
- Do not report IV antiviral starts
- There must be 21 or more days from the end of the first IV antimicrobial start to the beginning of a second IV antimicrobial start for two starts to be considered separate dialysis events, even if different antimicrobials are used.
- If IV antimicrobials are stopped for less than 21 days and then restarted, the second start is NOT considered a new dialysis event.
- To apply the 21 day rule to outpatient IV antimicrobial starts that are continuations of inpatient treatment, consider the start day to be the first day of outpatient treatment.
- Inter-facility patient transfers: If a patient at a dialysis facility has an IV antimicrobial start and then transfers to another facility (as a transient or permanent patient) where the antimicrobial is continued, the second facility would report the IV antimicrobial start in their facility as well

2- Positive blood culture

- Report all positive blood cultures collected as an outpatient or collected within the first 2 calendar days after a hospital admission, regardless of whether or not a true infection is suspected, infection is thought to be related to hemodialysis, or treatment is received
- The date of a blood culture result is based on the date the blood specimen was collected, not the date the laboratory reported the result.
• There must be 21 or more days between positive blood cultures for each positive blood culture to be considered a separate dialysis event, even if organisms are different.

• If positive blood cultures occur less than 21 days apart, the second positive blood culture(s) is NOT considered a new dialysis event: add new organisms from these subsequent positive blood cultures to the first report.

**Suspected source of the positive blood culture**

• **Vascular access:**
  ✓ If there is objective evidence of vascular access infection and the vascular access is thought to be the source of the positive blood culture.

• **A source other than the vascular access**
  ✓ If either (a) or (b) is true:
    ✓ a) a culture from another site (e.g., infected leg wound, urine) shows the same organism found in the blood and the site is thought to be the source of the positive blood culture
    ✓ b) there is clinical evidence of infection at another site which is thought to be the source of the positive blood culture, but the site was not sampled for culture

• **Contamination:**
  ✓ If the organism isolated from the blood culture is thought by the physician, infection preventionist, or head nurse to be a contaminant.
  ✓ Contamination is more likely if the organism is a common commensal and is isolated from only one blood culture.

• **Uncertain:**
  ✓ Only if there is insufficient evidence to decide among the three previous suspected source categories
3- Pus, redness, or increased swelling at the vascular access site

- Report each new outpatient episode where the patient has one or more symptoms of pus, greater than expected redness or greater than expected swelling at a vascular access site, regardless of whether the patient received treatment.
- There must be 21 or more days between the onset of a first episode and onset of a second episode of pus, redness, or increased swelling at a vascular access site to be considered separate dialysis events.
- If an episode of pus, redness, or increased swelling at a vascular access site resolves and then recurs within 21 days, the recurrence is NOT considered a new dialysis event.

Calculated dialysis events:

- Bloodstream infection:
  - Any positive blood cultures
- Local access site infection:
  - Pus, redness, or swelling of the vascular access site and bloodstream infection is not present.
- Access-related bloodstream infection:
  - Positive blood culture with the suspected source identified as the vascular access site or uncertain.
- Vascular access infection:
  - Either a local access site infection or an access-related bloodstream infection.

Numerator data:

- Complete a Dialysis Event form only if a maintenance hemodialysis outpatient has one or more of the following:
  - IV antimicrobial start
  - Positive blood culture
  - Pus, redness or increased swelling at the vascular access site
- If a patient has a positive blood culture and begins IV antimicrobials, these two events would be recorded together on one form.
• When reporting multiple dialysis events together, always use the date from the first event that occurred.
• Refer to dialysis event definitions for the 21 day rule.
• Do not report unrelated dialysis events on the same form.

**Number of forms**

<table>
<thead>
<tr>
<th>Scenario</th>
<th>IV antimicrobial start</th>
<th>Positive blood culture</th>
<th>Local infection</th>
<th>Number of forms</th>
</tr>
</thead>
<tbody>
<tr>
<td>One event type</td>
<td>X</td>
<td></td>
<td></td>
<td>One form</td>
</tr>
<tr>
<td>More than one event type in related episode in same month</td>
<td>X</td>
<td>X</td>
<td></td>
<td>One form</td>
</tr>
<tr>
<td>More than one event types in unrelated episodes in same month</td>
<td>X</td>
<td></td>
<td>X</td>
<td>Two forms</td>
</tr>
<tr>
<td>Same event type twice in the same month</td>
<td>XX</td>
<td></td>
<td></td>
<td>Two forms</td>
</tr>
<tr>
<td>Any type of events in different months</td>
<td>X</td>
<td>X</td>
<td></td>
<td>Two forms</td>
</tr>
</tbody>
</table>

**Denominator Data**

<table>
<thead>
<tr>
<th>Vascular Access Type</th>
<th>Number of Chronic Hemodialysis Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Day-1</td>
</tr>
<tr>
<td>Arterio-venous fistulas</td>
<td></td>
</tr>
<tr>
<td>Arterio-venous graft</td>
<td></td>
</tr>
<tr>
<td>Permanent central line</td>
<td></td>
</tr>
<tr>
<td>Temporary central line</td>
<td></td>
</tr>
<tr>
<td>Port access device</td>
<td></td>
</tr>
<tr>
<td>Total patients: sum of all patients listed above</td>
<td></td>
</tr>
</tbody>
</table>
• Record the number of chronic hemodialysis patients with each of the above 5 access types (individually and total) who received hemodialysis at your center on the first two working days of the month.
• Count each patient only once.
• Only chronic hemodialysis outpatients are included, including transient patients.
• A patient must be physically present for in-center hemodialysis on one of these two days to be counted on this form (exclude patients who are hospitalized).
• Exclude also non-hemodialysis patients and exclude inpatients.
• If the patient has multiple vascular accesses (even if not all used), record that patient once, reporting only their vascular access with the highest risk of infection.
• Therefore, if a patient has both an implanted access (graft or fistula) and a catheter, count this patient as having the catheter.
• If there are no patients in a given vascular access category, enter 0.
• Accurate data is strictly required in order to produce reliable rates.

**Analysis of DE:**

<table>
<thead>
<tr>
<th>Measure</th>
<th>Calculation</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DE Rates</strong></td>
<td>The number of DEs (separately or total) X100</td>
<td>Location specific measure</td>
</tr>
<tr>
<td></td>
<td>The number of patient-months</td>
<td></td>
</tr>
<tr>
<td><strong>DE SIR</strong></td>
<td>The number of observed DEs X100</td>
<td>Both location specific and summarized measure</td>
</tr>
<tr>
<td></td>
<td>The number of predicted DEs</td>
<td></td>
</tr>
</tbody>
</table>

SIR, Standardized Infection Ratio
13. Procedure-associated infections-SSI

SSI:
Infection occurs within 30 or 90 days (according to the operative procedures) after an operative procedure that involves the skin or subcutaneous tissue (superficial incisional SSI), deep soft tissue (deep incisional SSI), or any other part of the body that is opened or manipulated during the operative procedure (organ/space SSI).

Surveillance Settings:
Surveillance will occur with surgical patients in any inpatient/outpatient setting where the selected NHSN operative procedure(s) are performed.

Surveillance Methods:
- Active
- Patient based
- Prospective
- Priority-directed targeted
- Yield risk-adjusted incidence rates

Surveillance Requirements:
- Select at least one NHSN operative procedure category for at least one month
- A procedure must meet the NHSN definition of an operative procedure in order to be included in SSI surveillance.
- All procedures included in the NHSN monthly surveillance plan are followed for superficial incisional, deep incisional, and organ/space SSI events and the type of SSI reported must reflect the deepest tissue level where SSI criteria is met during the surveillance period.
- SSI events where infection present at the time of surgery (PATOS) are reported with SSI.
- An SSI event is attributed to the facility in which the NHSN operative procedure is performed.
Surveillance Types:

- Concurrent and post discharge surveillance methods should be used to detect SSIs following inpatient operative procedures
- Post-discharge surveillance for outpatient operative procedures.

Post-discharge Surveillance:

- Review of medical records or surgery clinic patient records
  - Admission, readmission, ED, and OR logs
  - Patient charts for signs and symptoms of SSI
  - Lab, imaging, other diagnostic test reports
  - Clinician notes
- Visit the ICU and wards – talk to primary care staff
- Surgeon surveys by mail or telephone
- Patient surveys by mail or telephone (though patients may have a difficult time assessing their infections).
- Review of medical records or surgery clinic patient records
- Any combination of these methods (or other methods identified by the facility) which has the capacity to identify all SSIs is acceptable for use; however, NHSN criteria for SSI must be used.

Definition of an NHSN Operative Procedure:

- Takes place during an operation where at least one incision (including laparoscopic approach and cranial Burr holes) is made through the skin or mucous membrane, or reoperation via an incision that was left open during a prior operative procedure
- And takes place in an operating room (OR), defined as a patient care area that met the Facilities Guidelines Institute’s (FGI) or American Institute of Architects’ (AIA) criteria for an operating room when it was constructed or renovated. This may include an operating room, C-section room, interventional radiology room, or a cardiac catheterization lab.
- Exclusions: Otherwise eligible procedures that are assigned an ASA score of 6 are not eligible for NHSN SSI surveillance.
### NHSN Operative Procedure:

<table>
<thead>
<tr>
<th>Code</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAA</td>
<td>Abdominal aortic aneurysm repair</td>
</tr>
<tr>
<td>AMP</td>
<td>Limb amputation</td>
</tr>
<tr>
<td>APPY</td>
<td>Appendix surgery</td>
</tr>
<tr>
<td>AVSD</td>
<td>AV shunt for dialysis</td>
</tr>
<tr>
<td>BILI</td>
<td>Bile duct, liver or pancreatic surgery</td>
</tr>
<tr>
<td>BRST</td>
<td>Breast surgery</td>
</tr>
<tr>
<td>CARD</td>
<td>Cardiac surgery</td>
</tr>
<tr>
<td>CBGB</td>
<td>Coronary bypass with chest &amp; donor incisions</td>
</tr>
<tr>
<td>CBGC</td>
<td>Coronary bypass graft with chest incision</td>
</tr>
<tr>
<td>CEA</td>
<td>Carotid endarterectomy</td>
</tr>
<tr>
<td>CHOL</td>
<td>Gallbladder surgery</td>
</tr>
<tr>
<td>COLO</td>
<td>Colon surgery</td>
</tr>
<tr>
<td>CRAN</td>
<td>Craniotomy</td>
</tr>
<tr>
<td>CSEC</td>
<td>Cesarean section</td>
</tr>
<tr>
<td>FUSN</td>
<td>Spinal fusion</td>
</tr>
<tr>
<td>FX</td>
<td>Open reduction of fracture</td>
</tr>
<tr>
<td>GAST</td>
<td>Gastric surgery</td>
</tr>
<tr>
<td>HER</td>
<td>Herniorrhaphy</td>
</tr>
<tr>
<td>HPRO</td>
<td>Hip prosthesis</td>
</tr>
<tr>
<td>HTP</td>
<td>Heart transplant</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Code</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>HYST</td>
<td>Abdominal hysterectomy</td>
</tr>
<tr>
<td>KPRO</td>
<td>Knee prosthesis</td>
</tr>
<tr>
<td>KTP</td>
<td>Kidney transplant</td>
</tr>
<tr>
<td>LAM</td>
<td>Laminectomy</td>
</tr>
<tr>
<td>LTP</td>
<td>Liver transplant</td>
</tr>
<tr>
<td>NECK</td>
<td>Neck surgery</td>
</tr>
<tr>
<td>NEPH</td>
<td>Kidney surgery</td>
</tr>
<tr>
<td>OVRY</td>
<td>Ovarian surgery</td>
</tr>
<tr>
<td>PACE</td>
<td>Pacemaker surgery</td>
</tr>
<tr>
<td>PRST</td>
<td>Prostate surgery</td>
</tr>
<tr>
<td>PVBY</td>
<td>Peripheral vascular bypass surgery</td>
</tr>
<tr>
<td>REC</td>
<td>Rectal surgery</td>
</tr>
<tr>
<td>SB</td>
<td>Small bowel surgery</td>
</tr>
<tr>
<td>SPLE</td>
<td>Spleen surgery</td>
</tr>
<tr>
<td>THOR</td>
<td>Thoracic surgery</td>
</tr>
<tr>
<td>THYR</td>
<td>Thyroid and/or parathyroid surgery</td>
</tr>
<tr>
<td>VHYS</td>
<td>Vaginal hysterectomy</td>
</tr>
<tr>
<td>VSHN</td>
<td>Ventricular shunt</td>
</tr>
<tr>
<td>XLAP</td>
<td>Exploratory laparotomy</td>
</tr>
</tbody>
</table>
Eligible surgeries under NHSN Operative Procedure:

<table>
<thead>
<tr>
<th>Code</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BRST</td>
<td>Breast surgery</td>
<td>Excision of lesion or tissue of breast including radical, modified, or quadrant resection, lumpectomy, incisional biopsy, or mammoplasty</td>
</tr>
<tr>
<td>CARD</td>
<td>Cardiac surgery</td>
<td>Procedures on the heart; includes valves or septum; does not include coronary artery bypass graft, surgery on vessels, heart transplantation, or pacemaker implantation</td>
</tr>
<tr>
<td>CBGB</td>
<td>Coronary bypass with chest &amp; donor incisions</td>
<td>Chest procedure to perform direct revascularization of the heart; includes obtaining suitable vein from donor site for grafting</td>
</tr>
</tbody>
</table>

Date of event (DOE):

- For an SSI, the date of event is the date when the first element used to meet the SSI infection criterion occurs for the first time during the SSI surveillance period.
- The date of event must fall within the SSI surveillance period to meet SSI criteria. The type of SSI (superficial incisional, deep incisional, or organ/space) reported and the date of event assigned must reflect the deepest tissue level where SSI criteria are met during the surveillance period. Synonym: infection date.
- All elements required to meet an SSI criterion usually occur within a 7 to 10-day timeframe with no more than 2-3 days between elements.
- The elements must be relational to each other, meaning you should ensure the elements all associate to the SSI, and this can only happen if elements occur in a relatively tight timeframe. Each case differs based on the individual elements occurring and the type of SSI.

Secondary BSI Attribution Period for SSI:

- The secondary BSI attribution period for SSI is a 17-day period that includes the date of SSI event, 3 days prior, and 13 days after.
Denominator for procedure details:

Diabetes:
- The NHSN SSI surveillance definition of diabetes indicates that the patient has a diagnosis of diabetes requiring management with insulin or a non-insulin anti-diabetic agent.
- This includes:
  - Patients with "insulin resistance" who are on management with anti-diabetic agents.
  - Patients with gestational diabetes.
  - Patients who are noncompliant with their diabetes medications.
- The NHSN definition of diabetes excludes patients with no diagnosis of diabetes. The definition also excludes patients who receive insulin for perioperative control of hyperglycemia but have no diagnosis of diabetes.

Duration of operative procedure:

The interval in hours and minutes between the Procedure/Surgery Start Time and the Procedure/Surgery Finish Time
- Procedure/Surgery Start Time (PST): Time when the procedure is begun (for example, incision for a surgical procedure).
- Procedure/Surgery Finish (PF): Time when all instrument and sponge counts are completed and verified as correct, all postoperative radiologic studies to be done in the OR are completed, all dressings and drains are secured, and the physicians/surgeons have completed all procedure-related activities on the patient.

Emergency operative procedure:

- A procedure that is documented per the facility’s protocol to be an Emergency or Urgent procedure.

General anesthesia:

- The administration of drugs or gases that enter the general circulation and affect the central nervous system to render the patient pain free, amnesic, unconscious, and often paralyzed with relaxed muscles. This does not include conscious sedation.
NHSN Inpatient Operative Procedure:

- An NHSN operative procedure performed on a patient whose date of admission to the healthcare facility and the date of discharge are different calendar days.

NHSN Outpatient Operative Procedure:

- An NHSN operative procedure performed on a patient whose date of admission to the healthcare facility and date of discharge are the same calendar day.

Non-primary Closure:

- The closure of the surgical wound in a way which leaves the skin level completely open following the surgery. Closure of any portion of the skin represents primary closure.
- For surgeries with non-primary closure, the deep tissue layers may be closed by some means (with the skin level left open), or the deep and superficial layers may both be left completely open.
- Wounds with non-primary closure may or may not be described as "packed" with gauze or other material, and may or may not be covered with plastic, “wound vancs,” or other synthetic devices or materials.

Primary Closure:

- The closure of the skin level during the original surgery, regardless of the presence of wires, wicks, drains, or other devices or objects extruding through the incision.
- This category includes surgeries where the skin is closed by some means. Thus, if any portion of the incision is closed at the skin level, by any manner, a designation of primary closure should be assigned to the surgery.
- Note: If a procedure has multiple incision/laparoscopic trocar sites and any of the incisions are closed primarily then the procedure technique is recorded as primary closed.

Scope:

- An instrument used to reach and visualize the site of the operative procedure. In the context of an NHSN operative procedure, use of a scope involves creation of several small incisions to perform or assist in the performance of an operation rather than use of a traditional larger incision (specifically, open approach).
Trauma:
- Blunt or penetrating injury occurring prior to the start of the procedure
- Complex trauma cases may require multiple trips to the OR during the same admission to repair the initial trauma

SSI Risk Index Category
- ASA score
  - ASA classification of 3, 4, or 5: give one
- Wound class
  - Contaminated (Class 3) or Dirty/infected (Class 4) wound class: give one
- Operative duration
  - Operation lasting more than the duration cut point: give one
- SSI Risk Index Category
  - Sum up the number of these factors present at the time of the operation

American Society of Anesthesiology (ASA) score:
- Assessment by the anesthesiologist of the patient’s preoperative physical condition
  1 = Normally healthy patient
  2 = Patient with mild systemic disease
  3 = Patient with severe systemic disease that is not incapacitating
  4 = Patient with an incapacitating systemic disease that is a constant threat to life
  5 = Moribund patient not expected to survive for 24 hours with or without operation
- Note: Do NOT report procedures with an ASA physical status of 6 (a declared brain-dead patient whose organs are being removed for donor purposes) to NHSN.
**Wound class:**

- An assessment of the degree of contamination of a surgical wound at the time of the operation.
- Wound class should be assigned by a person involved in the surgical procedure (for example, surgeon, circulating nurse, etc.).

<table>
<thead>
<tr>
<th>Wound class</th>
<th>Description</th>
</tr>
</thead>
</table>
| **Class I Clean**    | - An uninfected operative wound in which no inflammation is encountered and the respiratory, alimentary, genital, or uninfected urinary tract is not entered.  
                        - In addition, clean wounds are primarily closed and, if necessary, drained with closed drainage.                                                                                     
                        - The following NHSN operative procedure categories are NEVER considered to have a clean wound classification: APPY, BILI, CHOL, COLO, REC (Rectal surgery), SB (Small bowel), and VHYS (Vaginal hysterectomy) |
| **Class II Clean-contaminated** | - An operative wound in which the respiratory, alimentary, genital, or urinary tracts are entered under controlled conditions and without unusual contamination.                                                                                       
                        - Specifically, operations involving the biliary tract, appendix, vagina, and oropharynx are included in this category, provided no evidence of infection or major break in technique is encountered. |
| **Class III Contaminated** | - Open, fresh, accidental wounds.                                                                                                                             
                        - In addition, operations with major breaks in sterile technique (e.g., open cardiac massage) or gross spillage from the gastrointestinal tract, and incisions in which acute, non-purulent inflammation is encountered are included in this category. |
| **Class IV Dirty-infected** | - Old traumatic wounds with retained devitalized tissue and those that involve existing clinical infection or perforated viscera.                                                                                         
                        - This definition suggests that the organisms causing postoperative infection were present in the operative field before the operation. |
1. Surgical Site Infection Criteria (SSI)-Superficial incisional SSI

**Must meet the following criteria:**

Date of event occurs within 30 days after any NHSN operative procedure (where day 1 = the procedure date)

**AND** involves only skin and subcutaneous tissue of the incision

**AND** the patient has at least **one** of the following:

1. Purulent drainage from the superficial incision.

2. Organisms identified from an aseptically-obtained specimen from the superficial incision or subcutaneous tissue by a culture or non-culture based microbiologic testing method, which is performed for purposes of clinical diagnosis or treatment (for example, not Active Surveillance Culture/Testing (ASC/AST)).

3. Superficial incision that is deliberately opened by a surgeon, physician† or physician designee AND Culture or non-culture based testing of the superficial incision or subcutaneous tissue is not performed AND Patient has at least one of the following signs or symptoms:
   - Localized pain or tenderness
   - Localized swelling
   - Erythema
   - Heat

4. Diagnosis of a superficial incisional SSI by a physician or physician designee.

The term physician for the purpose of application of the NHSN SSI criteria may be interpreted to mean a surgeon, infectious disease physician, emergency physician, other physician on the case, or physician’s designee (nurse practitioner or physician’s assistant)
There are two specific types of superficial incisional SSIs:

1. Superficial Incisional Primary (SIP) – a superficial incisional SSI that is identified in the primary incision in a patient that has had an operation with one or more incisions (for example, C-section incision or chest incision for CBGB)

2. Superficial Incisional Secondary (SIS) – a superficial incisional SSI that is identified in the secondary incision in a patient that has had an operation with more than one incision (for example, donor site incision for CBGB)

**Reporting Instructions for Superficial SSI:**

The following do not qualify as criteria for meeting the NHSN definition of superficial SSI:

- Diagnosis/treatment of cellulitis (redness/warmth/swelling), by itself, does not meet criterion “d” for superficial incisional SSI. Conversely, an incision that is draining or that has organisms identified by culture or non-culture based testing is not considered a cellulitis.

- A stitch abscess alone (minimal inflammation and discharge confined to the points of suture penetration)

- For an NHSN operative procedure, a laparoscopic trocar site is considered a surgical incision and not a stab wound.

- A localized stab wound or pin site infection is not considered an SSI; depending on the depth, these infections might be considered either a skin (SKIN) or soft tissue (ST) infection.
2. **Surgical Site Infection Criteria (SSI)-Deep incisional SSI**

**Must meet the following criteria:**

The date of event occurs within 30 or 90 days after the NHSN operative procedure (where day 1 = the procedure date)

AND involves deep soft tissues of the incision (for example, fascial and muscle layers).

AND the patient has at least one of the following:

1. Purulent drainage from the deep incision.
2. A deep incision that spontaneously dehisces, or is deliberately opened or aspirated by a surgeon, physician* or physician designee
   
   **AND** organism(s) identified from the deep soft tissues of the incision by a culture or non-culture based microbiologic testing method which is performed for purposes of clinical diagnosis or treatment (for example, not Active Surveillance Culture/Testing (ASC/AST)) or culture or non-culture based microbiologic testing method is not performed. A culture or non-culture based test from the deep soft tissues of the incision that has a negative finding does not meet this criterion
   
   **AND** patient has at least one of the following signs or symptoms: fever (>38°C); localized pain or tenderness.
3. An abscess or other evidence of infection involving the deep incision that is detected on gross anatomical or histopathologic exam, or imaging test.

*The term physician for the purpose of application of the NHSN SSI criteria may be interpreted to mean a surgeon, infectious disease physician, emergency physician, other physician on the case, or physician’s designee (nurse practitioner or physician’s assistant).*
There are two specific types of deep incisional SSIs:

1. Deep Incisional Primary (DIP) – a deep incisional SSI that is identified in a primary incision in a patient that has had an operation with one or more incisions (for example, C-section incision or chest incision for CBGB)

2. Deep Incisional Secondary (DIS) – a deep incisional SSI that is identified in the secondary incision in a patient that has had an operation with more than one incision (for example, donor site incision for CBGB)

3. Surgical Site Infection Criteria (SSI)-Organ/Space SSI

**Must meet the following criteria:**

Date of event occurs within 30 or 90 days after the NHSN operative procedure (where day 1 = the procedure date)

AND involves any part of the body deeper than the fascial/muscle layers that is opened or manipulated during the operative procedure

AND the patient has at least one of the following:

1. Purulent drainage from a drain that is placed into the organ/space (for example, closed suction drainage system, open drain, T-tube drain, CT-guided drainage).

2. Organism(s) identified from fluid or tissue in the organ/space by a culture or non-culture based microbiologic testing method which is performed for purposes of clinical diagnosis or treatment (for example, not Active Surveillance Culture/Testing (ASC/AST)).

3. An abscess or other evidence of infection involving the organ/space that is detected on gross anatomical or histopathologic exam, or imaging test evidence suggestive of infection.

AND

Meets at least one criterion for a specific organ/space infection site listed in Table attached. These criteria are found in the Surveillance Definitions for Specific Types of Infections
### 30-day Surveillance:

<table>
<thead>
<tr>
<th>Category</th>
<th>Operative Procedure</th>
<th>Category</th>
<th>Operative Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAA</td>
<td>Abdominal aortic aneurysm repair</td>
<td>LAM</td>
<td>Laminectomy</td>
</tr>
<tr>
<td>AMP</td>
<td>Limb amputation</td>
<td>LTP</td>
<td>Liver transplant</td>
</tr>
<tr>
<td>APPY</td>
<td>Appendix surgery</td>
<td>NECK</td>
<td>Neck surgery</td>
</tr>
<tr>
<td>AVSD</td>
<td>Shunt for dialysis</td>
<td>NEPH</td>
<td>Kidney surgery</td>
</tr>
<tr>
<td>BILI</td>
<td>Bile duct, liver or pancreatic surgery</td>
<td>OVRY</td>
<td>Ovarian surgery</td>
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<tr>
<td>CEA</td>
<td>Carotid endarterectomy</td>
<td>PRST</td>
<td>Prostate surgery</td>
</tr>
<tr>
<td>CHOL</td>
<td>Gallbladder surgery</td>
<td>REC</td>
<td>Rectal surgery</td>
</tr>
<tr>
<td>COLO</td>
<td>Colon surgery</td>
<td>SB</td>
<td>Small bowel surgery</td>
</tr>
<tr>
<td>CSEC</td>
<td>Cesarean section</td>
<td>SPLE</td>
<td>Spleen surgery</td>
</tr>
<tr>
<td>GAST</td>
<td>Gastric surgery</td>
<td>THOR</td>
<td>Thoracic surgery</td>
</tr>
<tr>
<td>HTP</td>
<td>Heart transplant</td>
<td>THYR</td>
<td>Thyroid and/or parathyroid surgery</td>
</tr>
<tr>
<td>HYST</td>
<td>Abdominal hysterectomy</td>
<td>VHYS</td>
<td>Vaginal hysterectomy</td>
</tr>
<tr>
<td>KTP</td>
<td>Kidney transplant</td>
<td>XLAP</td>
<td>Exploratory laparotomy</td>
</tr>
</tbody>
</table>

### 90-day Surveillance:

<table>
<thead>
<tr>
<th>Category</th>
<th>Operative Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>BRST</td>
<td>Breast surgery</td>
</tr>
<tr>
<td>CARD</td>
<td>Cardiac surgery</td>
</tr>
<tr>
<td>CBGB</td>
<td>Coronary artery bypass graft with both chest and donor site incisions</td>
</tr>
<tr>
<td>CBGC</td>
<td>Coronary artery bypass graft with chest incision only</td>
</tr>
<tr>
<td>CRAN</td>
<td>Craniotomy</td>
</tr>
<tr>
<td>FUSN</td>
<td>Spinal fusion</td>
</tr>
<tr>
<td>HER</td>
<td>Herniorrhaphy</td>
</tr>
<tr>
<td>HPRO</td>
<td>Hip prosthesis</td>
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<tr>
<td>KPRO</td>
<td>Knee prosthesis</td>
</tr>
<tr>
<td>PACE</td>
<td>Pacemaker surgery</td>
</tr>
<tr>
<td>PVBY</td>
<td>Peripheral vascular bypass surgery</td>
</tr>
<tr>
<td>VSHN</td>
<td>Ventricular shunt</td>
</tr>
</tbody>
</table>
### Specific Sites of an Organ/Space SSI:

<table>
<thead>
<tr>
<th>Category</th>
<th>Specific Site</th>
<th>Category</th>
<th>Specific Site</th>
</tr>
</thead>
<tbody>
<tr>
<td>BONE</td>
<td>Osteomyelitis</td>
<td>MED</td>
<td>Mediastinitis</td>
</tr>
<tr>
<td>BRST</td>
<td>Breast abscess or mastitis</td>
<td>MEN</td>
<td>Meningitis or ventriculitis</td>
</tr>
<tr>
<td>CARD</td>
<td>Myocarditis or pericarditis</td>
<td>ORAL</td>
<td>Oral cavity infection (mouth, tongue, or gums)</td>
</tr>
<tr>
<td>DISC</td>
<td>Disc space infection</td>
<td>OREP</td>
<td>Deep pelvic tissue infection or other infection of the male or female reproductive tract</td>
</tr>
<tr>
<td>EAR</td>
<td>Ear, mastoid infection</td>
<td>PJI</td>
<td>Periprosthetic joint infection</td>
</tr>
<tr>
<td>EMET</td>
<td>Endometritis</td>
<td>SA</td>
<td>Spinal abscess/infection</td>
</tr>
<tr>
<td>ENDO</td>
<td>Endocarditis</td>
<td>SINU</td>
<td>Sinusitis</td>
</tr>
<tr>
<td>GIT</td>
<td>Gastrointestinal (GI) tract infection</td>
<td>UR</td>
<td>Upper respiratory tract, pharyngitis, laryngitis, epiglottitis</td>
</tr>
<tr>
<td>IAB</td>
<td>Intraabdominal infection, not specified elsewhere</td>
<td>USI</td>
<td>Urinary System Infection</td>
</tr>
<tr>
<td>IC</td>
<td>Intracranial infection</td>
<td>VASC</td>
<td>Arterial or venous infection</td>
</tr>
<tr>
<td>JNT</td>
<td>Joint or bursa infection</td>
<td>VCUF</td>
<td>Vaginal cuff infection</td>
</tr>
<tr>
<td>LUNG</td>
<td>Other infection of the lower respiratory tract</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Denominator:

All patients having any of the procedures included in the selected NHSN operative procedure category(s) are monitored for SSI. The Surgical Site Infection (SSI) form is completed for each SSI.

SSI Event Reporting Instructions

1. Infection present at time of surgery (PATOS)

- Must be documented at the start of or during the surgery
- Must be to the same depth as the SSI that is being attributed to the procedures (e.g., if a patient has evidence of an intraabdominal infection at the time of surgery and then later returns with a superficial or deep incisional SSI, so it NOT PATOS
- Previous infection does not need to meet NHSN definition but infection or abscess evidence does need to be noted
- Example:
  ✓ Patient admitted with an acute abdomen.
  ✓ Sent to OR for an exploratory laparotomy where there is a finding of an abscess due to ruptured appendix and an APPY is performed.
  ✓ Patient returns two weeks later and meets criteria for an organ space IAB SSI.
  ✓ This is PATOS SSI event
- Example:
  ✓ Patient is admitted with a ruptured diverticulum.
  ✓ In the OR note the surgeon documents that there are multiple abscesses in the intra-abdominal cavity.
  ✓ Patient returns three weeks later and meets criteria for a superficial SSI.
  ✓ This is NOT PATOS SSI event

2. Excluded organisms:

Community associated organisms (organisms belonging to the following genera: Blastomyces, Histoplasma, Coccidioides, Paracoccidioides, Cryptococcus and Pneumocystis) and/or organisms associated with latent infections (for example, herpes, shingles, syphilis, or tuberculosis) are excluded from meeting SSI criteria.
3. Attribution of SSI after multiple types of NHSN procedures are performed during a single trip to the OR:

- Procedure-associated HAIs are attributed to the procedure NOT the location
- If a patient has several NHSN operative procedures prior to an infection, report the operative procedure code of the operation that was performed most closely in time prior to the infection date, unless there is evidence that the infection is associated with a different operation.
- If more than one NHSN operative procedure was done through a single incision, attempt to determine the procedure that is thought to be associated with the infection.
- If it is not clear (as is often the case when the infection is a superficial incisional SSI), or if the infection site being reported is not an SSI, use the NHSN Principal Operative Procedure Selection Lists to select which operative procedure to report.

### NHSN Principal Operative Procedure Category Selection List

<table>
<thead>
<tr>
<th>Priority</th>
<th>Category</th>
<th>Abdominal Operative Procedures</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>LTP</td>
<td>Liver transplant</td>
</tr>
<tr>
<td>2</td>
<td>COLO</td>
<td>Colon surgery</td>
</tr>
<tr>
<td>3</td>
<td>BILI</td>
<td>Bile duct, liver or pancreatic surgery</td>
</tr>
<tr>
<td>4</td>
<td>SB</td>
<td>Small bowel surgery</td>
</tr>
<tr>
<td>5</td>
<td>REC</td>
<td>Rectal surgery</td>
</tr>
<tr>
<td>6</td>
<td>KTP</td>
<td>Kidney transplant</td>
</tr>
<tr>
<td>7</td>
<td>GAST</td>
<td>Gastric surgery</td>
</tr>
<tr>
<td>8</td>
<td>AAA</td>
<td>Abdominal aortic aneurysm repair</td>
</tr>
<tr>
<td>9</td>
<td>HYST</td>
<td>Abdominal hysterectomy</td>
</tr>
<tr>
<td>10</td>
<td>CSEC</td>
<td>Cesarean section</td>
</tr>
<tr>
<td>11</td>
<td>XLAP</td>
<td>Laparotomy</td>
</tr>
<tr>
<td>12</td>
<td>APPY</td>
<td>Appendix surgery</td>
</tr>
<tr>
<td>13</td>
<td>HER</td>
<td>Herniorrhaphy</td>
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<tr>
<td>14</td>
<td>NEPH</td>
<td>Kidney surgery</td>
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<tr>
<td>15</td>
<td>VHYS</td>
<td>Vaginal hysterectomy</td>
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<tr>
<td>16</td>
<td>SPLE</td>
<td>Spleen surgery</td>
</tr>
<tr>
<td>17</td>
<td>CHOL</td>
<td>Gall bladder surgery</td>
</tr>
<tr>
<td>18</td>
<td>OVRY</td>
<td>Ovarian surgery</td>
</tr>
</tbody>
</table>
4. **Multiple tissue levels are involved in the infection:**

The type of SSI (superficial incisional, deep incisional, or organ/space) reported must reflect the deepest tissue level where SSI criteria is met during the surveillance period.

- Report infection that involves the organ/space as an organ/space SSI, whether or not it also involves the superficial or deep incision sites.
- Report infection that involves the superficial and deep incisional sites as a deep incisional SSI.
- If an SSI started as a deep incisional SSI on day 10 of the SSI surveillance period and then a week later (day 17 of the SSI surveillance period) meets criteria for an organ space SSI, the date of event would be the date of the organ/space SSI.

5. **Attributing SSI to a NHSN procedure when several are performed on different dates:**

If a patient has several NHSN operative procedures performed on different dates, attribute the SSI to the most recently performed NHSN operative procedure.

6. **Attributing SSI to NHSN procedures that involve multiple primary incision sites:**

If multiple primary incision sites of the same NHSN operative procedure become infected, only report as a single SSI, and assign the type of SSI (superficial incisional, deep incisional, or organ/space) that represents the deepest tissue level where SSI criteria is met at any of the involved primary incision sites during the surveillance period.

Examples:

- If one laparoscopic incision meets criteria for a superficial incisional SSI and another meets criteria for a deep incisional SSI, only report one deep incisional SSI.
- If one or more laparoscopic incision sites meet criteria for superficial incisional SSI but the patient also has an organ/space SSI related to the laparoscopic procedure, only report one organ/space SSI.
- If an operative procedure is limited to a single breast and involves multiple incisions in that breast that become infected, only report a single SSI.
- In a colostomy formation or reversal (take down) procedure, the stoma and other abdominal incision sites are considered primary incisions. If both the stoma and
another abdominal incision site develop superficial incisional SSI, report only as one SSI (SIP).

7. **Attributing SSI to NHSN procedures that have secondary incision sites:**

- Certain procedures can involve secondary incisions (specifically the following, BRST, CBGB, CEA, FUSN, PVBY, REC, and VSHN).
- The surveillance period for all secondary incision sites is 30 days, regardless of the required deep incisional or organ/space SSI surveillance period for the primary incision site(s).
- Procedures meeting this designation are reported as only one operative procedure.
- For example:
  - A saphenous vein harvest incision site in a CBGB procedure is considered the secondary incision site. One CBGB procedure is reported, the saphenous vein harvest site is monitored for 30 days after surgery for SSI, and the chest incision is monitored for 90 days after surgery for SSI. If the patient develops an SSI of the leg site (such as a superficial incisional SSI) and an SSI of the chest site (such as a deep incisional SSI) two SSIs are reported.
  - A tissue harvest site (for example, Transverse Rectus Abdominis Myocutaneous [TRAM] flap) in a BRST procedure is considered the secondary incision site. One BRST procedure is reported, and if the secondary incision site gets infected, report as either SIS or DIS as appropriate.

8. **SSI detected at another facility:**

It is required that if an SSI is detected at a facility other than the one in which the operation was performed, SSI event is attributed to the facility in which the NHSN operative procedure is performed.
9. SSI following invasive manipulation/accession of the operative site:

An SSI will not be attributed if the following 3 criteria are ALL met:

- During the post-operative period the surgical site is without evidence of infection and,
- Invasive manipulation/accession of the site is performed for diagnostic or therapeutic purposes (for example, needle aspiration, accession of ventricular shunts, accession of breast expanders) and,
- Infection subsequently develops in a tissue level which was entered during the manipulation/accession.

**Analysis of SSI**

<table>
<thead>
<tr>
<th>Measure</th>
<th>Calculation</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>SSI Rates</td>
<td>The number of SSIs detected after a procedure</td>
<td>Location specific measure</td>
</tr>
<tr>
<td></td>
<td>Total number of that procedures examined X100</td>
<td></td>
</tr>
<tr>
<td>SSI SIR</td>
<td>The number of observed SSIs</td>
<td>Both location specific and summarized measure</td>
</tr>
<tr>
<td></td>
<td>The number of predicted SSIs</td>
<td></td>
</tr>
</tbody>
</table>

SIR, Standardized Infection Ratio
14. Surveillance of MDRO and CDI

MDROs

MDROs are defined as microorganisms, predominantly bacteria, that are resistant to one or more classes of antimicrobial agents.

Gram negative MDROs

Gram negative MDROs include the followings:

1. **CephR-Klebsiella**: non-susceptible (resistant or intermediate) to at least one cephalosporin agent (ceftazidime, cefotaxime, ceftriaxone, or cefepime)

2. **Carbapenem resistant Enterobacteriaceae (CRE)**: E-coli, Klebsiella, or Enterobacter resistant to at least one carbapenem agent (imipenem, meropenem, doripenem, or ertapenem) OR by production of a carbapenemase

3. **MDR Acinetobacter**: non-susceptible (resistant or intermediate) to at least one agent in at least 3 or 4 out of 6 antimicrobial classes (penicillins, aminoglycosides, cephalosporins, fluoroquinolones, carbapenems, and sulbactam)

4. **MDR Klebsiella or Pseudomonas**: non-susceptible (resistant or intermediate) to at least one agent in at least 3 or 4 out of 5 antimicrobial classes (penicillins, aminoglycosides, cephalosporins, fluoroquinolones, and carbapenems)

5. **Note**: Classes: Penicillins (Piperacillin, Piperacillin/Tazobactam), Aminoglycosides (Amikacin, Gentamicin, Tobramycin), Cephalosporins (Cefepime, Ceftazidime), Fluoroquinolones (Ciprofloxacin, Levofloxacin), Carbapenems (Imipenem, Meropenem, Doripenem), And Sulbactam (Ampicillin/Sulbactam)

Gram positive MDROs;

Gram positive MDROs include MRSA and VRE.

1. **MRSA**: Includes S. aureus cultured from any specimen that tests oxacillin-resistant by standard susceptibility testing methods, or by a positive result from molecular testing for mecA and PBP2a; these methods may also include positive results of specimens tested by any other FDA approved PCR test for MRSA.

2. **VRE**: Any Enterococcus spp. (regardless of whether identified to the species level), that is resistant to vancomycin.
ESBLs:
Extended Spectrum Beta Lactamases (developed enzymes that inactivate penicillin & cephalosporin drugs

Unique Blood Source
- For this organism and location, an MDRO isolate from blood in a patient with no prior positive blood culture for the same MDRO and location in ≤2 weeks, even across calendar months and different facility admissions
- There should be 14 days with no positive blood culture result from the laboratory for the patient, MDRO, and location before another Blood LabID Event is considered with the date of specimen collection is considered Day 1

Excluded isolated from MDRO surveillance
No duplicate isolates or surveillance cultures are included when filling MDRO forms.
- **Duplicate isolate** is an isolate of the same species of bacteria, regardless of antimicrobial susceptibility pattern, in the same patient, regardless of specimen site, during a given reporting period. The time is calendar month in non-blood samples and ≤2 weeks in blood samples.
- **Surveillance cultures**: Those cultures not performed for purposes of clinical diagnosis or treatment including, but not limited to stool cultures for VRE and/or nasal swabs for MRSA surveillance

Presentation by onset time:
- **Community-Onset (CO)**: Any positive test for CDI collected in an outpatient location or an inpatient location ≤3 days after admission to the facility
- **Healthcare Facility-Onset (HO)**: Any positive test for CDI collected >3 days after admission to the facility
Presentation of MDRO by symptoms:

Colonization:

- The multiplication of a microorganism at a body site or sites without any clinical signs and symptoms or detected immune reaction in the host at the time that the microorganism is isolated.
- Colonization may or may not be a precursor of infection.
- Colonization may be a form of carriage and is a potential source of transmission.
- Does not require treatment.

Infection:

- The successful transmission of a microorganism to the host with subsequent multiplication, colonization, and invasion.
- Infection may be clinical or subclinical and may not produce identifiable disease.
- However, it is usually accompanied by measurable host immune response(s), such as specific antibodies or cell-mediated reactions.
- Requires treatment.
**Clostridium difficile Infection (CDI):**
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).

**Duplicate C. difficile:**
Any C. difficile toxin-positive laboratory result from the same patient and location, following a previous C. difficile toxin-positive laboratory result within the past 2 weeks [14 days] (even across calendar months and readmissions to the same facility).

**Categorization of CDI based on date specimen:**
- **Incident CDI Assay:** Any positive test for CDI from a specimen obtained >8 weeks after the most recent positive test for CDI (or with no previous positive test for CDI documented) for that patient.
- **Recurrent CDI Assay:** Any positive test for CDI from a specimen obtained >2 weeks and ≤8 weeks after the most recent positive test for CDI for that patient.

**Categorizing of CDI based on date of admission**
- **Community-Onset (CO):** Any positive test for CDI collected in an outpatient location or an inpatient location ≤3 days after admission to the facility
- **Community-Onset Healthcare Facility-Associated (CO-HCFA):** Any positive test for CDI collected from a patient who was discharged from the facility ≤4 weeks prior to current date of stool specimen collection. Data from outpatient locations (e.g., outpatient encounters) are not included in this definition.
- **Healthcare Facility-Onset (HO):** Any positive test for CDI collected >3 days after admission to the facility
MDRO/CDI Reporting Methods:

1. **Facility-wide by location:**
   - Report for each location separately and cover all locations in a facility.
   - This reporting method requires the most effort, but provides the most detail for local and national statistical data.

2. **Selected one or more:**
   - Report separately from one or more specific locations within a facility.
   - This reporting method is ideal for use during targeted prevention programs.

3. **Overall facility-wide:** (LabID Event ONLY)
   - Report individual LabID events from each location separately and aggregate denominator counts for the entire facility
     - Overall Facility-wide Inpatient to cover all inpatient locations* AND separately for outpatient emergency department, and 24-hour observation location(s) AND/OR
     - Overall Facility-wide Outpatient to cover all outpatient locations affiliated with the facility
     - *Except locations that have a different certification than acute care facility, e.g. inpatient rehabilitation or psychiatric facilities

4. **Overall facility-wide: Blood Specimens Only** (LabID Event ONLY)
   - Report individual LabID events from each location separately and aggregate denominator counts for the entire facility
     - Overall Facility-wide Inpatient to cover all inpatient locations* AND separately for outpatient emergency department, and 24-hour observation location(s) AND/OR
     - Overall Facility-wide Outpatient to cover all outpatient locations affiliated with the facility
     - *Except locations that have a different certification than acute care facility, e.g. inpatient rehabilitation or psychiatric facilities
MDRO/CDI Reporting Methods:

1. Laboratory-Identified (LabID) Event:
   - Include all non-duplicate MDRO isolates from any specimen source and unique blood source MDRO isolates
   - Allows laboratory testing data to be used without clinical evaluation of the patient
   - Provides proxy infection measures of MDRO and/or C. difficile exposure burden, infection burden, and healthcare acquisition
   - ONLY for positive laboratory results (e.g., cultures) that are collected for “clinical” purposes (i.e., for diagnosis and treatment).

2. Infection Surveillance Reporting:
   - Enables users to utilize HAI definitions for identifying and reporting infections associated with MDROs and/or C. difficile.
   - Surveillance must occur from at least one patient care area and requires active, patient-based, prospective surveillance of the chosen MDRO(s) and/or C. difficile infections (CDIs) by a trained Infection Preventionists (IP).
   - Infection Surveillance can occur in any inpatient location where such infections may be identified and where denominator data can be collected,
   - Surveillance for all types of HAIs with MDRO selected for monitoring in at least one location in the healthcare facility
   - No Active Surveillance Culture/Testing (ASC/AST) results are to be included in this reporting of individual results.

<table>
<thead>
<tr>
<th></th>
<th>LabID MDRO</th>
<th>LabID CDI</th>
<th>Infection</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Facility-wide by location</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>2. Selected one or more</td>
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<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>3. Overall facility-wide</td>
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<td>YES</td>
<td></td>
</tr>
<tr>
<td>4. Overall facility-wide: Blood Specimens Only</td>
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Analysis of MDRO

<table>
<thead>
<tr>
<th>Measure</th>
<th>Calculation</th>
<th>Application</th>
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<tbody>
<tr>
<td>MDRO infection incidence rate</td>
<td>The number of infections of a certain MDRO type</td>
<td>Location specific measure</td>
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<td></td>
<td>X10000 The number of patient days</td>
<td></td>
</tr>
<tr>
<td>MDRO- LabID Event</td>
<td>Laboratory-identified MDRO Events</td>
<td>Location specific measure</td>
</tr>
<tr>
<td></td>
<td>The number of patient days, admissions, or encounters</td>
<td></td>
</tr>
</tbody>
</table>

**MDRO-Infection Surveillance:**

- Rate is then stratified by time (e.g., month, quarter, etc.) and patient care location.

**MDRO-Laboratory-Identified (LabID) Event:**

- These data are used to calculate four distinct proxy measures including:
  
  ✓ Admission prevalence rate and
  
  ✓ Overall prevalence rate based on clinical testing (measures of exposure burden),
  
  ✓ MDRO bloodstream infection incidence rate (measure of infection burden), and
  
  ✓ Overall MDRO infection/colonization incidence rate (measure of healthcare acquisition).

- LabID Events proxy measures are categorized as healthcare facility-onset (> 3 days after admission to the facility) versus community-onset (≤ 3 days after admission to the facility).
15. Bundles

Preventive bundle:
A bundle is a structured way of improving the processes of care and patient outcomes.
It is a small, straightforward set of evidence-based practices, generally three to five — that, when performed collectively and reliably, have been proven to improve patient outcomes.

Type of prevention bundle:
- Central line Insertion bundle
- Central line maintenance bundle
- Ventilator bundle
- Urinary catheter bundle
- Surgical bundle
- Dialysis bundle
- MDRO bundle
15.1 Central Line Insertion Bundle

Central line bundle:
It is a group of evidence-based interventions for patients with intravascular central catheters that, when implemented together, result in better outcomes (reduce BSI) than when implemented individually.

Objective:
- Central line bundle aims to prevent CLABSI
- Application of the central line bundle has demonstrated marked reductions in the rate of central line infections in many hospitals

Setting:
- Inpatient areas where patients with one or more central lines are hospitalized
- However, the central line bundle was designed to apply in ICUs only (where temporary central line is common)
- The use of central line bundle in specialty care areas may be problematic because of the large number of permanent central lines

Sampling:
- Sampling is allowed but at the level of days
- Therefore, review all patients in a specific unit with central line one or two days a week

Components of central line (insertion) bundle:
1- Hand hygiene
2- Maximal barrier precautions
3- Chlorhexidine skin antisepsis
4- Optimal catheter site selection, with subclavian vein as the preferred site for non-tunneled catheters
5- Daily review of line necessity, with prompt removal of unnecessary lines
1. Hand hygiene

Washing hands or using an alcohol-based waterless hand cleaner helps prevent contamination of central line sites and resultant bloodstream infections. When caring for central lines, indications for hand hygiene include:

- Before and after palpating catheter insertion sites (Palpation of the insertion site should not be performed after the application of antiseptic, unless aseptic technique is maintained.)
- Before and after inserting, replacing, accessing, repairing, or dressing an intravascular catheter
- When hands are visibly soiled or if contamination is suspected
- Before and after any invasive procedures are done
- In between the patients
- Before donning and after removing gloves
- After using the bathroom

2. Maximal barrier precautions

A key change to decrease the likelihood of central line infections is to apply maximal barrier precautions in preparation for line insertion.

For the operator placing the central line and for those assisting in the procedure, maximal barrier precautions mean strict compliance with hand hygiene and wearing a cap, mask, sterile gown, and sterile gloves. The cap should cover all hair and the mask should cover the nose and mouth tightly. These precautions are the same as for any other surgical procedure that carries a risk of infection.

For the patient, applying maximal barrier precautions means covering the patient from head to toe with a sterile drape, with a small opening for the site of insertion.
3. Chlorhexidine skin antisepsis

Chlorhexidine skin antisepsis has been proven to provide better skin antisepsis than other antiseptic agents such as povidone-iodine solutions.

The technique, for most kits, is as follows:

- Prepare skin with antiseptic/detergent chlorhexidine 2% in 70% isopropyl alcohol (according to IHI recommendations).
- Pinch wings on the chlorhexidine applicator to break open the ampule (when ampule is included). Hold the applicator down to allow the solution to saturate the pad.
- Press sponge against skin, and apply chlorhexidine solution using a back-and-forth friction scrub for at least 30 seconds. Do not wipe or blot.
- Allow antiseptic solution time to dry completely before puncturing the site (~ 2 minutes).

4. Optimal catheter site selection, with avoidance of using the femoral vein for central venous access in adult patients

- Several non-randomized studies show that the subclavian vein site is associated with a lower risk of CLABSI than the internal jugular vein.
- The femoral site is associated with greater risk of infection in adults; however, this may be limited to overweight adult patients.
- The bundle requirement for optimal site selection suggests that other factors (e.g., the potential for mechanical complications, the risk of subclavian vein stenosis, and catheter-operator skill) should be considered when deciding where to place the catheter.
- In these instances, teams are considered compliant with the bundle element as long as they use a rationale construct to choose the site.
- The physician must determine the risks and benefits of using any vein.
• Absolute contraindications to subclavian approach
  ✓ Trauma to the ipsilateral clavicle, anterior proximal rib, or subclavian vessels
  ✓ Anticoagulation therapy or bleeding disorder (Inability to do direct pressure to stop bleeding)
  ✓ Distorted local anatomy (eg, vascular injury, prior surgery, radiation history)
  ✓ Infection at insertion site
  ✓ Inexperienced operator
  ✓ Uncooperative patient
  ✓ Patients with higher risks for pneumothorax or inability to tolerate pneumothorax

5. Daily review of central line necessity with prompt removal of unnecessary lines

• Daily review of central line necessity will prevent unnecessary delays in removing lines that are no longer needed for the care of the patient.

• However, it is clear that the risk of infection increases over time as the line remains in place and that the risk of infection decreases if the line is removed when it is not required anymore.

Analysis of data:

| Central line bundle compliance | Patients with central line compliant to all applicable bundle components | Total number of patients with central line reviewed for the bundle compliance X100 |
15.2 Central line maintenance bundle

Central line maintenance bundle:

It is a group of evidence-based interventions for patients with intravascular central catheters that, when implemented together, result in better outcomes (reduce CLABSI) than when implemented individually.

Objective:

- Central line maintenance bundle aims to prevent CLABSI

Setting:

- Inpatient areas where patients with one or more central lines are hospitalized
- Unlike central line bundle, the central line maintenance bundle was designed can be applies in ICUs and specialty care areas

Sampling:

- Sampling is allowed but at the level of days
- Therefore, review all patients in a specific unit with central line one or two days a week

Components of central line maintenance bundle:

1. Hand hygiene before catheter access/manipulation

2. Daily review/assessment of catheter necessity with prompt removal of unnecessary lines

3. Proper dressing choice:
   - Use transparent semipermeable dressing
   - Use gauze only if the site is bleeding or oozing

4. Proper frequency of dressing change:
   - Replace transparent dressing every 7 days
   - Replace gauze dressing every 48 hours
   - Replace immediately any dressing that is soiled, dampened, or loosened
5. Proper replacement of administrative sets:

- Unless used for blood, blood products or fat emulsions, replace administration sets no more frequently than at 72-hour intervals, but at least every 7 days
- If used for blood/blood products, replace administration sets every 4 hours
- If used for TPN/intralipids, replace administration sets every 24 hours
- If used for chemotherapy, replace administration sets after each use
- Caps are changed no more often than 72 hours or whenever the administration set is changed

**Analysis of data:**

\[
\frac{\text{Patients with central line compliant to all applicable bundle components}}{\text{Total number of patients with central line reviewed for the bundle compliance}} \times 100
\]
15.3 Ventilator bundle

Ventilator bundle:

Ventilator bundle is a group of evidence-based interventions for patients with ventilator that, when implemented together, result in better outcomes (reduce VAP) than when implemented individually.

Objective:

- Ventilator bundle aims to prevent ventilator associated pneumonia (VAP) and VAE
- Applying the ventilator bundle in the care of ventilated patients can significantly reduce the incidence of VAP and VAE
- A number of distinct complications associated with mechanical ventilation and critical illness were identified:
  - Ventilator-associated pneumonia
  - Upper gastrointestinal hemorrhage
  - Bacteremia
  - Barotrauma
  - Venous thromboembolic disease
  - Cholestasis
  - Sinusitis requiring surgical intervention

Setting:

- Inpatient areas where patients with ventilator are hospitalized

Sampling:

- Sampling is allowed but at the level of days
- Therefore, review all patients in a specific unit with ventilator one or two days a week
Components of ventilator bundle:

1- Elevation of the head of the bed to between 30 and 45 degrees
2- Daily “sedative interruption” & daily assessment of readiness to extubate
3- Peptic ulcer disease (PUD) prophylaxis
4- Deep venous thrombosis (DVT) prophylaxis (unless contraindicated)
5- Daily oral care with chlorhexidine

1. Elevation of the head of the bed

- Elevation of the head of the bed is an integral part of the ventilator bundle and has been correlated with reduction in the rate of ventilator-associated pneumonia.

- The recommended elevation is 30-45 degrees. This help to
  ✓ Reduce potential for aspiration
  ✓ Potential to improve ventilation

- However, elevation of the head of the bed issues and concerns
  ✓ It is uncomfortable for the patient
  ✓ Causes the patient to slide down in bed
  ✓ Potential for skin-shearing

2. Daily sedative interruption and daily assessment of readiness to extubate

- Using daily sedative interruptions and assessing the patient’s readiness to extubate are an integral part of the ventilator bundle and have been correlated with reduction in the rate of ventilator-associated pneumonia.

- Include this intervention on the bundle form for initiation and weaning of mechanical ventilation, delivery of tube feedings, and provision of oral care.

- Seven distinct complications associated with mechanical ventilation and critical illness were identified:
  ✓ Ventilator-associated pneumonia
  ✓ Upper gastrointestinal hemorrhage
Bacteremia
Barotrauma
Venous thromboembolic disease
Cholestasis
Sinusitis requiring surgical intervention

3. Peptic ulcer disease (PUD) prophylaxis

- Stress ulcerations are the most common cause of gastrointestinal bleeding in intensive care unit patients, and the presence of gastrointestinal bleeding due to these lesions is associated with a five-fold increase in mortality compared to ICU patients without bleeding.

- Applying peptic ulcer disease prophylaxis is a necessary intervention in critically ill patients.

- Prophylactic therapy for stress ulceration has been the potential for increased risk of health care associated pneumonia.

  - Agents that raise gastric pH may promote the growth of bacteria in the stomach, particularly gram-negative bacilli that originate in the duodenum.

  - Esophageal reflux and aspiration of gastric contents along the endotracheal tube may lead to endobronchial colonization and pneumonia or may precipitate pneumonia due to the decreased bacterial killing in the low-acid environment. Elevating the head of the bed should reduce the amount of aspiration patients have.

- PUD prophylaxis in the bundle is that provided with medications; H2 blockers are preferred over sucralfate. Proton pump inhibitors may be efficacious, and an alternative to sucralfate or H2 antagonist.
4. Deep venous thrombosis (DVT) prophylaxis

- Applying deep venous thrombosis prophylaxis is an appropriate intervention in all patients who are sedentary.

- The risk of venous thromboembolism is reduced if antithrombotic and thrombolytic therapy is recommended for the prophylaxis of patients undergoing surgery, trauma patients, acutely ill medical patients, and patients admitted to the intensive care unit.

- While it is unclear if there is any association between DVT prophylaxis and decreasing rates of ventilator associated pneumonia, our experience is that VAP rates decreased most dramatically in hospitals where all elements of the ventilator bundle were implemented, including this one. The intervention remains excellent practice in the general care of ventilated patients.

- Important considerations include that the risk of bleeding may increase if anticoagulants are used to accomplish prophylaxis.

- When prophylactic anticoagulation cannot be used because of high risk of bleeding, sequential compression devices may be used. Often, sequential compression devices are not applied reliably to patients when they go to or return from procedures negating their effectiveness.

5. Daily Oral Care with Chlorhexidine

- Dental plaque biofilms are colonized by respiratory pathogens in mechanically ventilated patients.

- Dental plaque develops in patients that are mechanically ventilated because of the lack of mechanical chewing and the absence of saliva, which minimizes the development of biofilm on the teeth.

- Dental plaque can be a significant reservoir for potential respiratory pathogens that cause ventilator-associated pneumonia (VAP).

- Chlorhexidine antiseptic has long been approved as an inhibitor of dental plaque formation and gingivitis.
Ventilator bundle in pediatric and neonatal population

1. **Elevation of the head of the bed**
   - It is OK but the angle is modified
   - 15 – 30 degrees for neonates
   - 30 – 45 degrees for infants or above

2. **Daily assessment of readiness to extubate**
   - It is OK but daily “sedative interruption” is not recommended due to high risk of unplanned extubation.

3. **Peptic ulcer disease (PUD) prophylaxis**
   - As appropriate for the age and condition of the child

4. **Deep venous thrombosis (DVT) prophylaxis (unless contraindicated)**
   - As appropriate for the age and condition of the child

5. **Daily oral care**
   - It is OK, but should be more frequent (every 2 hours)
   - 0.12% chlorhexidine oral rinse only for children greater than 2 months of age

6. **Keep the ventilator circuit free from condensate by draining water away every 2 – 4 hours.**
   - Drain condensate away from the patient and especially prior to repositioning.
   - Consider heated vent circuits which decrease the occurrence of condensate.
   - Circuit changes should take place only when it is visibly soiled or mechanically malfunctioning.
   - Use meticulous hand hygiene before and after contact with ventilator circuits.

7. **Change in-line suction catheter systems only when soiled or otherwise indicated;** open catheter systems should be considered single use.

8. **Store oral suction devices in a clean non-sealed plastic bag when not in use**
## Analysis of data:

<table>
<thead>
<tr>
<th>Ventilator bundle compliance</th>
<th>Patients with ventilator compliant to all applicable bundle components</th>
<th>Total number of patients with ventilator reviewed for the bundle compliance</th>
<th>X100</th>
</tr>
</thead>
</table>
15.4 Urinary catheter bundle

Urinary catheter bundle:

Urinary catheter bundle is a group of evidence-based interventions for patients with urinary catheter that, when implemented together, result in better outcomes (reduce CAUTI) than when implemented individually.

Objective:

- Urinary catheter bundle aims to prevent CAUTI

Setting:

- Inpatient areas where patients with urinary catheter are hospitalized
- Implementation of these four components of urinary catheter bundle requires a multidisciplinary approach involving physicians, nurses, leaders, and experts in infection prevention and urological care.

Sampling:

- Sampling is allowed but at the level of days
- Therefore, review all patients in a specific unit with urinary catheter one or two days a week

Components of urinary catheter bundle:

1. Avoid unnecessary urinary catheters
2. Insert using aseptic technique
3. Maintain catheters based on recommended guidelines (daily care)
4. Review catheter necessity daily and remove promptly
1. Avoid unnecessary urinary catheters

- No invasive device should ever be used unless absolutely necessary, including urinary catheters.

- Patients do not find indwelling catheters comfortable, and in one study nearly half described catheters as uncomfortable or painful. When catheters are in place, mobility may be significantly decreased, which may impair rehabilitation and recovery. It may increase the risk of complications such as DVTs and pressure ulcers.

- Following are the indications for placement of urinary catheters:
  - Perioperative use for selected surgical procedures
  - Urine output monitoring in critically ill patients
  - Management of acute urinary retention and urinary obstruction
  - Assistance in pressure ulcer healing for incontinent patients
  - As an exception, at patient request to improve comfort (SHEA-IDSA) or for comfort during end of life care (CDC)

- Perioperative use for selected surgical procedures
  - Patients undergoing urologic surgery or other surgery on contiguous structures of the genitourinary tract
  - Anticipated prolonged duration of surgery (catheters inserted for this reason should be removed in post-anesthesia care unit)
  - Patients anticipated to receive large-volume infusions or diuretics during surgery
  - Need for intraoperative monitoring of urinary output

- Alternatives to indwelling catheters include the following:
  - External condom catheters for male patients without urinary retention or bladder outlet obstruction have been shown to have lower risk of bacteriuria
or symptomatic UTI. Such catheters are reported by patients to be more comfortable and limit mobility less than indwelling catheters.

- Intermittent catheterization several times per day may have the same or lower risk of infection, yet provide the patient with greater mobility and ensure an indwelling catheter is not left in place longer than necessary.

- Placement of catheters for convenience should be avoided at all times, and nursing personnel should be fully educated about all risks associated with catheters, including infections, decreased mobility, and urethral trauma. Patient preference and comfort is an important consideration.

2. **Insert urinary catheters using aseptic technique**

Make sure that the catheter is inserted only by trained personnel following aseptic technique. Note the following basic elements for insertion:

- Utilize appropriate hand hygiene practice, immediately before insertion of the catheter.
- Insert catheters using aseptic technique and sterile equipment, by using:
  - Gloves, a drape, and sponges;
  - Sterile or antiseptic solution for cleaning the urethral meatus; and
  - Single-use packet of sterile lubricant for insertion.
- Use as small a catheter as possible that is consistent with proper drainage, to minimize urethral trauma.

A checklist may be a helpful tool for staff at the time of insertion and may also serve as a data collection tool to assess compliance.

Education and training of staff are fundamental. Organizations should train and verify competency of all clinical staff (nurses, physicians, residents, etc.) who may insert urinary catheters.
3. Maintain catheters based on recommended guidelines

- Appropriate hand hygiene practices are a basic standard of care and should be followed before and after any patient care activity. Standard precautions, including the use of gloves as appropriate, should be used during manipulation of the catheter site or apparatus. Catheter maintenance can be classified in two general categories: routine maintenance and practices that should be avoided.

- Routine maintenance includes
  - Maintain a sterile, continuously closed drainage system.
  - Keep catheter properly secured to prevent movement and urethral traction.
  - Keep collection bag below the level of the bladder at all times.
  - Maintain unobstructed urine flow.
  - Empty collection bag regularly, using a separate collecting container for each patient, and avoid allowing the draining spigot to touch the collecting container.
  - Routine hygiene (e.g., cleansing of the meatal surface during daily bathing) is appropriate. Do not clean the periurethral area with antiseptics to prevent CA-UTI while the catheter is in place.
  - Collection of urine samples should follow aseptic technique.

- Some practices actually increase the risk of infection or other complications and should be avoided:
  - Irrigating catheters, except in cases of catheter obstruction;
  - Disconnecting the catheter from the drainage tubing;
  - Replacing catheters routinely (in the absence of obstruction or infection); and
  - Use aseptic technique to replace the collection system.

- Educating all staff and physicians about practices that should occur routinely and those that should be avoided is a fundamental first step.
4. Review urinary catheter necessity daily and remove promptly

- “The duration of catheterization is the most important risk factor for development of infection.”

- If use of an indwelling catheter is necessary, the most important strategy is removing the catheter as soon as possible.

- Daily review of catheter necessity should be conducted for all patients with urinary catheters (using the same criteria for appropriate insertion shown before)

Analysis of data:

<table>
<thead>
<tr>
<th>Urinary catheter bundle compliance</th>
<th>Patients with urinary catheter compliant to all applicable bundle components</th>
<th>X100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number of patients with urinary catheter reviewed for the bundle compliance</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
15.5 Surgical bundle

Surgical bundle:
The surgical bundle is a group of evidence-based interventions for patients undergoing surgery that, when implemented together, result in better outcomes (reduce SSI) than when implemented individually.

Objective:
- Surgical bundle aims to prevent SSI

Setting:
- Inpatient or outpatient areas where patients are undergoing surgeries

Sampling:
- Sampling allowed at the level of procedure as the following:

<table>
<thead>
<tr>
<th>Number of surgeries done</th>
<th>Number of surgical bundle forms</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;555</td>
<td>20% (maximum 111 form)</td>
</tr>
<tr>
<td>140-555</td>
<td>20%</td>
</tr>
<tr>
<td>28-140</td>
<td>Minimum 28 forms</td>
</tr>
<tr>
<td>&lt;28</td>
<td>No sampling, review all</td>
</tr>
</tbody>
</table>

*HESN calculate the bundle compliance from all forms entered

Components of surgical bundle:

1- Appropriate use of prophylactic antibiotics:
   - Selection
   - Timely administration
   - Timely discontinuation

2- Appropriate hair removal;

3- Controlled 6 AM postoperative serum glucose in cardiac surgery and diabetic patients

4- Immediate postoperative normothermia (36.1-37.1 °C) for colorectal surgery patients.
1. Appropriate use of prophylactic antibiotics

- Prophylactic antibiotic selection for surgical patients consistent with national guidelines.
- Prophylactic antibiotic received within 1 hour prior to surgical incision.

  ✓ Due to the longer infusion time required for Vancomycin, it is acceptable to start this antibiotic (e.g., when indicated because of beta-lactam allergy or high prevalence of MRSA) within 2 hours prior to incision.

  ✓ A single dose of antibiotics is considered sufficient for most procedures.
  ✓ Repeat doses are indicated for procedures lasting more than 4 hours or those with significant blood loss.
  ✓ Always give at least a full therapeutic dose of antibiotic.
  ✓ Consider the upper range of doses for large patients and/or long operations.

- Prophylactic antibiotics discontinued within 24 hours after surgery end time (48 hours for cardiac patients).

  ✓ There is no need to continue coverage beyond 24 hours’ even if a patient has tubes or drains postoperatively unless in cardiovascular surgery (48 hours after surgery is allowed)

  ✓ Most studies have confirmed efficacy of 12 hours
  ✓ Many studies have shown efficacy of a single dose
  ✓ Whenever compared, the shorter course has been as effective as the longer course.

2. Appropriate Hair Removal

- The use of razors prior to surgery increases the incidence of wound infection when compared to clipping, depilatory use, or no hair removal at all.
- Razors can cause small cuts and nicks to skin, many of which may be microscopic and not visible to the human eye.
- The use of clippers has been found to be the best method in many hospitals, as depilatory creams can cause skin reactions and allergies.
• Staff must be trained in the proper use of clippers because an untrained user can damage the skin.
• If hair must be removed preoperatively, it is generally recommended to do outside the operating room itself, as loose hairs are difficult to control.
• If not the pre requisite for the surgery, hair removal should not be encouraged.

3. Controlled postoperative serum glucose in cardiac surgery
• The degree of hyperglycemia in the postoperative period is correlated with the rate of SSI in patients undergoing major cardiac surgery.
• Glucose control is defined as serum glucose levels below 200 mg/dl, collected at or closest to 6:00 AM on each of the first two postoperative days.
• Glucose control postoperatively is focused on the cardiac surgical population and patients with diabetes.

4. Immediate postoperative normothermia in colorectal surgery
• The medical literature indicates that patients undergoing colorectal surgery have a decreased risk of SSI if they are not allowed to become hypothermic during the perioperative period.
• Anesthesia, anxiety, wet skin preparations, and skin exposure in cold operating rooms can cause patients to become clinically hypothermic during surgery.
• There is evidence to show that preventing hypothermia is beneficial in reducing other complications, and it is more comfortable for patients.

Analysis of data:

\[
\text{Surgical bundle compliance} \times 100 = \frac{\text{Surgical patients compliant to all applicable components of the surgical bundle}}{\text{Total number of surgical patients reviewed for the bundle compliance}} \times 100
\]
15.6 Dialysis bundle

Hemodialysis bundle:

The hemodialysis bundle is a group of evidence-based interventions for patients undergoing hemodialysis that, when implemented together, result in better outcomes (reduce bacteremia) than when implemented individually.

Objective:

- Hemodialysis bundle aims to prevent bacteremia

Setting:

- The tool can be also used by the staff hemodialysis centers to help guide their practices.

Sampling:

- Sampling is allowed but at the level of days
- Therefore, review all patients in a specific hemodialysis unit with dialysis access one or two days a week

A. Components of hemodialysis bundle for catheter:

1- Appropriate hemodialysis catheter connection
2- Appropriate hemodialysis catheter disconnection
3- Appropriate hemodialysis catheter exit site care
4- Appropriate dialysis station routine disinfection
5- Appropriate hemodialysis injectable medication preparation
6- Appropriate hemodialysis injectable medication administration
**Appropriate hemodialysis catheter connection**

- Perform hand hygiene
- Don proper PPE (mask with face shield or mask with goggles, plus gown & gloves)
- Provide mask for the patient
- Soak dialysis catheter with Betadine 3-5 minutes
- Scrub catheter hub with antiseptic and allow to dry
- Connect catheter to blood lines aseptically
- Attach new caps aseptically / weekly (Saturday or Sunday)

**Appropriate hemodialysis catheter disconnection**

- Perform hand hygiene
- Don proper PPE (mask with face shield or mask with goggles, plus gown & gloves)
- Provide mask for the patient
- Soak dialysis catheter with Betadine 3-5 minutes
- Disconnect catheter from blood lines aseptically
- Discard tubing in a leak-proof container
- Scrub catheter hub with antiseptic and allow to dry

**Appropriate hemodialysis catheter exit site care**

- Perform hand hygiene
- Apply skin antiseptic
- Allow skin antiseptic to dry
- Apply dressing aseptically
B. Components of hemodialysis bundle for fistula/graft:

1- Appropriate arteriovenous fistula/graft cannulation
2- Appropriate arteriovenous fistula/graft decannulation
3- Appropriate dialysis station routine disinfection
4- Appropriate hemodialysis injectable medication preparation
5- Appropriate hemodialysis injectable medication administration

**Appropriate arteriovenous fistula/graft cannulation**

- Perform hand hygiene
- Don proper PPE (mask with face shield or mask with goggles, plus gown & gloves)
- Clean site with 2% CHG wipes or Soap and water
- Apply skin antiseptic (Chlorhexidine 2% or 10 % Povidone Iodine according to CDC) & allow it to dry
- Do not contact site (after antisepsis)
- Insert needles & Connect to blood lines aseptically

**Appropriate arteriovenous fistula/graft decannulation**

- Perform hand hygiene
- Don proper PPE (mask with face shield or mask with goggles, plus gown & gloves)
- Disconnect from blood lines aseptically
- Discard tubing in a leak-proof container
- Wear clean gloves (patient and/or staff) to compress site
- Remove needles aseptically
- Apply clean gauze/bandage to site
Appropriate dialysis station routine disinfection

- Don Proper PPE (as per indication but at least use gloves)
- Ensure that the patient has left the dialysis station before cleaning
- Discard all single-use supplies, Clean and disinfect reusable equipment
- Nursing: Clean and disinfect dialysis station (dialysis machine and bedside table)
- Keep used or potentially contaminated items away from the disinfected surfaces
- Housekeeping: Clean and disinfect dialysis chair or bed (rails, armrests & mattresses)

Appropriate hemodialysis injectable medication preparation

- Perform hand hygiene
- Prepare medications in clean designated areas
- Inspect all vials
- Prepare medications using aseptic techniques
- Use new needle and new syringe to enter all vials
- Discard all single dose vial(s)
- Discard or properly store all multi dose vial(s)

Appropriate hemodialysis injectable medication administration

- Perform hand hygiene (before and after)
- Use proper PPE (gloves)
- Properly transport medication to patient station
- Disinfect injection port with appropriate antiseptic
- Administer medications using aseptic techniques
- Discard syringe at point of use
### Analysis of data:

<table>
<thead>
<tr>
<th>Dialysis bundle compliance</th>
<th>Patients with catheter or AV fistula/graft compliant to all applicable bundle components</th>
<th>Total number of patients with catheter or AV fistula/graft reviewed for the bundle compliance</th>
<th>X100</th>
</tr>
</thead>
</table>
**15.7 Multi Drug Resistance Organism MDRO bundle**

**MDRO bundle:**

It is composed of a group of indicators to assess the preventive practices related to antimicrobial resistance;

- **Outcome (MDRO rate)**
- **Prevention of selection of resistant organisms as a result of antimicrobial exposure**
- **Prevention of patient-to-patient transmission of resistant organisms**

**Objective:**

- MDRO bundle aims to prevent antimicrobial resistance

**Setting:**

- Inpatient and outpatient locations where MDRO data are collected

**Sampling:**

- Not applicable
- It can be done at specific unit or units where MDRO data are collected

**Components of MDRO bundle:**

1. Overall MDRO rate (per 10000 patient days(PD))
2. Overall antimicrobial use rate (defined daily dose (DDD) per 100 PD)
3. Compliance with environmental cleaning (%)
4. Compliance with contact precautions (%)
5. Compliance with hand hygiene (%)
1- Overall MDRO rate (per 10000 PD)

\[
\frac{\text{Number of MDRO isolates (all organism) in selected unit/quarter}}{\text{Patient-days in the same unit/quarter}} \times 10,000
\]

2- Overall antimicrobial use rate (DDD per 100 PD)

\[
\frac{\text{Number of DDDs of antimicrobial use (for all antibiotics) in selected unit/quarter}}{\text{Patient-days in the same unit/quarter}} \times 10,000
\]

3- Compliance with environmental cleaning (%)

\[
\frac{\text{Number of opportunities with surfaces appropriately cleaned in selected unit/quarter}}{\text{Number of surfaces evaluated in the same unit/quarter}} \times 100
\]

4- Compliance with contact precautions (%)

\[
\frac{\text{Number of opportunities with PPE or HH done appropriately in selected unit/quarter}}{\text{Number of opportunities of PPE or HH evaluated in the same unit/quarter}} \times 100
\]

5- Compliance with hand hygiene (%)

\[
\frac{\text{Number of WHO HH opportunities with hand wash or use of alcohol-based hand rub}}{\text{Number of WHO HH opportunities evaluated}} \times 100
\]
16. Surveillance data collection

Surveillance data can be categorized into two groups; numerator or denominator data.

\[
\begin{array}{c|c|c}
1 & 25 & \text{Numerator} \\
\hline
4 & 100 & \text{Denominator} \\
\end{array}
\]

\[
\begin{array}{c|c|c}
\text{Fraction bar} & \\
\hline
\end{array}
\]

16.1 Numerator data

Numerator is the upper portion of a fraction used to calculate a rate or ratio. In surveillance, it is usually the number of cases of a disease or event being studied.

Responsibility of numerator data collection

1. Infection control professional (ICP)
2. Personnel other than ICPs may be trained to screen data sources for HAI, or automated screening of electronic databases may be used, as long as the ICP makes the final determination of presence of HAI according to the criteria for defining HAI.

Types of numerator data to collect

1. Demographic data: name, date of birth, gender, hospital identification number, admission date
2. Infection: onset date, site of infection, patient care location of HAI onset
3. Risk factors: devices, procedures, other factors associated with HAI
4. Laboratory: pathogens, antibiogram, serology, pathology
5. Radiology/imaging: X-ray, CT scan, MRI, etc.

Sources of numerator data

1. Admission/discharge/transfer records, microbiology laboratory records
2. Visits to patient wards for observation and discussion with caregivers
3. Patient charts (paper or computerized) for case confirmation
• Laboratory and radiology/imaging results
• Nursing and physician’s notes and consults
• Admission diagnosis
• History and physical examination findings
• Records of diagnostic and surgical interventions
• Temperature chart
• Information on administration of antibiotics

4. For post-discharge detected SSI, sources include records from surgery clinics, physician’s offices, emergency departments

How an ICP collects numerator data
1. Screens admission/discharge/transfer records for patients admitted with infection and those whose diagnoses put them at risk of acquiring HAI

2. Reviews laboratory reports looking for patients with possible infections (e.g., positive microbiology cultures, positive pathology findings) and converses with laboratory personnel trying to identify patients that might be infected and to identify clusters of infections, especially in areas not targeted for routine HAI surveillance

3. During ward rounds, quickly screens nursing care reports, temperature charts, antibiotic administration sheets, and conversation with nurses and physicians trying to identify patients who might be infected

4. Performs chart review of patients suspected of having HAI: reviews physician’s progress notes and nurse’s notes, laboratory data, radiology/imaging reports, surgery reports, etc.; if electronic charts are available, these can be reviewed from the ICP’s desk, but ward rounds are still essential for surveillance, prevention, and control activities

5. Completes HAI data collection forms/screens as data sources are reviewed
16.2 Denominator data

Denominator is the lower portion of a fraction used to calculate a rate or ratio. The purpose of denominator is to adjust the HAI events and other related numerator data to the counts of the cohorts of patients at risk of acquiring HAI so as to make fair comparisons.

Types of denominator data collection

<table>
<thead>
<tr>
<th>Surveillance</th>
<th>Types of denominator data</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLABSI</td>
<td>Patient-days and central line-days</td>
</tr>
<tr>
<td>CAUTI</td>
<td>Patient-days and urinary catheter-days</td>
</tr>
<tr>
<td>VAP</td>
<td>Patient-days and ventilator-days</td>
</tr>
<tr>
<td>VAE</td>
<td>Patient-days, ventilator-days, ventilator episodes</td>
</tr>
<tr>
<td>DE</td>
<td>Patient-months</td>
</tr>
<tr>
<td>SSI</td>
<td>Number of operative procedures of the same type</td>
</tr>
<tr>
<td>MDRO</td>
<td>Patient-days, number of admissions, number of encounters</td>
</tr>
</tbody>
</table>
Responsibility of denominator data collection

1. **Unit staff:**
   - Denominator data may be collected by someone other than the ICP as long as that person is trained.
   - Training should be checked periodically, especially when staff take leaves or in areas of high staff turnover

2. **Electronic sources:**
   - When denominator data are available from electronic databases (e.g., patient tracking systems, respiratory therapy database), these sources may be used as long as the counts are not substantially different (+/- 5%) from those collected manually.
   - When shifting from one electronic counting system to another electronic counting system, the new electronic system should be validated against manual counts as above.
Methods of denominator data collection

1. **Manual, daily:** Device-associated denominator data (other than DE) including patient days and device days should be collected at the same time, every day, for each location performing surveillance to ensure that different collection methods don't result in device days being > patient days.

2. **Manual, weekly:** Device-associated denominator data (other than DE) including patient days and device days should be collected at the same time on the same designated day, once per week. The idea is to reduce staff time spent collecting surveillance data, once weekly collection of denominator data is good for:
   - For CLABSI, CAUTI and VAP/VAE denominators only
   - For locations with 75 or more device days per month
   - For locations other than specialty care areas/oncology and NICUs
   - It was shown that the use of Friday and Saturday generate the least accurate estimates, so avoid them
   - If the day designated for the collection of sampled data is missed, collect the data on the next available day instead

3. **Electronic sources:**
   - When denominator data are available from electronic databases (e.g., patient tracking systems, respiratory therapy database), these sources may be used as long as the counts are not substantially different (+/- 5%) from those collected manually.

4. **DE denominator data:** record the number of chronic outpatients hemodialysis patients with each access type who received hemodialysis at the center during the first two working days of the month.

5. **SSI denominator data:** record information on operative procedures selected for surveillance (e.g., type of procedure, date, risk factors, etc.)
17. Infection control indicators

Infection control indicators have been used to assess the overall activity and efficiency of infection control program. They are not meant to identify or report every infection or infection prevention activity. Several countries and organizations have adopted one of the following infection control indicators:

<table>
<thead>
<tr>
<th>Domain</th>
<th>Items</th>
<th>Metric expression</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infection prevention</td>
<td>Hand hygiene compliance</td>
<td>100 opportunities</td>
</tr>
<tr>
<td>Device-associated HAI</td>
<td>CLABSI rate</td>
<td>1000 central line days</td>
</tr>
<tr>
<td></td>
<td>CAUTI rate</td>
<td>1000 urinary catheter days</td>
</tr>
<tr>
<td></td>
<td>VAE rate</td>
<td>1000 ventilator days</td>
</tr>
<tr>
<td>Procedure-associated HAI</td>
<td>SSI: C-section rate</td>
<td>100 C-section procedures done</td>
</tr>
<tr>
<td></td>
<td>SSI: cholecystectomy rate</td>
<td>100 cholecystectomy procedures done</td>
</tr>
<tr>
<td>Antimicrobial resistance</td>
<td>MRSA rate</td>
<td>10,000 patient days</td>
</tr>
<tr>
<td></td>
<td>Clostridium difficile rate</td>
<td>10,000 patient days</td>
</tr>
</tbody>
</table>
Suggested Infection control indicators:

1. **Central line-associated bloodstream infection (CLABSI) rate:**
   - It should be done in one or more intensive care unit (ICUs) such as adult medical-surgical ICU or neonatal ICU
   - The rate is expressed as CLABSI events per 1000 central lines days
   - Both average in a certain period and quarterly trend are required

2. **Surgical site infection (SSI) rate:**
   - SSI rate should be calculated per surgery and per risk index category
   - It is expressed as SSI events per 100 surgeries done (of same type)
   - Suggested surgeries are cesarean section and cholecystectomy
   - Both average in a certain period and quarterly trend are required

3. **Hand hygiene compliance:**
   - It should be calculated for the whole hospital, ICU versus non-ICU locations, and by professional category.
   - It is expressed per 100 observed hand hygiene opportunities.
   - Both average in certain period and quarterly trend are required

4. **Multi-drug resistant organisms (MDRO) rate:**
   - It should be calculated for the whole hospital, ICU versus non-ICU locations
   - It is expressed as organism per 10,000 patient days
   - Suggested organism is methicillin-resistant Staphylococcus aureus (MRSA)
   - Both average in certain period and quarterly trend are required
18. Evaluation of surveillance program

Program evaluation:

Program evaluation is a systematic method for collecting, analyzing, and using information to answer questions about projects, policies and programs, particularly about their effectiveness and efficiency.

Types of evaluation:

There are several types of evaluations that can be conducted. Some of them include the following:

1. **Formative evaluation** ensures that a program or program activity is feasible, appropriate, and acceptable before it is fully implemented. It is usually conducted when a new program or activity is being developed or when an existing one is being adapted or modified.

2. **Process/implementation evaluation** determines whether program activities have been implemented as intended.

3. **Outcome/effectiveness evaluation** measures program effects in the target population by assessing the progress in the outcomes or outcome objectives that the program is to achieve.

4. **Impact evaluation** assesses program effectiveness in achieving its ultimate goals.

Process evaluation of surveillance activities

Using WHO Infection Prevention and Control (IPC) Assessment Framework (IPCAF) tool

1. Organization of surveillance

2. Priorities for surveillance - defined according to the scope of care

3. Methods of surveillance

4. Information analysis and dissemination/data use, linkage, and governance
Process evaluation of surveillance activities (IPCAF tool)

1. Organization of surveillance

- Is surveillance a defined component of your IPC program?
- Do you have personnel responsible for surveillance activities?
- Have the professionals responsible for surveillance activities been trained in basic epidemiology, surveillance and IPC (that is, capacity to oversee surveillance methods, data management and interpretation)?
- Do you have informatics/IT support to conduct your surveillance (for example, equipment, mobile technologies, electronic health records)?

2. Priorities for surveillance - defined according to the scope of care

- Do you go through a prioritization exercise to determine the HAIs to be targeted for surveillance according to the local needs (e.g. annual risk assessment)?
- In your facility is surveillance conducted for:
  - Surgical site infections?
  - Device-associated infections (such as CLABSI, CAUTI, VAP, VAE, DE)?
  - Clinically-defined infections (such healthcare pneumonia)?
  - Colonization or infections caused by MDR pathogens according to your local epidemiological situation?
  - Infections in vulnerable populations (for example, neonates, intensive care unit, immunocompromised, burn patients)?
- Do you regularly evaluate if your surveillance is in line with the current needs and priorities of your facility?
3. **Methods of surveillance**

- Do you use reliable surveillance case definitions (defined numerator and denominator according to international definitions e.g. NHSN) or if adapted, through an evidence-based adaptation process and expert consultation?

- Do you use standardized data collection methods (for example, active prospective surveillance) according to international surveillance protocols (e.g. NHSN/GCC) or if adapted, through an evidence-based adaptation process and expert consultation?

- Do you have processes in place to regularly review data quality (for example, assessment of case report forms, review of microbiology results, denominator determination, etc.)?

- Do you have adequate microbiology and laboratory capacity to support surveillance?
  - Can differentiate gram-positive/negative strains but cannot identify pathogens
  - Can reliably identify pathogens (for example, isolate identification) in a timely manner
  - Can reliably identify pathogens and antimicrobial drug resistance patterns (that is, susceptibilities) in a timely manner

4. **Information analysis and dissemination/data use, linkage, and governance**

- Are surveillance data used to make tailored unit/facility-based plans for the improvement of IPC practices?

- Do you analyze antimicrobial drug resistance on a regular basis (for example, quarterly/half-yearly/annually)?

- Do you regularly (for example, quarterly/half-yearly/annually) feedback up-to-date surveillance information to:
  - Frontline health care workers (doctors/nurses)?
- Clinical leaders/heads of department
- IPC committee
- Non-clinical management/administration (chief executive officer/chief financial officer)?
  - How do you feedback up-to-date surveillance information? (at least annually)
    - By written/oral information only
    - By presentation and interactive problem-orientated solution finding

**Outcome evaluation of surveillance activities**

1. **Infection control indicators (mentioned above):**
   - Central line-associated bloodstream infection (CLABSI) rate
   - Surgical site infection (SSI) rate
   - Hand hygiene compliance
   - Multi-drug resistant organisms (MDRO) rate:

2. **Other common measures:**
   - Rates before and after starting surveillance
   - Rates before and after applying bundles
   - Rates before and after improvement project

3. **Impact measures:**
   - Hospital length of stay
   - ICU length of stay
   - Cost per admission in different departments
   - Cost per event in ICUs
   - Attributable mortality
19. Surveillance data analysis

As mentioned before, surveillance is a systematic method of ongoing collection, consolidation, and data analysis concerning the distribution and determinants of a given disease or event, followed by the dissemination of that information to those who can improve the outcome. Therefore, statistical analysis is an integral part of the surveillance process. Actually, weak analysis turns the surveillance activities into data collection only.

Requirements of data analysis

- Epidemiologist or biostatistician
- Data entry staff
- Computers with excel and SPSS software
- Data collected in standardized data collection forms
- Pre-prepared data entry files for each type of surveillance
- Analysis plans and defined metrics
- Benchmarking

Example of main duties of epidemiologist or biostatistician

- Maintains excellent database quality by performing required data cleaning
- Works with other related personnel in developing appropriate instrument for data collection (both hardcopies and electronic).
- Manages and analyze surveillance data on timely manner
- Produces periodic, annual and sometimes urgent statistical report.
- Provides interpretation of data analysis results with appropriate recommendation
- Supervises statistical assistant(s) and data entry staff.
- Communicates analysis interpretation effectively with relevant staff at ICP department
19.1 Basic statistics

There are two types of statistics, descriptive and inferential. Descriptive statistics provides numerical information about variables (e.g. mean). Inferential statistics makes an assumption about a population based on a sample of the population (Z test).

<table>
<thead>
<tr>
<th>Quantitative data</th>
<th>Categorical data</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sub-type</strong></td>
<td><strong>Example</strong></td>
</tr>
<tr>
<td>Continuous</td>
<td>● Blood pressure</td>
</tr>
<tr>
<td></td>
<td>● Height &amp; weight</td>
</tr>
<tr>
<td></td>
<td>● Age</td>
</tr>
<tr>
<td>Discrete</td>
<td>● Number of children</td>
</tr>
<tr>
<td></td>
<td>● Number of attacks of asthma per week</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Descriptive Statistics:

- Frequency table
- Frequency histogram
- Relative frequency histogram
- Frequency polygon
- Relative frequency polygon
- Bar chart
- Pie chart
- Stem-and-leaf display
- Box plot
- Scatter plot
Examples of descriptive Statistics

**Bar chart**

<table>
<thead>
<tr>
<th>BMI Groups</th>
<th>Percentage of Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>60%</td>
</tr>
<tr>
<td>Overweight</td>
<td>25%</td>
</tr>
<tr>
<td>Obese</td>
<td>15%</td>
</tr>
</tbody>
</table>

**Pie chart**

- Normal: 60%
- Overweight: 25%
- Obese: 15%

**Frequency Table**

<table>
<thead>
<tr>
<th>Age Groups</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>32-36.99</td>
<td>2</td>
<td>6.7%</td>
</tr>
<tr>
<td>37-41.99</td>
<td>3</td>
<td>10.0%</td>
</tr>
<tr>
<td>42-46.99</td>
<td>4</td>
<td>13.3%</td>
</tr>
<tr>
<td>47-51.99</td>
<td>3</td>
<td>10.0%</td>
</tr>
<tr>
<td>52-56.99</td>
<td>8</td>
<td>26.7%</td>
</tr>
<tr>
<td>57-61.99</td>
<td>3</td>
<td>10.0%</td>
</tr>
<tr>
<td>62-66.99</td>
<td>4</td>
<td>13.3%</td>
</tr>
<tr>
<td>67-72</td>
<td>3</td>
<td>10.0%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>30</strong></td>
<td><strong>100.0%</strong></td>
</tr>
</tbody>
</table>

**Box plot**

- Min
- Q1
- Median
- Q3
- Max

**Relative Frequency Histogram & Polygon**

- Percentage of patients

<table>
<thead>
<tr>
<th>Age (year)</th>
<th>Number of patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>30</td>
<td>50</td>
</tr>
<tr>
<td>40</td>
<td>100</td>
</tr>
<tr>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>60</td>
<td>20</td>
</tr>
<tr>
<td>70</td>
<td>10</td>
</tr>
<tr>
<td>80</td>
<td>10</td>
</tr>
</tbody>
</table>
### Measures of central tendency:

<table>
<thead>
<tr>
<th>Measure</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arithmetic mean</td>
<td>• Uses all the data values</td>
<td>• Distorted by outliers</td>
</tr>
<tr>
<td></td>
<td>• Algebraically defined and so mathematically manageable</td>
<td>• Distorted by skewed data</td>
</tr>
<tr>
<td>Median</td>
<td>• Not distorted by outliers</td>
<td>• Ignores most of the information</td>
</tr>
<tr>
<td></td>
<td>• Not distorted by skewed data</td>
<td>• Not algebraically defined</td>
</tr>
<tr>
<td>Mode</td>
<td>• Easily determined for categorical data</td>
<td>• Ignores most of the information</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Not algebraically defined</td>
</tr>
</tbody>
</table>

### Measures of variation:

<table>
<thead>
<tr>
<th>Measure</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range</td>
<td>The difference between the largest value and the smallest value.</td>
</tr>
<tr>
<td>Interquartile range</td>
<td>The difference between the first and the third quartiles (25th and 75th percentiles)</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>The mean differences of individual data from the arithmetic mean of all data. It is the square root of the variance.</td>
</tr>
<tr>
<td>Variance</td>
<td>The mean of the squares of the deviations from the arithmetic mean of a data set</td>
</tr>
<tr>
<td>Standard error of the mean</td>
<td>It is calculated by dividing the standard deviation by the square root of the sample size.</td>
</tr>
<tr>
<td>Coefficient of Variation</td>
<td>It is the ratio of the sample standard deviation to the sample mean</td>
</tr>
</tbody>
</table>
# Measures of variations:

<table>
<thead>
<tr>
<th>Measures</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range</td>
<td>• Easily determined</td>
<td>• Uses only two observations</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Distorted by outliers</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Tends to increase with increasing sample size</td>
</tr>
<tr>
<td>Interquartile range</td>
<td>• Unaffected by outliers</td>
<td>• Clumsy to calculate</td>
</tr>
<tr>
<td></td>
<td>• Independent of sample size</td>
<td>• Cannot be calculated for small samples</td>
</tr>
<tr>
<td></td>
<td>• Appropriate for skewed data</td>
<td>• Uses only two observations</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Not algebraically defined</td>
</tr>
<tr>
<td>Variance</td>
<td>• Uses every observation</td>
<td>• Units of measurement are the square of the units of the raw data</td>
</tr>
<tr>
<td></td>
<td>• Algebraically defined</td>
<td>• Sensitive to outliers</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Inappropriate for skewed data</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>• Same advantages as the variance</td>
<td>• Sensitive to outliers</td>
</tr>
<tr>
<td></td>
<td>• Units of measurement are the same as those of</td>
<td>• Inappropriate for skewed data</td>
</tr>
<tr>
<td></td>
<td>the raw data</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Easily interpreted</td>
<td></td>
</tr>
</tbody>
</table>
Measures of relative standing:

<table>
<thead>
<tr>
<th>Measure</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentile</td>
<td>Data divided into 100 equal parts by rank (i.e., the kth percentile is that value greater than k% of the others). Example,</td>
</tr>
<tr>
<td></td>
<td>• 30th percentile means values more than 30% of the values</td>
</tr>
<tr>
<td></td>
<td>• 90th percentile means values more than 90% of the values</td>
</tr>
<tr>
<td>Quartile</td>
<td>Data divided into 4 equal parts by rank:</td>
</tr>
<tr>
<td></td>
<td>• Q1 (first quartile) is greater than ¼;</td>
</tr>
<tr>
<td></td>
<td>• Q2 is identical to the median</td>
</tr>
<tr>
<td></td>
<td>• Q3 (third quartile) is the value greater than ¾ of the others</td>
</tr>
<tr>
<td>z score</td>
<td>Measures the distance from the mean in terms of standard deviation</td>
</tr>
</tbody>
</table>

Measures of Frequency:

Rates, ratios, and proportions are used to measure the occurrence and risk of an event in a specific population during a given period.

1. **Rate**: an expression of the frequency with which an event occurs in a defined population, for example, CLA-BSI incidence rate is 5.3 per 1000 patient-days
2. **Ratio**: the value obtained by dividing one quantity by another, for example, the ratio of females to males is 2:1
3. **Proportion**: a type of ratio in which the values in the numerator are included in (i.e., are a subset of) the denominator, for example, 33% of the population is in risk category 1
19.2 Measures of morbidity and mortality

Surveillance should yield risk-adjusted incidence rates to allow inter- and intra-facility rate comparisons.

Risk-adjusted rates and crude rates

1. Risk-adjusted rates

- Rates are controlled for variations in the distribution of major risk factors associated with an event’s occurrence
- Such rates allow inter- and intra-facility rate comparisons

2. Crude rates

- Rates assume equal distribution of risk factors for all events
- Such rates cannot be used for inter-facility comparisons

Measures of morbidity and mortality

1- Measures of morbidity:

- Incidence rate
- Prevalence rate

2- Measures of mortality:

- Mortality rate
- Case fatality
- Proportionate mortality
Measures of morbidity:

- **Incidence rate**: a measure of the frequency with which an event occurs in a population over a defined time period. The numerator is the number of new cases occurring during the defined time period, and the denominator is the population at risk.

- **Attack rate** is a type of incidence rate used to measure the frequency of new cases of a disease or condition in a specific population during a given (short) period of time; expressed as a percentage.

- **Prevalence rate**: the proportion of persons in a population who have a particular disease or condition (new and previously existing) at a specified point in time or over a specified period of time.

<table>
<thead>
<tr>
<th>Measure</th>
<th>Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Point prevalence</strong></td>
<td>[rac{\text{Number of all cases (old and new) in a given point in time}}{\text{Total population at risk at the given point in time}}]</td>
</tr>
<tr>
<td><strong>Period prevalence</strong></td>
<td>[rac{\text{Number of all cases (old and new) in a given period of time}}{\text{Total population at risk at the given period in time}}]</td>
</tr>
<tr>
<td><strong>Cumulative incidence</strong></td>
<td>[rac{\text{Number of new cases in a given period of time}}{\text{Total population at risk during that time}}]</td>
</tr>
<tr>
<td><strong>Attack rate</strong></td>
<td>[rac{\text{Number of new cases in a short period of time}}{\text{Total population at risk during that time}}]</td>
</tr>
<tr>
<td><strong>Incidence Density</strong></td>
<td>[rac{\text{Number of new cases in a given period of time}}{\text{Total person-time of observation}}]</td>
</tr>
</tbody>
</table>
Measures of mortality:

- **Mortality rate**: The frequency of occurrence of death in a defined population during a specified interval.

- **Case fatality**: The proportion of deaths from a certain disease compared to the total number of people diagnosed with the disease for a particular period.

- **Proportionate mortality**: It describes the proportion of deaths in a specified population over a period of time attributable to different causes. Each cause is expressed as a percentage of all deaths, and the sum of the causes must add to 100%.

<table>
<thead>
<tr>
<th>Mortality rate =</th>
<th>Deaths in a given period of time</th>
<th>Total population in the given period of time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case fatality =</td>
<td>Deaths from a certain disease</td>
<td>All patients diagnosed with that disease</td>
</tr>
<tr>
<td>Proportionate mortality =</td>
<td>Deaths from a certain disease in a given period of time</td>
<td>Deaths from all causes in the given period of time</td>
</tr>
</tbody>
</table>
19.3 Calculating infection rates and ratios

**CLABSI:**
- The CLABSI rate per 1000 central line-days is calculated by dividing the number of CLABSI by the number of central line-days and multiplying the result by 1000.
- The Central Line Utilization Ratio is calculated by dividing the number of central line-days by the number of patient-days.
- These calculations will be performed separately for different types of ICUs, specialty care areas, and other locations in the institution.
- Separate rates and ratios will also be calculated for different types of catheters and birthweight categories in NICUs.

**CAUTI:**
- The CAUTI rate per 1000 urinary catheter-days is calculated by dividing the number of CAUTIs by the number of catheter-days and multiplying the result by 1000.
- The Urinary Catheter Utilization Ratio is calculated by dividing the number of urinary catheter-days by the number of patient-days.
- These calculations will be performed separately for the different types of ICUs, specialty care areas, and other locations in the institution.

**VAP:**
- The VAP rate per 1000 ventilator-days is calculated by dividing the number of VAPs by the number of ventilator-days and multiplying the result by 1000.
- The Ventilator Utilization Ratio is calculated by dividing the number of ventilator-days by the number of patient-days.
- These calculations will be performed separately for the different types of ICUs, specialty care areas, and other locations in the institution, as well as by each birthweight category in NICUs.
VAE:

- The VAE rate per 1000 ventilator-days is calculated by dividing the number of VAEs by the number of ventilator-days and multiplying the result by 1000.

- The VAE rate per 100 episodes of mechanical ventilation is calculated by dividing the number of VAEs by the number of episodes of mechanical ventilation and multiplying the result by 100 (episodes of mechanical ventilation).

- The Ventilator Utilization Ratio is calculated by dividing the number of ventilator-days by the number of patient-days.

- These calculations will be performed separately for the different types of ICUs, specialty care areas, and other adult locations in the institution.

DE:

- The numbers of various events (In-unit IV antimicrobial start, positive blood culture, or local infection) are tabulated, and rates of these events per 100 patient-months calculated by dividing the number of events by the number of patient-months and multiplying the result by 100.

- These rates are stratified by vascular access type and compared to the mean rate of all centers combined.

SSI:

- The SSI rates per 100 operative procedures are calculated by dividing the number of SSIs by the number of specific operative procedures and multiplying the results by 100.

- These calculations will be performed separately for the different types of operative procedures and stratified by risk index category.

- Standardized infection ratios are also calculated using indirect standardization or multivariate models.
MDRO-Infection Surveillance:

- MDRO infection incidence rate is calculated by dividing the number of infections of a certain MDRO type by the number of patient days and multiplying the results by 10,000.
- Rate is then stratified by time (e.g., month, quarter, etc.) and patient care location.

MDRO-Laboratory-Identified (LabID) Event:

- Numerator data are the Laboratory-identified MDRO Events while denominator data are the number of patient days, admissions, and encounters (for ER and outpatient locations).
- These data are used to calculate four distinct proxy measures including:
  - Admission prevalence rate and
  - Overall prevalence rate based on clinical testing (measures of exposure burden),
  - MDRO bloodstream infection incidence rate (measure of infection burden), and
  - Overall MDRO infection/colonization incidence rate (measure of healthcare acquisition).
- LabID Events proxy measures are categorized as healthcare facility-onset (> 3 days after admission to the facility) versus community-onset (≤ 3 days after admission to the facility).
19.4 Calculating SIR

The standardized infection ratio (SIR):

- SIR is a summary measure used to track HAIs at a national, regional, or facility level over time.
- SIR provides improved risk adjustment and can replace risk-stratified HAI rates.

Calculation of SIR:

<table>
<thead>
<tr>
<th>Observed HAI events</th>
<th>Expected HAI events</th>
</tr>
</thead>
</table>

- The observed HAI events: It is the HAI events you detect during surveillance
- The expected HAI events: It can be calculated from the published benchmarking reports of NHSN, INICC, GCC, or MOH.
- To allow for more precise comparisons, SIRs are calculated only if the number of expected HAIs is ≥1
- When the expected HAI <1, this indicates that the denominator (e.g. number of device days or procedures) in the facility or location is too low to calculate a precise SIR and comparative statistics.

Interpretation of SIR:

- SIR<1 means that after adjusting for differences, fewer HAIs were observed than predicted
- SIR>1 means that after adjusting for differences, more HAIs were observed than predicted
- SIR=1 means that after adjusting for differences, Same HAIs were observed as predicted
Example of SIR calculation:

Assume you have CLABSI rates for 4 ICUs and you want to calculate overall SIR for CLABSI at your hospital compared with published NHSN/MOH rates

1- Abstract the published NHSN/MOH rates corresponding to the above four ICUs (e.g. medical cardiac ICU is 2.0 per 1000 central line days)

2- Calculate the expected CLABSI rates for each ICU separately by multiplying the observed central lines days in each unit with its corresponding published NHSN/MOH rates (e.g. in medical cardiac ICU 380 X 2.0 /1000 = 0.76)

3- Sum up expected CLABSI events in the four ICUs (e.g. 0.76 + 0.67 + 0.94 + 1.78 = 4.15)

4- Calculate the SIR by dividing observed CLABSI events by expected CLABSI events (e.g. 8 / 4.15 = 1.93)

5- Interpret the SIR: Your hospital had 93% more CLABSIs than expected assuming your ICUs have CLABSI rates similar to that of NHSN/MOH ICUs

<table>
<thead>
<tr>
<th>Type of ICU</th>
<th>Observed CLABSI events</th>
<th>Observed central line days</th>
<th>Hospital rates</th>
<th>Published NHSN rates</th>
<th>Expected CLABSI events</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medical cardiac</td>
<td>2</td>
<td>380</td>
<td>5.26</td>
<td>2.0</td>
<td>0.76</td>
</tr>
<tr>
<td>Medical</td>
<td>1</td>
<td>257</td>
<td>3.89</td>
<td>2.6</td>
<td>0.67</td>
</tr>
<tr>
<td>Medical surgical</td>
<td>3</td>
<td>627</td>
<td>4.78</td>
<td>1.5</td>
<td>0.94</td>
</tr>
<tr>
<td>Neurosurgical</td>
<td>2</td>
<td>712</td>
<td>2.81</td>
<td>2.5</td>
<td>1.78</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>8</strong></td>
<td><strong>1976</strong></td>
<td><strong>4.05</strong></td>
<td></td>
<td><strong>4.15</strong></td>
</tr>
</tbody>
</table>
19.5 Data validation

Surveillance data validation:

It is the process of confirming that surveillance data meets the requirements and the standards for which it was intended.

Purpose of surveillance data validation:

- Ensure that surveillance data are of high quality: Complete, accurate, and timely.
- Ensure that surveillance data are suitable for fair comparison of HAI rates between hospitals.
- Provide insights into systematic weaknesses in the surveillance process and suggest how to correct them.
- Estimate coefficient of underreporting.

Levels of surveillance data validation:

Validation should strive to address data quality across several components that comprise HAI measures. This includes the completeness and accuracy of:

- The population denominator at risk for the HAI.
- Identified cases.
- Reported data elements, including those used for risk adjustment.

Types of surveillance data validation:

1- Intrinsic validation:

- It is an automated process built into a computer application that controls the values and types of data that are entered into the system.
- Point-of-entry validation is a process for routinely checking whether data are reasonable, complete, consistent, and formatted in accordance with system requirements.
• Intrinsic validation serves as a means for detecting and preventing some input errors. However, intrinsic validation does not prevent all errors and does not assure the quality and completeness of HAI case ascertainment or the caliber of numerator and denominator data acquisition.

2- Internal validation
• It is a systematic process that enables facility personnel themselves to assess whether sound surveillance methods, optimal healthcare data sources, and the highest caliber data abstraction and entry are in use when numerator and denominator records are completed.
• Investigations of surveillance practices and analysis and follow-up of aberrant or outlying results are the main methods of internal validation.

3- External validation
• It is a survey and audit process conducted by an agency outside the reporting facility (e.g. Ministry of health team), in which a facility’s surveillance determinations and methods are assessed by one or more validators who work for the agency and who are trained to evaluate completeness and accuracy of reporting.
• External validation complements internal validation by systematically reinforcing the obligation of facilities to conduct complete and accurate surveillance.
• Findings from external validation can be used to correct misconceptions about definitions, criteria, and data requirements.

4- Validation of internal data against external dataset
• This may involve the acquiring of data from an independent source such as a microbiology laboratory database and the cross-checking of these data with the surveillance data to check for missing infections.
• This could be undertaken on an intermittent basis (e.g. quarterly or annually) or undertaken on a continuous basis, especially if the process can be semi-automated.
5- Validation of ICP surveillance skills

- This may involve a person responsible for collecting surveillance data being externally examined using a standardized assessment tool by an accredited surveyor.

- This may involve case scenarios and require the person to correctly identify the classification of HAI data.

- This may involve inter-rater reliability between two ICPs using kappa statistic

6- Denominator data validation

- The denominator data are usually provided by the medical statistics department of the hospital or unit staff.

- It is important that surveillance personnel are familiar with the way that these data are obtained; have documentary evidence that the extracted data meet the definitions for patient days and device days

- This will usually involve direct communication with those responsible for generating the data extract.

- Comparing electronic and manually collected denominators

Examples of some validation items in CLABSI surveillance:

- Not all positive blood cultures reviewed by ICP (need a list from the laboratory)

- Not all patients on central line included in the surveillance

- Misclassification of primary and secondary BSI due to mismatch of pathogens

- Misclassification of primary and secondary BSI due to missing candida

- Misclassification of primary and secondary BSI due to failure to recognize infections at other sites (such as GIT infections)

- Misclassification of HAI and POA because of wrong window period estimation

- Use of current weight group rather than birth weight group in neonatal ICU
- Wrong location of attribution after transfer
- Counting both CLABSI and MBI in the same patient
- Misclassification of LCBI criterion due to failure to distinguish between recognized pathogen and skin contaminant
- Using LCBI criterion 3 outside neonatal ICU
- Central line days more than patient days
- Central line days extremely higher or lower than expected
- Data entry errors (need impenent entry of about 5% of the cases)
- Considering expired patient as out of surveillance
19.6 Benchmarking

Benchmarking is the process of “comparing oneself to others performing similar activities, so as to continuously improve.” Although it is very appealing to compare one’s rates externally with others, comparisons should be made only after ensuring that the several conditions are met.

Benchmarking conditions

- Using standardized case definition
- Using similar data collection methods
- The population and time period for study is well defined.
- The size of the population should be large enough and the duration should be sufficient to allow fair comparisons
- Using same data description methods including:
  - Similar rate calculation
  - Similar rate stratification by risk factors
  - Similar rate stratification by hospital locations
  - Similar adjusting methods
- Using sound statistical comparisons methods
- Patients confidentiality are safeguarded

Benchmarking Reports

- The National Healthcare Safety Network (NHSN)
- The International Nosocomial Infection Control Consortium (INICC)
- European Centre for Disease Prevention and Control (ECDC)
- World Health Organization (WHO) estimates
- Ministry of health reports(MOH) and Gulf Cooperation Council (GCC)
20. Surveillance reporting

Surveillance report:

- A written report should be developed to provide a mechanism to interpret and disseminate surveillance data.
- Tables, graphs, and charts are effective tools for organizing, summarizing, and visually displaying data and should be used as applicable.
- The format and level of detail in each report will depend on the intended audience.
- Surveillance is not finished until dissemination of “Surveillance report”.

Surveillance report criteria:

- Define the event, population, setting, and time period studied (e.g., surgical site infections in patients undergoing coronary artery bypass graft in hospital A from January through December 2003).
- State the criteria used for defining a case (e.g., NHSN criteria for urinary tract infection).
- Specify the number of cases or events identified and the number in the population studied (e.g., 2 surgical site infections in 179 total hip replacement procedures performed).
- Explain the methodology used to identify cases (e.g., case reports from personnel and review of medical records and laboratory results).
- Identify the statistical methods and calculations used, when appropriate (e.g., fall rate in April = falls in April / # resident days in April x 1000 or 3/414 x 1000 =7.2 falls per 1000 resident-days).
- State the purpose for conducting surveillance (e.g., to reduce the rate of occurrence of an event).
- Interpret the findings in a manner that is understandable to those who read the report.
• Describe any actions taken and recommendations made for prevention and control measures
• Identify the author and date of the report
• Identify the recipients of the report

**Surveillance report structure:**

1- Author information
2- Target audience information
3- Executive Summary
4- Background literature
5- Objectives of the surveillance
6- Methods:
   • Define population, setting, and time period studied
   • State the criteria used for defining a case
   • Explain the methodology used to identify cases
   • Describe the statistical methods and calculations used, when appropriate
7- Results:
   • Specify the number of cases or events identified and the number in the population studied
   • Describe findings using tables, graphs, and charts
   • Interpret the findings in a manner that is understandable to those who read the report
   • Benchmarking
8- Conclusions and recommendations:
   • Describe the main findings
• Describe any actions taken and recommendations made for prevention and control measures.

9- References

**Surveillance report recipients:**

After you prepare the report according to the above criteria (including easy to understand conclusions and recommendations), the following stakeholders (persons/bodies) need to receive a copy of your final report:

- Immediate supervisor, higher rank administration, or any other healthcare facility employee who are required (by your facility local policies) to be informed and/or are authorized to implement the suggested recommendation.
- Healthcare workers who have immediate concern with the report contents (e.g. surgical team who performed the procedures for which you are reporting SSI rates)
- ICPs who are directly involved in data collection as a way to keep them informed as well as promote quality improvements.
21. References

   (Last accessed Dec 2020)

   https://www.cdc.gov/nhsn/pdfs/outlineforhaisurveillance.pdf
   (Last accessed Dec 2020)

   (Last accessed Dec 2020)

   (Last accessed Dec 2020)


22. Appendices
### 22.1 Abbreviations

<table>
<thead>
<tr>
<th>Abbreviations</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABUTI</td>
<td>Asymptomatic Bacteremic Urinary Tract Infection</td>
</tr>
<tr>
<td>AIA</td>
<td>America Institute of Architects</td>
</tr>
<tr>
<td>AIDS</td>
<td>Acquired immunodeficiency Syndrome</td>
</tr>
<tr>
<td>ANC</td>
<td>Absolute Neutrophil Count</td>
</tr>
<tr>
<td>APIC</td>
<td>Association for Professionals in Infection Control and Epidemiology</td>
</tr>
<tr>
<td>APRV</td>
<td>Airway Pressure Release Ventilation</td>
</tr>
<tr>
<td>ASA</td>
<td>American Society of Anesthesiologists</td>
</tr>
<tr>
<td>ASAP</td>
<td>As Soon As Possible</td>
</tr>
<tr>
<td>ASC/AST</td>
<td>Active Surveillance Culture/Testing</td>
</tr>
<tr>
<td>AV</td>
<td>Arteriovenous</td>
</tr>
<tr>
<td>BAL</td>
<td>Broncho alveolar Lavage</td>
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<tr>
<td>Bipap</td>
<td>Bi-level positive airway pressure</td>
</tr>
<tr>
<td>BSI</td>
<td>Blood Stream Infection</td>
</tr>
<tr>
<td>CABG</td>
<td>Coronary Artery Bypass Graft</td>
</tr>
<tr>
<td>CAP</td>
<td>Community Acquired Pneumonia</td>
</tr>
<tr>
<td>CAUTI</td>
<td>Catheter Associated Urinary Tract Infection</td>
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<tr>
<td>CBAHI</td>
<td>Central Board for Accreditation of Healthcare Institutes</td>
</tr>
<tr>
<td>CCU</td>
<td>Coronary Care Unit</td>
</tr>
<tr>
<td>CDC</td>
<td>Centers for Disease Control</td>
</tr>
<tr>
<td>CDI</td>
<td>Clostridium Difficile Infection</td>
</tr>
<tr>
<td>CFU</td>
<td>Colony Forming Unit</td>
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<tr>
<td>CHG</td>
<td>Chlorhexidine gluconate</td>
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<td>CIC</td>
<td>Certified in Infection Control</td>
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<tr>
<td>CLABSI</td>
<td>Central Line Associated Blood Stream Infection</td>
</tr>
<tr>
<td>CLIPI</td>
<td>Central Line Insertion Practices</td>
</tr>
<tr>
<td>CO</td>
<td>Community Onset</td>
</tr>
<tr>
<td>CO-HCFA</td>
<td>Community-Onset Healthcare Facility-Associated</td>
</tr>
<tr>
<td>CPAP</td>
<td>Continuous Positive Airway Pressure</td>
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<tr>
<td>CRE</td>
<td>Carbapenem Resistant Enterobacteriaceae</td>
</tr>
<tr>
<td>Acronym</td>
<td>Definition</td>
</tr>
<tr>
<td>---------</td>
<td>------------</td>
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<tr>
<td>DA HAI</td>
<td>Device Associated Healthcare Associated infection</td>
</tr>
<tr>
<td>DDD</td>
<td>Defined Daily Dose</td>
</tr>
<tr>
<td>DE</td>
<td>Dialysis Event</td>
</tr>
<tr>
<td>DI</td>
<td>Deep Incisional</td>
</tr>
<tr>
<td>DIP</td>
<td>Deep Incisional primary</td>
</tr>
<tr>
<td>DIS</td>
<td>Deep Incisional Secondary</td>
</tr>
<tr>
<td>DOE</td>
<td>Date of Event</td>
</tr>
<tr>
<td>DUR</td>
<td>Device Utilization Ratio</td>
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<td>DVT</td>
<td>Deep Vein Thrombosis</td>
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<tr>
<td>ECDC</td>
<td>European Centre for Disease Prevention and Control</td>
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<tr>
<td>ECMO</td>
<td>Extracorporeal Membrane Oxygenation</td>
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<tr>
<td>ED</td>
<td>Emergency Department</td>
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<tr>
<td>EIA</td>
<td>Enzyme Immunoassay</td>
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<tr>
<td>ENT</td>
<td>Ear, Nose and Throat</td>
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<tr>
<td>ESBLs</td>
<td>Extended Spectrum Beta Lactamases</td>
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<td>ETA</td>
<td>Endotracheal Aspirate</td>
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<td>FDA</td>
<td>Food and Drug Administration</td>
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<tr>
<td>FGI</td>
<td>Facilities Guidelines Institutes</td>
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<tr>
<td>FiO2</td>
<td>Fraction of Inspired Oxygen</td>
</tr>
<tr>
<td>GDIPC</td>
<td>General Directorate of Infection Prevention and Control</td>
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<tr>
<td>GVHD</td>
<td>Gastrointestinal Graft Versus Host Disease</td>
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<td>HAI</td>
<td>Healthcare Associated Infections</td>
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<td>HCWs</td>
<td>Healthcare Workers</td>
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<td>HeRO</td>
<td>Hemodialysis Reliable Outflow</td>
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<td>HESN</td>
<td>Health Electronic System Network</td>
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<tr>
<td>HH</td>
<td>Hand Hygiene</td>
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<tr>
<td>HIV</td>
<td>Human Immunodeficiency Virus</td>
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<td>HO</td>
<td>Healthcare Facility Onset</td>
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<tr>
<td>IAB</td>
<td>Intra-abdominal</td>
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<tr>
<td>IABP</td>
<td>Intra-aortic Balloon Pump</td>
</tr>
<tr>
<td>ICP</td>
<td>Infection Control Practitioner</td>
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<td>ICU</td>
<td>Intensive Care Unit</td>
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<tr>
<td>IFA</td>
<td>Immunofluorescent antibody</td>
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<tr>
<td>Abbreviation</td>
<td>Full Form</td>
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</tr>
<tr>
<td>INICC</td>
<td>International Nosocomial Infection Control Consortium</td>
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<tr>
<td>IP</td>
<td>Infection Preventionist</td>
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<tr>
<td>IPCAF</td>
<td>Infection Prevention and Control Assessment Framework</td>
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<td>IPPB</td>
<td>Intermittent Positive Pressure Breathing</td>
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<td>IVAC</td>
<td>Infection-related Ventilator Associated Complication</td>
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<td>IWP</td>
<td>Infection Window Period</td>
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<td>KAP</td>
<td>Knowledge, Attitude and Practices</td>
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<td>LabID</td>
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<td>LCBI</td>
<td>Laboratory-confirmed Bloodstream Infection</td>
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<td>LRT</td>
<td>Lower Respiratory Tract</td>
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<td>MBI</td>
<td>Mucosal Barrier Injury</td>
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<td>MBI-LCBI</td>
<td>Mucosal Barrier Injury Laboratory-Confirmed Bloodstream Infection</td>
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<td>MDRO</td>
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<td>MICU</td>
<td>Medical intensive Care Unit</td>
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<td>MOH</td>
<td>Ministry of Health</td>
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<td>MRSA</td>
<td>Methicillin Resistant Staphylococcus Aureus</td>
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<td>MV</td>
<td>Mechanical ventilation</td>
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<td>NB</td>
<td>Non bronchoscopically</td>
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<td>NHSN</td>
<td>National Healthcare Safety Network</td>
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<tr>
<td>NICU</td>
<td>Neonatal Intensive Care Unit</td>
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<tr>
<td>OR</td>
<td>Operating Room</td>
</tr>
<tr>
<td>OR</td>
<td>Organ/Space</td>
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<tr>
<td>PaO2</td>
<td>Partial Pressure of Oxygen</td>
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<td>PATOS</td>
<td>Present at the time of surgery</td>
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<tr>
<td>PCR</td>
<td>Polymerase Chain reaction</td>
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<td>PCV</td>
<td>Pressure Control Ventilation</td>
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<tr>
<td>PD</td>
<td>Patient Days</td>
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<tr>
<td>PEEP</td>
<td>Positive end expiratory pressure</td>
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<tr>
<td>PF</td>
<td>Procedure/Surgery Finish</td>
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<tr>
<td>PICU</td>
<td>Pediatric Intensive Care Unit</td>
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<td>PMN</td>
<td>Polymorphic nuclear</td>
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<td>Pneumonia</td>
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<td>POA</td>
<td>Present On Admission</td>
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<tr>
<td>Abbreviation</td>
<td>Description</td>
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<td>PPE</td>
<td>Personal Protective Equipment</td>
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<td>PPS</td>
<td>Point Prevalence Survey</td>
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<td>PSB</td>
<td>Protected Specimen Brushing</td>
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<td>PST</td>
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<td>PUD</td>
<td>Peptic Ulcer Disease</td>
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<td>Possible Ventilator Associated Pneumonia</td>
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<td>QAD</td>
<td>Qualifying Antimicrobial Day</td>
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<td>RIA</td>
<td>Radioimmunoassay</td>
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<tr>
<td>RIT</td>
<td>Repeat Infection Timeframe</td>
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<td>SCA</td>
<td>Specialty Care Area</td>
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<td>SHEA-IDSA</td>
<td>Society for healthcare epidemiology of America-Infectious Disease Society of America</td>
</tr>
<tr>
<td>SI</td>
<td>Superficial Incision</td>
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<tr>
<td>SICU</td>
<td>Surgical Intensive Care Unit</td>
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<td>SIR</td>
<td>Standardized Infection Ratio</td>
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<tr>
<td>SUR</td>
<td>Standardized Utilization Ratio</td>
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<tr>
<td>SPSS</td>
<td>Statistical Package for the Social Sciences</td>
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<td>SSI</td>
<td>Surgical Site Infection</td>
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<td>SUTI</td>
<td>Symptomatic Urinary Tract Infection</td>
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<tr>
<td>TB</td>
<td>Tuberculosis</td>
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<tr>
<td>URI</td>
<td>Upper Respiratory Tract Infection</td>
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<td>VAC</td>
<td>Ventilator Associated Condition</td>
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<td>VAE</td>
<td>Ventilator Associated Event</td>
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<td>Ventilator Associated Pneumonia</td>
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<td>VRE</td>
<td>Vancomycin Resistant Enterococcus</td>
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<tr>
<td>WBC</td>
<td>White Blood Cell</td>
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22.2 Surveillance Forms