Module I

EPIDEMIOLOGICAL SURVEILLANCE OF HEALTHCARE-ASSOCIATED INFECTIONS

Pan American Health Organization
Regional Office of the World Health Organization

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Abbreviations

BAC	laboratory-confirmed bloodstream infection
BAL	bronchoalveolar lavage
BSI	blood stream infection
CPAP	continuous positive airway pressure
PSB	protected-specimen brushing
IUC	indwelling urinary catheter
CVC	central venous catheter or central line
FIO2	fraction of inspired oxygen
ET-CPAP	endotracheal continuous positive airway pressure
IPPB	intermittent positive pressure breathing
MINI BAL	synonym for NB-BAL
NB-BAL	nonbronchoscopic bronchoalveolar lavage
ml	milliliter
PAHO	Pan American Health Organization
PaO2	partial pressure of oxygen in arterial blood
P-BAL	protected bronchoalveolar lavage
PMN	polymorphonuclear leukocyte
ICU	intensive care unit
CFU/ml	colony forming units per milliliter
MV	mechanical ventilation
*** PEEP**	positive end-expiratory pressure
RSV	respiratory syncytial virus

Table of Contents

Introduction and Rationale

I

1 / Evaluation of programs for the prevention and control of healthcare-associated infections in Latin America

In order to improve country capacity to detect and respond effectively and quickly to infectious disease, the Pan American Health Organization (PAHO) has worked in the Region of the Americas to strengthen epidemiological surveillance systems for both health-facilities and laboratories.

Between 2006 and 2007, PAHO, in partnership with national experts, conducted an assessment of the status of programs for the prevention and control of healthcare-associated infections in 67 hospitals in seven countries in the Region (1). As a result of that evaluation, the countries adopted measures to improve their programs. PAHO is addressing the issue at the Regional level.

Epidemiological surveillance and the diagnosis of healthcare-associated infections (HAIs) were among the areas found to require additional attention. Issues with diagnosis were affecting intervention measures, which were implemented based on flawed data. An analysis of surveillance indicator data obtained through the evaluations revealed that these intervention measures needed improvement in over half of participating institutions.

Epidemiological surveillance in hospitals generates data on the principal problems of infectious etiology present at each facility, and on invasive procedures primarily associated with these

cases of infection. Surveillance also helps detect outbreaks and epidemics, and can be used to measure the impact of prevention and control measures.

From the results of the evaluations, it cannot be determined whether the limitations found in the evaluated hospitals are present in other facilities, since the former were not selected as a representative sample of the hospital universe in each country. On the other hand, the hospitals selected for evaluation by each country's Ministry of Health or social security system tended to be the largest in either the capital or a particular geographical region.

2 / Core components of programs for the prevention and control of healthcare-associated infections*

In 2008, the World Health Organization convened a meeting of experts on the control of healthcare-associated infections in order to identify core components of national and healthcare facility-based programs for the prevention and control of healthcare-associated infections (2). The group concluded that the core components of such a program are: organization, technical guidelines, trained human resources, surveillance of healthcare-associated infections, assessment of compliance with international recommendations, support from microbiology laboratories, the environment, program evaluation, and collaboration with public health or other services. Following the meeting, the issue of healthcare-associated infection surveillance regained international visibility.

With regard to surveillance, the group of experts recommended that national health authorities should collect and document data available on healthcare-associated infections; define national objectives for surveillance efforts; establish priorities for surveillance of healthcare-associated infections and pathogens; determine what data should be provided to the health authority and in what form; and comply with reporting requirements of stakeholders regarding the national state of healthcare-associated infection and during special disease events. National health authorities would also be responsible for standardizing case definitions and surveillance methods, and promoting the assessment of infection prevention practices and other relevant processes.

In addition, the principal duties of each healthcare facility are to document the state of healthcare-associated infections and processes related to their prevention and control; define institutional objectives for surveillance that align with national objectives; establish priorities for surveillance according to the scope of care provided by the facility; determine what data must be collected; apply existing national definitions and methods; detect outbreaks and coordinate an appropriate response; promote practices for the prevention and control of healthcare-associated infections and related aspects of organizational culture without retaliation; and produce and disseminate information on healthcare-associated infections and other related events to local stakeholders and health authorities.

* Any further mention of infection in this document refers to healthcare-associated infection (HAI).

Surveillance that has been systematized and documented in this way will provide health facilities and authorities with the means for early outbreak detection and response, as well as with data to document the status of healthcare-associated infections and initiate the implementation of preventive measures.

3 / Burden of disease and proposal

In the Americas, the burden of disease from healthcare-associated infections is unknown. The data available are from targeted studies that reflect specific situations in healthcare facilities or, at best, in some countries. The availability of data in the Region varies dramatically. Some countries have very good surveillance of healthcare-associated infections in health facilities, but do not have national data; others have data from healthcare facilities and national data; and others have neither structured surveillance in healthcare facilities nor data at the national level. As a result of this wide range of situations, the impact of actions in the Region cannot be adequately evaluated.

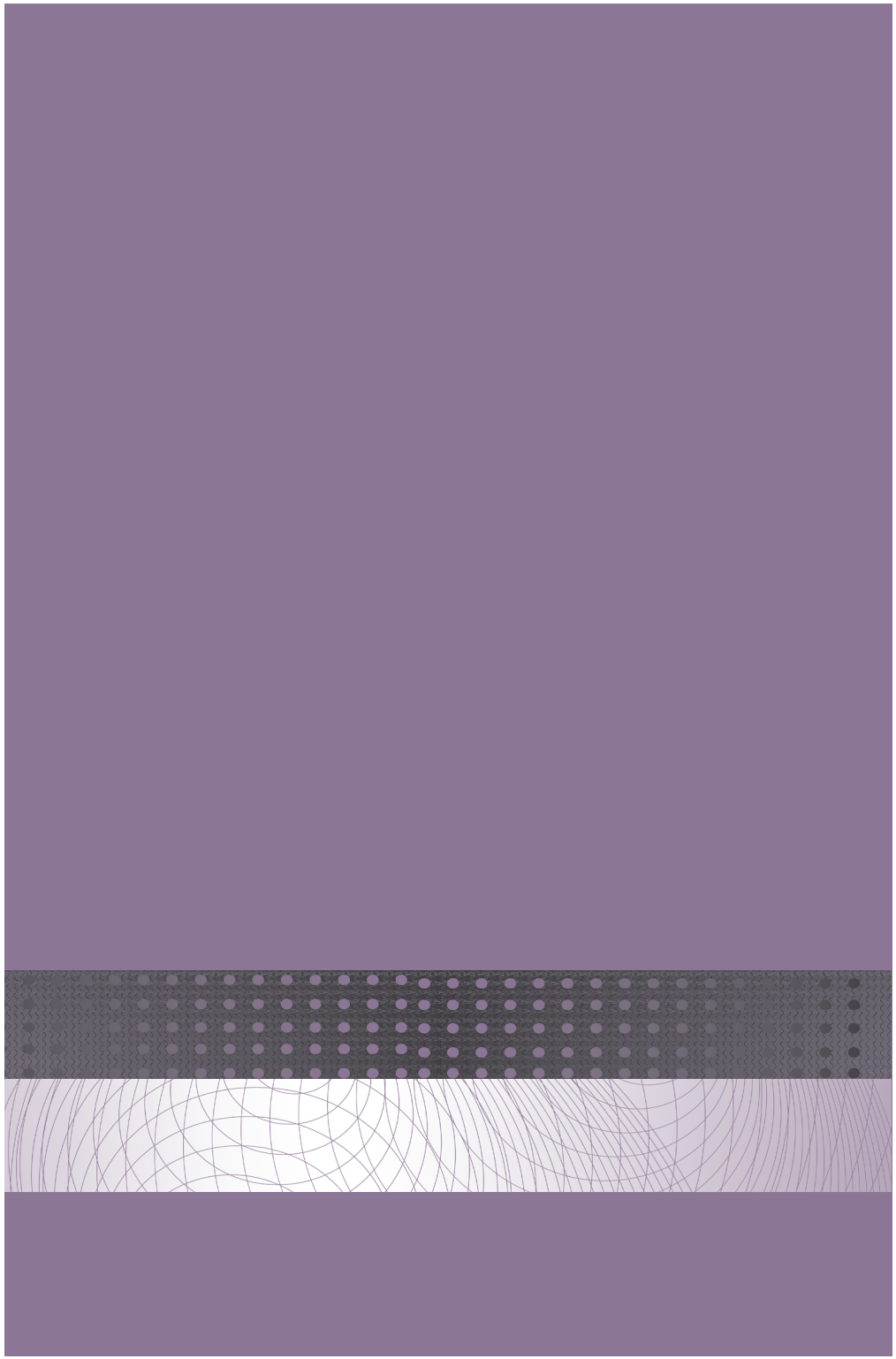
Because of this, and with the aim of strengthening the capacity of healthcare facilities and local and national governments to identify outbreaks and to understand the burden of disease caused by healthcare-associated infections, a surveillance system for these infections and methods for its implementation are proposed. The system will be flexible enough that each country can determine its priorities with regard to the infections and pathogens to monitor, and will provide case definitions and instruments for the active surveillance of infections. Instruments will be offered for systematic evaluation of efforts to prevent and control healthcare-associated infections, with the aim of detecting and promptly responding to outbreaks.

It is recommended that, with modifications appropriate to the Region, the definitions and criteria of the United States Centers for Disease Control and Prevention (CDC)* be used, given that they are widely known and have a long history of use.

Several experts in the prevention and control of healthcare-associated infections in the Region of the Americas collaborated with PAHO during the development of this proposal in order to guarantee its applicability and usefulness.

* Available at http://www.cdc.gov/ncidod/dhqp/pdf/nnis/NosInfDefinitions.pdf

Horan TC, Andrus M and Dudeck MA. CDC/NHSN surveillance definition of health care–associated infection and criteria for specific types of infections in the acute care setting. Am J Infect Control 2008;36:309-32. Available at http://www.cdc.gov/ncidod/dhqp/pdf/nnis/NosInfDefinitions.pdf



Surveillance Methodology

II

Place: All information reported through this surveillance system will come from intensive care units.

Country capacity: In order to participate, countries must have the capacity to collect and analyze data. To this end, it is essential that they have professionals who are devoted to collecting and analyzing data provided by hospitals, and who can make decisions about the problems detected. Countries that already have their own surveillance system with definitions and information systems are requested to provide those national definitions to PAHO.

Healthcare-associated infections: A healthcare-associated infection is an infection that is not present or incubating at the time of admission to a healthcare setting, but which is observed during the patient's hospital stay or after the patient's time of discharge.

Healthcare-associated infections in the intensive care unit (ICU): A healthcare-associated infection that was not present or incubating at the time of admission to the ICU that might be associated with a patient's stay in the ICU, and might be detected after discharge from the ICU.

Healthcare-associated infection in the ICU and associated with an invasive procedure: A healthcare-associated infection that was not present or incubating at the time of admission to the ICU and that might be associated with a patient's stay in that unit and with invasive procedures undergone during the patient's stay.

Microbiological data should be analyzed by unit of care where the infection was identified.

1 / Minimum capacity of participating hospitals

Intensive care unit: In order to be included in reporting systems, a hospital must have at least one intensive care unit. For this purpose, an intensive care unit is defined as the hospital unit in which beds are reserved for the care of critically ill patients who require specialized medical and nursing care 24 hours a day, in addition to specialized life-support equipment (3). This excludes intermediate therapies (without mechanical respiratory assistance).

Program for the prevention of healthcare-associated infections: Hospitals should also have a program for the prevention and control of healthcare-associated infections that is responsible for setting policy, objectives, strategies, and legal and scientific bases for the prevention and control of hospital infections. The program will also be responsible for the surveillance of those infections. The hospital program should have qualified, dedicated staff with defined responsibilities and duties, and have a budget sufficient to meet the tasks programmed in their work plans (2).

Trained local staff: The responsibilities of these staff members are to detect cases (numerators) and identify the exposed population (denominators), keep records, and consolidate and analyze collected data. In general, these duties are carried out by nursing personnel dedicated to infection control, although other clinicians familiar with the topic may participate depending on the organization of the facility or hospital and of the surveillance system. The following is a more detailed list of the responsibilities of staff dedicated to the monitoring and control of healthcare-associated infections:

1. Review the charts of patients with exposure factors in order to detect infections.
2. In the event that an infection is suspected, use case definition criteria to classify it as such, if appropriate.
3. Record infection information for all confirmed cases (numerators): pneumonia, urinary tract infection, or bloodstream infection (dates and etiologic agents).
4. For patients with confirmed HAI record epidemiological information in order to establish numerators: patient identification, name, hospital identification, bed, primary underlying disease (ICD-9 or ICD-10) (optional), sex, age, date of ICU admission, date of ICU discharge, reason for discharge, and length of exposure to mechanical ventilation, indwelling urinary catheter, or central venous catheter. Keep information for later consolidation.

The professional in charge of surveillance should have the time necessary to perform tasks and receive training. The time that surveillance activities require depends on the number of patients and the quality of records kept by the facility or hospital, as well as on the frequency of surveillance rounds in the intensive care units. There is no universal, precise ratio of minutes per patient. This decision is generally made locally. However, experience has shown that 15 to 20 minutes per inpatient per week, with at least two weekly rounds, may be required. In other words, a 10-bed ICU could require between 150 and 200 dedicated minutes per week.

2 / Device-associated hospital infection

Methodology: Surveillance of device-associated infections in intensive care units should be active, selective, prospective, and patient-based.

Case-finding: A properly trained infection prevention and control professional will identify patients suspected of having a device-associated infection and collect the corresponding denominator data.

Numerator: The infection prevention and control professional will find infections incurred during the patient's stay using different sources, including: temperature charts, antibiotic use, cultures performed, physician' instructions, and the suspicion of attending clinicians.

Monitoring of any HAI is no longer required after the patient is discharged from the ICU.

Case confirmation: In patients suspected of having a device-associated infection, the infection prevention and control professional will confirm the infection based on case definition criteria using: records from the laboratory, pharmacy, patient admission, discharge, and transfer, and radiology (imaging); pathological anatomy databases and patient charts, including interviews, physical exam notes, and notes taken by physicians and nurses (4). Laboratory surveillance data should not be used in isolation, unless all possible criteria for diagnosing an infection are determined by laboratory evidence alone.

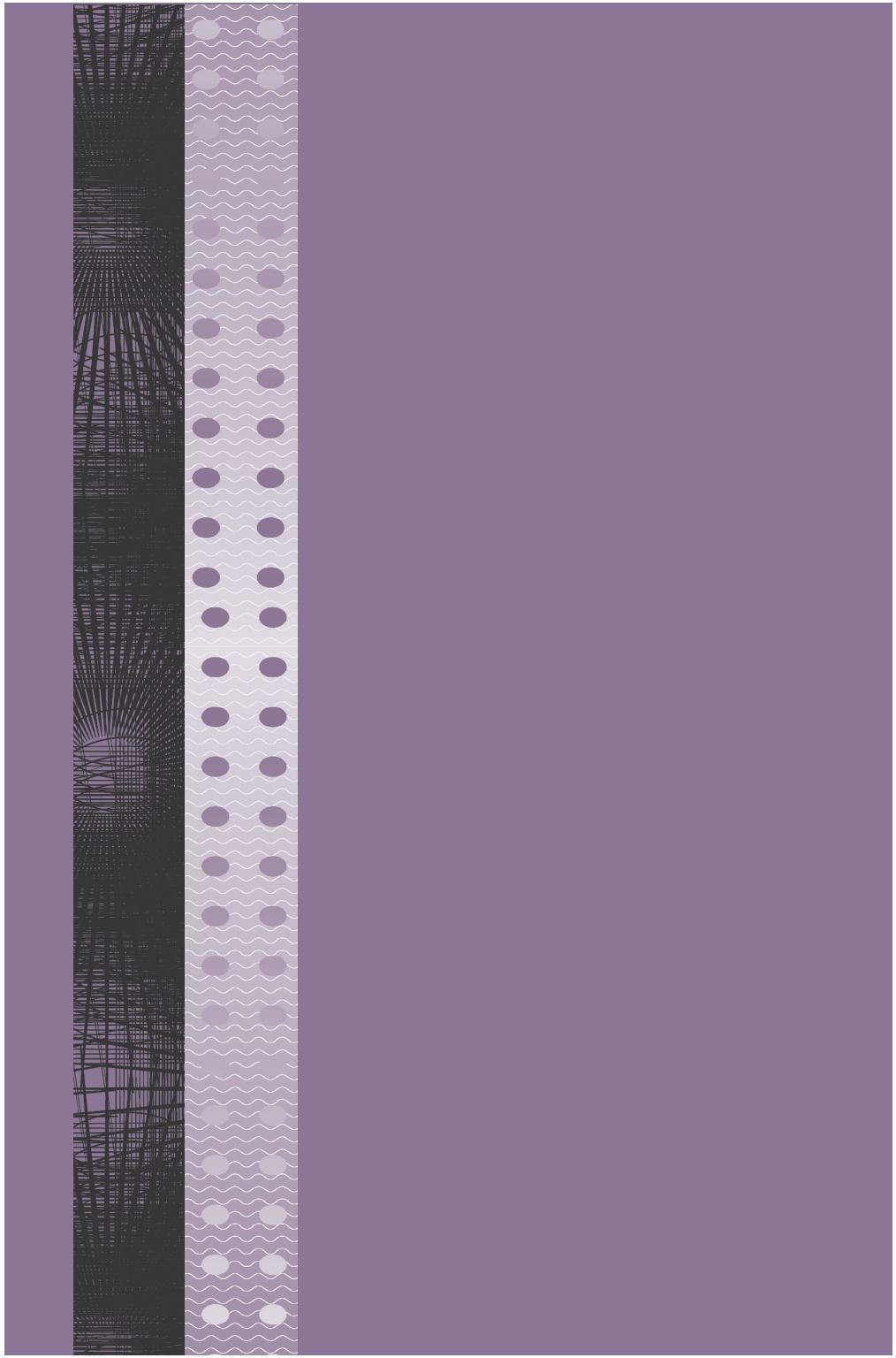
The collection of data on the infection should be completed for all confirmed cases (numerators) — pneumonia, urinary tract infection, or bloodstream infection (dates and etiologic agents) — on the form in Appendix 1 and titled, FORM FOR DEVICE-ASSOCIATED INFECTION MONITORING—HEALTHCARE-ASSOCIATED INFECTION SURVEILLANCE.

Denominator: The infection prevention and control professional will record the device-day counting the number of patient with mechanical ventilation, indwelling urinary catheter, or central venous catheter at ICU, ON THE FORM IN APPENDIX 1 AND TITLED, DENOMINATORS

Devices inserted outside the unit under surveillance: Infections that develop within 48 hours of a patient's arrival and that are related to devices inserted outside the intensive care unit will NOT be counted in the numerator.

Retrospective chart reviews should be used only when patients have been discharged before all necessary information can be obtained. Use the attached form (Appendix 1) to record the data.

Frequency of surveillance: It is recommended that surveillance be carried out in intensive care units at least twice a week. Data should be consolidated monthly for the hospital's use, and forwarded to the Ministry of Health following its analysis. The Ministry of Health should ensure that all hospitals providing data do so in a standardized way and according to a regular timetable.



Infections Subject to Surveillance

III

1 / Pneumonía (PNEU)

Pneumonia is diagnosed through a combination of radiologic, clinical, and laboratory criteria. The following paragraphs describe the various assessment criteria that may be used for meeting the surveillance definition of nosocomial pneumonia. For cases of ventilator-associated pneumonia, a patient has to be intubated and ventilated at the time of onset of symptoms, or have been ventilated up to 48 hours prior to the onset of infection.

NOTE: There is no minimum length of time the mechanical ventilator has to be in place for the pneumonia to be associated with mechanical ventilation. Cases of infection should be analyzed on a case by case basis. Mechanical ventilation can be associated with infection even if it was in place over **48 hours** before the onset of infection.

Setting: Pneumonia surveillance will be conducted in the ICU. Monitoring of ventilation-associated pneumonia is no longer required after the patient is discharged from the ICU.

Requirements: Surveillance of ventilator-associated pneumonia should be conducted in at least one ICU in the healthcare facility. Ideally, monitoring should be conducted year-round. However, if surveillance is scheduled to occur only during specific periods, monitoring should take place during at least one calendar month.

Mechanical ventilator: A device used to assist or control respiration continuously, inclusive of the weaning period, through a tracheostomy or by endotracheal or nasotracheal intubation.

NOTE: Lung expansion devices such as intermittent positive-pressure breathing (IPPB); nasal positive end-expiratory pressure (PEEP); and continuous nasal positive airway pressure (CPAP) are **not** considered mechanical ventilators unless delivered via tracheostomy or endotracheal intubation (e.g. ET-CPAP).

Cases are those patients who have or have had an invasive device to assist or control respiration continuously through a tracheostomy or invasive intubation (endotracheal or nasotracheal tube) or who have or have had a non-invasive device (with nose, nose and mouth, or full-face mask). Pneumonia in patients who have used non-invasive ventilation is not considered ventilator-associated and is not considered part of the numerator or denominator.

Criteria for defining nosocomial pneumonia

General comments

1. Physician's diagnosis of pneumonia alone is **not** an acceptable criterion for nosocomial pneumonia.
2. Although there are specific criteria for infants and children, pediatric patients are included and may meet any of the other pneumonia-specific criteria.
3. Ventilator-associated pneumonia should be so designated when reporting data.
4. When assessing a patient for the presence of pneumonia, it is important to distinguish between changes in clinical status due to other conditions, such as myocardial infarction, pulmonary embolism, respiratory distress syndrome, atelectasis, malignancy, chronic obstructive pulmonary disease, hyaline membrane disease, bronchopulmonary dysplasia, etc. Also, care must be taken when assessing intubated patients to distinguish between tracheal colonization, upper respiratory tract infections (e.g. tracheobronchitis), and early-onset pneumonia. Finally, it should be recognized that it may be difficult to determine nosocomial pneumonia in the elderly, infants, and immunosuppressed patients since such conditions may mask typical signs and symptoms associated with pneumonia.
5. Nosocomial pneumonia can be characterized by its onset: early or late. Early onset pneumonia occurs during the first four days of hospitalization, and is often caused by strains of *Moraxella catarrhalis, Haemophilus influenzae,* and *Streptococcus pneumoniae.* Causative agents of late-onset pneumonia are frequently gram-negative bacilli or Staphylococcus aureus, including methicillin-resistant S. aureus. Viruses (e.g. Influenza A and B or Respiratory

Syncytial Virus) can cause early and late onset nosocomial pneumonia, whereas yeasts, fungi, legionellae, and *P. jirovecii* are usually pathogens of late-onset pneumonia.

6. Positive Gram stain for bacteria and positive potassium hydroxide (KOH) mount for elastin fibers and/or fungal hyphae from appropriately collected sputum specimens are important clues that point toward the etiology of the infection. However, sputum samples are frequently contaminated with airway colonizers and therefore must be interpreted cautiously. In particular, *Candida* is commonly seen on stain, but infrequently causes nosocomial pneumonia.
7. Pneumonia due to gross aspiration is considered nosocomial if it meets the aforementioned criteria, and was not clearly present or incubating at the time of admission to the hospital.
8. Multiple episodes of nosocomial pneumonia may occur in critically ill patients with lengthy hospital stays. When determining whether to report multiple episodes of nosocomial pneumonia in a single patient, look for resolution of the initial infection. The addition of or change in pathogen alone is **not** indicative of a new episode of pneumonia. The combination of new signs and symptoms and radiographic evidence, or other diagnostic testing is required.

Pneumonia case definition for surveillance

Criterion 1:

a) Radiological data: Two or more serial chest x-rays with at least one of the following (1, 2):
- New or progressive and persistent infiltrate
- Consolidation
- Cavitation, **and**

(NOTE: In patients **without** underlying pulmonary or cardiac disease (e.g. respiratory distress syndrome, bronchopulmonary dysplasia, pulmonary edema, or chronic obstructive pulmonary disease), one definitive chest x-ray is acceptable [1].)

b) At least **one** of the following signs or symptoms:
- Fever (>38 °C) with no other recognized known cause
- eukopenia (<4000 WBC/mm^3) or leukocytosis (>12,000 WBC/mm^3)
- For adults >70 years old, altered mental status with no other recognized cause, **and**

c) At least **two** of the following:
- New onset of purulent sputum (3), or change in character of sputum (4), or increased respiratory secretions, or increased suctioning requirements
- New onset or worsening cough, or dyspnea, or tachypnea (5)
- Rales (6) or bronchial breath sounds
- Worsening gas exchange [e.g. O_2 desaturations (e.g. $PaO_2/FiO_2 < 240$) (7), increased oxygen requirements, or increased mechanical ventilator demand]

Criterion 2:

a) Radiological data: Two or more serial chest radiographs with at least one of the following (1,2):

- New or progressive and persistent infiltrate
- Consolidation
- Cavitation

(NOTE: In patients **without** underlying pulmonary or cardiac disease (e.g. respiratory distress syndrome, bronchopulmonary dysplasia, pulmonary edema, or chronic obstructive pulmonary disease), one definitive chest radiograph is acceptable (1).

b) At least **one** of the following signs or symptoms:

- Fever (>38 °C) with no other known cause
- Leukopenia (<4000 WBC/mm^3) or leukocytosis (>12,000 WBC/mm^3)
- For adults >70 years old, altered mental status with no other recognized cause, **and**

c) At least **one** of the following:

- New onset of purulent sputum (3), or change in character of sputum (4), or increased respiratory secretions, or increased suctioning requirements
- New onset or worsening cough, or dyspnea, or tachypnea (5)
- Rales (6) or bronchial breath sounds
- Worsening gas exchange [e.g. O_2 desaturations (e.g. PaO_2/FiO_2 <240) (7), increased oxygen requirements, or increased mechanical ventilator demand], **and**

d) At least **one** of the following laboratory findings:

- Positive growth in blood culture (8) not related to another source of infection
- Positive growth in culture of pleural fluid
- Positive quantitative culture (9) from minimally contaminated lower respiratory tract specimen (e.g. bronchoalveolar lavage or protected specimen brushing)
- ≥5% bronchoalveolar lavage-obtained cells contain intracellular bacteria on direct microscopic exam (e.g. Gram stain)
- Histopathologic exam shows at least one of the following evidences of pneumonia:
  . Abscess formation or foci of consolidation with intense polymorphonuclear leukocyte (PMN) accumulation in bronchioles and alveoli
  . Positive quantitative culture (9) of lung parenchyma
  . Evidence of lung parenchyma invasion by fungal hyphae or pseudohyphae

NOTES:

1. Occasionally, in nonventilated patients, the diagnosis of nosocomial pneumonia may be quite clear on the basis of symptoms, signs, and a single definitive chest radiograph. However, in patients with pulmonary or cardiac disease (e.g. interstitial lung disease or congestive heart failure), the diagnosis of pneumonia may be particularly difficult. Other noninfectious conditions (e.g. pulmonary edema from decompensated congestive heart failure) may simulate the presentation of pneumonia. In these more difficult cases, serial chest radiographs must be examined to help separate infectious from noninfectious pulmonary processes. To help confirm difficult cases, it may be useful to review radiographs on the day of diagnosis, three days prior to the diagnosis, and on days two and seven after the diagnosis. Pneumonia may have rapid onset and progression, but does not resolve quickly. Radiographic changes of pneumonia persist for several weeks. As a result, rapid radiographic resolution suggests that the patient does not have pneumonia, but rather a noninfectious process, such as atelectasis or congestive heart failure.
2. Note that there are many ways of describing the radiographic appearance of pneumonia. Examples include, but are not limited to, "air-space disease", focal opacification, and 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.
3. An adequate sample for culture in an immunocompromised patient is one with a Gram stain of ≥25 neutrophils and ≤10 squamous epithelial cells per low power field (x100).
4. A single notation of either purulent sputum or change in character of the sputum is not meaningful; repeated notations over a 24-hour period would be more indicative of the onset of an infectious process. Change in character of the sputum refers to color, consistency, odor, and quantity.
5. In adults, tachypnea is defined as respiration rate >25 breaths per minute. Tachypnea is defined as >75 breaths per minute in premature infants born at <37 weeks gestation and until the 40th week; >60 breaths/minute in patients <2 months old; >50 breaths/minute in patients 2-12 months old; and >30 breaths/minute in children >1 year old.
6. Rales may be described as "crackles".
7. This measure of arterial oxygenation is defined as the ratio of the arterial tension (PaO_2) to the inspiratory fraction of oxygen (FiO_2).
8. Care must be taken to determine the etiology of pneumonia in a patient with positive blood cultures and radiographic evidence of pneumonia, especially if the patient has invasive devices in place such as intravascular lines or a urinary catheter. In general, in an immunocompetent patient, blood cultures positive for coagulase-negative staphylococci, common skin contaminants, and yeasts will not be the etiologic agent of the pneumonia.
9. Once laboratory-confirmed cases of pneumonia due to respiratory syncytial virus (RSV), adenovirus, or influenza virus have been identified in a hospital, a clinician's presumptive diagnosis of these pathogens in subsequent cases with similar clinical signs and symptoms is an acceptable criterion for presence of hospital infection.
10. Scant or watery sputum is commonly seen in adults with pneumonia due to viruses and *Mycoplasma* although sometimes the sputum may be mucopurulent. In infants, pneumonia due to RSV or influenza yields copious sputum. Patients, except premature infants, with viral or mycoplasmal pneumonia may exhibit few signs or symptoms even when significant infiltrates are present on radiographic exam.
11. Few bacteria may be seen on stains of respiratory secretions from patients with pneumonia due to *Legionella* spp., mycoplasma, or viruses.
12. Immunocompromised patients include those with neutropenia (absolute neutrophil count <500/mm^3), leukemia, lymphoma, HIV with CD4 count <200, or splenectomy; those who have had a recent transplant; and those who are on cytotoxic chemotherapy or on daily doses of steroids for >2 weeks (e.g. >20mg prednisone or its equivalent).
13. Blood and sputum specimens must be collected within 48 hours of each other.
14. Semiquantitative or nonquantitative cultures of sputum obtained by deep cough, induction, aspiration, or lavage are acceptable. If quantitative culture results are available, refer to algorithms that include such specific laboratory findings.

Collection of culture specimens* used in the diagnosis of pneumonia, and threshold values	
Specimen type	**Value**
Lung parenchyma (open lung biopsy specimens and immediate post-mortem specimens obtained by transthoracic or transbronchial biopsy)	≥10^4 CFU/g tissue
Endotracheal aspirate	10^5 o 10^6 CFU
Bronchoscopically (B) obtained specimens	
- Bronchoalveolar lavage (B-BAL)	≥10^4 UFC/ml
- Protected bronchoalveolar lavage (BP-BAL)	≥10^4 UFC/ml
- Protected specimen brushing (B-PSB)	≥10^3 UFC/ml
Non-bronchoscopically (NB) obtained (blind) specimens	
- NB-BAL or MINI BAL	≥10^4 UFC/ml
- NB-PSB	≥10^3 UFC/ml

* For specimen collection techniques, see Appendix 7.

Numerator data: The form included in Appendix 1 is used to collect and report on every case of ventilator-associated pneumonia that is identified during the month selected for surveillance. The form includes patient demographic information and information regarding the use of mechanical ventilation. Additional data include whether the patient died, thewhat microorganisms were isolated from cultures and their antimicrobial susceptibilities. (See Section II on surveillance methodology.)

Denominator data: The number of patients managed with a ventilation device is collected on the Appendix 2. The patient count is obtained daily. The sum of these daily counts is reported monthly. The data are compiled separately for each intensive care unit identified. (See Section II on surveillance methodology.)

Data analysis: The rate of ventilator-associated pneumonia per 1,000 mechanical ventilator-days is calculated by dividing the number of cases of ventilator associated pneumonia by the number of mechanical ventilator-days and multiplying the result by 1,000. These calculations are performed separately for each ICU.

2 / Urinary Tract Infection (UTI)

Urinary tract infections are diagnosed through a combination of clinical and laboratory criteria. UTIs will be counted only for patients with an indwelling urinary catheter or an infection related to its use; in other words, the patient had a urinary catheter inserted at the time of, or within seven days before, the onset of infection.

NOTE: There is no a minimum length of time that the catheter has to be in place for a UTI to be considered catheter-associated.

For the purposes of hospital infection surveillance systems, case definitions for urinary tract infections are divided into symptomatic and asymptomatic infections. In this proposal, only data on symptomatic urinary tract infections will be compiled.

Setting: Surveillance will take place in the intensive care units. Monitoring of patients following their discharge from the ICU is not required.

Requirements: Surveillance for urinary tract infection is performed in at least one ICU in the healthcare facility for at least one calendar month. Ideally, monitoring should be conducted year-round. However, if surveillance is scheduled to occur only during specific periods, monitoring should take place during at least one calendar month.

Indwelling urinary catheter (IUC): A drainage tube that is inserted into the urinary bladder through the urethra, is left in place, and is connected to a closed collection system; also called a Foley catheter. Does not include straight in-and-out catheters.

Closed urine collection system: A closed system that does not allow any type of disconnection (bag-tube) no matter how brief. Systems remain connected even during urine removal or specimen collection.

Urinary Tract Infection Case Definition

A symptomatic urinary tract infection must meet at least one of the following criteria:

Criterion 1:

a) Clinical data: at least **one** of the following signs or symptoms with no other recognized cause:

- fever (>38 °C)
- urgency (urinary)
- increased urinary frequency
- dysuria or suprapubic tenderness, **and**

b) The following laboratory criterion:

- positive urine culture (i.e. $>10^5$ microorganisms/cm^3 of urine with no more than two species of microorganisms).

Criterion 2:

a) At least two of the following signs or symptoms with no other recognized cause:
   - ever (>38 °C),
   - urgency (urinary)
   - increased urinary frequency
   - dysuria or suprapubic tenderness, **and**

b) At least one of the following:
   - positive dipstick for leukocyte esterase or nitrate
   - pyuria (urine specimen with >10 leukocytes/mm^3 or >3 leukocytes/high-power field of unspun urine)
   - organisms seen on Gram stain of unspun urine
   - $\leq 10^5$ colonies/ml of a single uropathogen (Gram-negative bacteria or *S. saprophyticus*) in a patient being treated with an effective antimicrobial agent for a urinary tract infection
   - physician diagnosis of a urinary tract infection
   - physician institutes treatment for a urinary tract infection

NOTE:
A positive culture of a urinary catheter tip is not an acceptable laboratory test to diagnose a urinary tract infection. Urine cultures must be obtained using appropriate technique, such as clean-catch collection or catheterization. (See Appendix 7).

Numerator data: The form included in Appendix 1 is used to collect the information and report each urinary tract infection that is identified during the month selected for surveillance. The UTI form includes patient demographic information and information on whether or not a urinary catheter was present. Additional data include whether the patient died, what microorganisms were isolated from cultures and their antimicrobial susceptibilities. (See Section II on surveillance methodology.)

Denominator data: The number of patients managed with an indwelling urinary catheter is collected on Appendix 2. The patient count is obtained daily. The sum of these daily counts is reported monthly. The data are compiled separately for each intensive care unit identified. (See Section II on surveillance methodology.)

Data analysis: The urinary tract infection rate per 1,000 catheter-days is calculated by dividing the number of infections by the number of catheter-days and multiplying the result by 1,000. This calculation is performed separately for each intensive care unit.

3 / Bloodstream Infection (BSI)

Bloodstream infections are classified according to clinical and laboratory criteria, either as laboratory-confirmed bacteremia (BAC) or clinical sepsis (CSEP). A bloodstream infection is considered either primary or secondary depending on whether it is caused by an infection at another site. For surveillance, only laboratory-confirmed, primary, intravascular catheter-associated bacteremia will be recorded.

Setting: Surveillance will occur in intensive care units. Monitoring of bloodstream infections after the patient is discharged from the ICU is not required.

Requirements: Surveillance for bloodstream infection in at least one ICU in the healthcare institution for at least one calendar month. Ideally, monitoring should be conducted year-round. However, if surveillance is scheduled to occur only during specific periods, monitoring should take place during at least one calendar month. Only bloodstream infections associated to central catheter are reported.

Definitions

Primary BSI: BSI not related to an infection at another site.

Central line-associated BSI: Primary BSI in a patient with a central line or catheter in place at the time of detection or no more than 48 hours before the onset of infection.

NOTE: There is no required minimum length of time the central line must be in place for the infection to be considered central line-associated.

Central line (CVC): An intravascular catheter that terminates at or close to the heart or in one of the great vessels that is used for infusion, withdrawal of blood, or hemodynamic monitoring. The following are considered great vessels for the purpose of reporting central-line infections and counting central-line days: aorta, pulmonary artery, superior vena cava, inferior vena cava, brachiocephalic veins, internal jugular veins, subclavian veins, external ileac veins, and common femoral veins.

Temporary central line: A non-tunneled catheter.

Permanent central line: Includes tunneled catheters, including dialysis catheters, and implanted catheters, including port-a-cath.

NOTES:

1. An introducer is not considered an intravascular catheter.
2. Neither the location of 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 to qualify as a central line.
3. Pacemaker wires and other nonlumened devices inserted into central blood vessels or the heart are not considered central lines, because fluids are not infused, pushed, or withdrawn through such devices.

Infusion: The introduction of a solution through a blood vessel via a catheter lumen. This may include drip phleboclysis, as in the case of nutritional fluids or medications, or intermittent infusions such as flushes or intravenous antimicrobial administration, or blood, in the case of transfusion or hemodialysis.

Bactermia Definition Criteria*

Laboratory-confirmed bacteremia must meet at least one of the following criteria:

Criterion 1:

a) A pathogen was identified in one or more blood cultures of the patient, except for common skin contaminant microorganisms (see Criterion 2 below), **and**

b) The microorganism cultured from the blood is not related to infections at other sites.

Criterion 2:

a) Clinical data: patient has at least one of the following signs or symptoms with no other recognized cause:

- fever (>38 °C)
- chills
- hypotension, **and**

b) Positive laboratory results are not related to an infection at another site, **and**

c) The following laboratory criterion: common skin contaminant (e.g. diphtheroids [*Corynebacterium* spp.], *Bacillus* [not B. *anthracis*] spp., *Propionibacterium* spp., coagulase-negative staphylococci [including S. *epidermidis*], *viridans* group *Streptococci*, *Aerococcus* spp., *Micrococcus* spp.) cultured from **two or more** blood samples drawn on separate occasions. (See Appendix 7 for specimen collection technique.)

Numerator data: The form included in Appendix 1 includes patient demographic information and information on the central line. The form is also used to record whether the patient died, what microorganisms were isolated from blood cultures and their antimicrobial susceptibilities. (See Section II on surveillance methodology.)

Denominator data: Denominator data are collected using the form included in Appendix 2. Since the patient may have more than one bloodline, data will need to be recorded for all blood lines during the patient's entire stay in the ICU. (See Section II on surveillance methodology.)

- 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, this is counted as one temporary-central-line day.
- If a patient has only one permanent central line, include it in the daily permanent central-line day count, beginning on the day of first access and continuing through the entire stay.

Data analysis: The bloodstream infection rate per 1,000 central-line days is calculated by dividing the number of BSIs by the number of central-catheter days multiplied by 1,000. These calculations are performed separately for each intensive care unit.

Indicators

IV

Indicators for Calculating ICU Healthcare Associated Infection Rates		
Infection and Indicator	**Description**	**Calculation**
Ventilator-associated pneumonia	Incidence of ventilator- associated pneumonia	Number of cases of pneumonia in patients with mechanical ventilation/ Number of mechanical ventilator-days x 1000
Indwelling urinary catheter associated urinary tract infection	Incidence of indwelling urinary catheter-associated urinary tract infections	Number of urinary tract infections in patients with indwelling urinary catheters/ Number of IUC-days x 1000
Central venous catheter- associated bloodstream infection	Incidence of central venous catheter-associated bloodstream infection	Number of bloodstream infections in patients with central venous catheter/ Number of central venous catheter -days x 1000

Data Analysis and Information Systems

V

Infections subject to surveillance:

1. Mechanical ventilator-associated pneumonia
2. Indwelling urinary catheter-associated symptomatic urinary tract infection
3. Central venous catheter-associated, laboratory-confirmed bloodstream infection.

Data: Data will only be collected from intensive care units during the patient's stay; infections occurring after the patient's discharge from the ICU will not be counted, even if they are related to the patient's stay in the intensive care unit. Microbiology data are compiled separately for each intensive care unit identified.

Numerator: Numerators will be collected in the intensive care unit at least twice per week through active surveillance under the responsibility of the infection prevention and control team.

The following information should be recorded for all confirmed cases (numerators): pneumonia (date and etiologic agent), urinary tract infection (date and etiologic agent), bloodstream infection (date and etiologic agent). These data will be recorded on the form in Appendix 1.

Denominator: Denominator data to be used for calculating rates will be: mechanical ventilation days; indwelling urinary

catheter days; central venous catheter days; and total patient days per month and per intensive care unit.

Information system: The information system has three levels: first, the local level, or healthcare facility; second, the national health authority; and third, the Pan American Health Organization.

Hospital: The hospital is responsible for compiling the data (numerators and denominators), for its analysis, and for calculating indicators. Analysis should be conducted by the surveillance unit or the intensive care unit, preferably monthly. The hospital should send aggregate data for mechanical ventilation-associated pneumonia, indwelling urinary catheter-associated urinary tract infection, and central venous catheter-associated bloodstream infection to the health authority on a monthly basis. The hospital will fill out the form in Appendix 1.

The patient should be monitored until departure from the intensive care unit. Data from the form will be entered into the computer program to produce the necessary reports (Appendix 3).

The hospital will send data from the Table for Submission of Data to Health Authorities (Appendix 3) to the health authority, preferably monthly.

Health authority: The health authority will receive the aggregated information from each hospital, on the form in Appendix 3. The information will be the sum of the data collected from all of the intensive care units in the hospital within a given time period. The health authority should determine the frequency with which data should be sent from each hospital. We recommend, at a maximum, quarterly reports.

The health authority will receive the hospital's identification and demographic data and:

- Incidence density for indwelling urinary catheter-associated urinary infections
- Incidence density for central venous catheter-associated bloodstream infections
- Incidence density for mechanical ventilation-associated pneumonias

With this information, the health authority can calculate the 10^{th}, 25^{th}, 50^{th}, 75^{th}, and 90^{th} percentiles for each of the rates of infection under surveillance Appendix 4. It is recommended that this analysis be done monthly in addition to an annual report.

Pan American Health Organization: PAHO requests that the national health authority send the annual data on the form included in Appendix 5 (Form for Submission of Data to the Pan American Health Organization). Together with the data, health authorities should provide the hospital infection definitions being used in the country and the demographic information requested in Appendix 4.

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VI

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Appendices

Appendix 1. **Form for Device-Associated Infection Monitoring**			
Numerator and Denominator Collection Form			
Infection 1:		Incoming ICU date:	
Patient identifcation:		Discharge ICU date:	
Name:		Gender: (F) o (M)	
Patient identification:		Discharge motive: discharge of hospital(0), transfer to another hospital (1)†, discharge of ICU (2), death (3)†.	
Age:		Incoming disease:	
Bed number:			
Pneumonia (PNEU)			
Mechanical Ventilation YES(1)/NO (0)		Mechanical Ventilation YES(1)/NO (0)	
Date of MV start: (dd/mm/aaaa)		Date of MV ends: (dd/mm/aaaa)	
Date of MV ends: (dd/mm/aaaa)		Date of MV ends: (dd/mm/aaaa)	
MV days:		MV days:	
Pneumonia? YES(1)/NO (0)		Pneumonia? YES(1)/NO (0)	
Pneumonia date:		Pneumonia date:	
Etiological agent:		Etiological agent:	
Urinary tract infection (UTI)			
Indwelling urinary catheter YES(1)/NO (0)		Indwelling urinary catheter YES(1)/NO (0)	
Date of IUC start: (dd/mm/aaaa)		Date of IUC start: (dd/mm/aaaa)	
Date of IUC ends: (dd/mm/aaaa)		Date of IUC ends: (dd/mm/aaaa)	
IUC days:		IUC days:	
Syntomatic Urinary tract infection? YES(1)/NO (0)		Syntomatic Urinary tract infection? YES(1)/NO (0)	
UTI date:		UTI date:	
Etiological agent:		Etiological agent:	
Bloodstream infection (BSI)			
Central venous catheter YES(1)/NO (0)		Central venous catheter YES(1)/NO (0)	
Date of CVC start: (dd/mm/aaaa)		Date of CVC start: (dd/mm/aaaa)	
Date of CVC ends: (dd/mm/aaaa)		Date of CVC ends: (dd/mm/aaaa)	
CVC days:		CVC days:	
Bloodstream infection? YES(1)/NO (0)		Bloodstream infection? YES(1)/NO (0)	
BSI date:		BSI date:	
Etiological agent:		Etiological agent:	

Appendix 2. **Denominators**				
Hospital				
ICU				
Month/Day	# patiente w/ CVC	# patiente w/ IUC	# patiente w/ MV	# Patient
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
1 1				
12				
13				
14				

Month/Day	# patiente w/ CVC	# patiente w/ IUC	# patiente w/ MV	# Patient
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				
26				
27				
28				
29				
30				
31				
Total				

Appendix 3. **Healthcare-Associated Infections Data Collection Table-Hospital**

Year

Intensive care unit	Number of mechanical ventilation associated pneumonia	Number of indwelling urinary catheter associated urinary tract	Number of central venous catheter associated bloodstream infection	Ventilation-days	CVC-days	IUC-days	Total patient-days
Total							

Incidence	PNEU/MV	BAC/CVC	UTI/IUC	% USE MV	% USE CVC	% USE IUC
Total Hospital						

Appendix 4. **Healthcare-Associated Infections Data Collection Table-Ministry of Health**							
Year/Month							
Hospital name	Number of mechanical ventilation associated pneumonia	Number of indwelling urinary catheter associated urinary tract infections	Number of central venous catheter associated bloodstream infection	ventilation-days	CVC-days	IUC-days	Total patient-days
Total Country							

Incidence	PNEU/MV	BAC/CVC	UTI/IUC	% USE MV	% USE CVC	% USE IUC
Total Country						

Appendix 5. **Form for Sending Data to the Pan American Health Organization**		
Annual Country Report		
Country:	Total population:	Year:
Total number of hospitals reporting:	Number of ICUs:	
Administrative category: Number of public hospitals: Number of private hospitals: Number of university hospitals: Number of other:		
Total number of beds:	Laboratory:	
Number of intensive care unit (ICU) beds:	Number of isolates/year:	
Number ICU/adults:	Number of antibiograms/year:	
Number ICU/pediatrics:		
Number ICU/neonatology:		

Healthcare-associated infections in ICU			**Year**		
Incidence Density (per 1000 device days). Percentil					
Infections under surveillance	10	25	50	75	90
Mechanical ventilation-associated pneumonia					
Indwelling urinary catheter-associated urinary tract infection					
Central venous catheter-associated bloodstream infection					

Appendix 6. **Etiologic Agents of Health-Associated Infections and Antibiotic Susceptibility Profile of Microorganisms**				
Microorganism Code	Microorganism and resistance profile	Number of isolates		
		Pneumonia	Bacteremia	Urinary tract infection
1	*Acinetobacter baumanii* imipenem-resistant			
10	*Candida albicans*			
11	*Candida* non albicans			
12	*Candida* sp (fill only when no species is identified by the laboratory)			
32	*Escherichia coli* resistant to third generation cephalosporins			
31	*Enterococcus* sp rvancomycin-resistant			
40	*Klebsiella pneumoniae* resistant to third generation cephalosporins			
54	*Pseudomonas* spmipenem-resistant			
64	*Staphylococcus aureus* oxacillin-resistant			
65/66	*S. epidermidis* and other oxacillin- resistant coagulase-negative staphylococcus			

Appendix 7. **Specimen Collection**

VENTILATOR-ASSOCIATED PNEUMONIA

Pneumonia diagnosis can be performed through conventional, non-invasive methods such as the collection of a sputum sample or tracheal aspirate (tracheal tube or tracheostomy) using a DeLee trap and more aggressive methods that require an invasive procedure. Invasive methods for obtaining samples are:

- Endotracheal aspirate
- Bronchial washing
- Bronchoalveolar lavage
- Protected specimen brushing
- Mini-BAL
- Lung biopsy

Endotracheal aspirate, bronchoalveolar lavage, and protected specimen brushing, in that order, go from highest to lowest sensitivity, but least to greatest specificity. The quantitative culture produced by an endotracheal aspirate is very useful in light of the fact that a bronchoscope and personnel trained in its use are necessary for more invasive measures.

Endotracheal Aspirate:

This technique is used when a patient is unable to expectorate, the potential pathogen is unknown, or there is a poor response to treatment. It is the simplest method for obtaining tracheobronchial secretions in the patient with mechanical respiratory assistance.

With an endotracheal aspirate, the sample is taken by aspiration of respiratory secretions through the endotracheal tube using a DeLee trap. The trap, which holds the sample, is sent to the laboratory. No saline solution should be instilled, since its introduction would dilute the secretions and alter the bacterial count. A sample can also be taken through a tracheostomy. In the absence of a DeLee trap, a suction catheter can be used, and the sample obtained sent to the laboratory in a sterile container. The suction tube should not be sent to the laboratory.

Label the sample, indicating the suspected diagnosis and the antimicrobial drugs the patient is receiving. Do not refrigerate the sample, and transport it immediately to the laboratory.

All endotracheal aspirates should be processed for bacterial count, which should be included in the laboratory report.

Bronchoalveolar Lavage (BAL)

Bronchoalveolar lavage is an invasive procedure for obtaining a sample, which means that an exhaustive search for microorganisms is justified regardless of the quality of the sample ( ). This sample is obtained by a specialist. The method is used to wash cells in airways that cannot be accessed through the use of a bronchoscope. The goal is to wash the affected lobe, although bilateral washing increases the likelihood of recovery of certain pathogens. In addition to being particularly useful for diagnosing ventilator-associated pneumonia in patients with mechanically assisted ventilation, it is also useful in HIV or AIDS cases and, to a lesser extent, for patients with pneumonia 2,3,4). A BAL procedure requires the following:

1. A double-lumen bronchoscope with a telescoping double catheter and a distal polyethylene glycol plug for collecting the wash. The involved area of the lung should be accessible.
2. Lidocaine (2%) for anesthesia, delivered locally through the lumen of the fibroscope.
3. Ringer's lactate or saline solution for washing.
4. A Lukens trap in which to place the sample.
5. An intravenous sedative to improve the patient´s tolerance of the procedure.

Appendix 7. **Specimen Collection** *(Continued)*

In order to perform the BAL, tilt the patient into a semi-Fowler´s position. Lubricate the bronchoscope with 2% xylocaine jelly, avoiding the distal tip. Introduce the bronchoscope transnasally. Attach the Lukens trap to the bronchoscope.

When treating an adult, strongly instill 100 ml of sterile saline solution through the channel opening in 20 ml aliquots. For pediatric patients, instill no more than 1 to 2 ml/kg of weight. Generally, fewer than 10 ml of fluid are retrieved from children. (If more than 10 ml are retrieved, sample centrifugation improves recovery in the culture and visualization in the stains).

If convenient, after the third or fourth instillation, the 70 ml trap can be replaced with a 40 ml trap. Both collection traps should be sent to the laboratory (label 70 ml and 40 ml trap). The first trap to be collected is the most contaminated with purulent respiratory secretions and is very useful for detecting fungus, mycobacteria and *P. jiroveci*; the second trap is useful for quantitative cultures and bacterial studies. For this reason, in the case of ventilator-associated pneumonia, only the second trap is required. Instead of sending the traps to the laboratory, it is also possible to withdraw 10 ml of liquid from each trap, placing them in sterile tubes. These tubes, labeled 1 and 2, are sent to the lab using the same guidelines for sending traps.

Samples are not to be refrigerated. They are sent to the laboratory immediately and should be processed within two hours of collection.

Mini-Bal:

A telescopic catheter is introduced into the bronchial tree and advanced until met with resistance. The internal catheter is then advanced, and 25 ml of normal saline are instilled using a syringe. The aspirated fluid and the internal catheter tip are used for microbiological studies.

The advantage of this technique is that is does not require the use of a fibrobronchoscope. It is offered as an alternative to other techniques for the diagnosis of ventilator-associated pneumonia. According to a study by Rouby (5), the usefulness of mini-BAL for diagnosing ventilator-associated pneumonia was found to be low. The procedure has an LR+ of 2.2 and an LR- of 0.43 and lacks the reliability of endotracheal aspirates, bronchoalveolar lavage, and protected bronchial brushing.

Protected Bronchial Brushing (PBB):

This procedure is similar to the bronchoalveolar lavage, with the exception that the bronchoscope is advanced through a double-sheathed, balloon-tipped, plugged catheter. The previously inflated balloon tip is used to protect the sample from possible contamination by flora in the upper respiratory tract (6,7).

- Insert the cytology brush into the channel opening of the bronchoscope and advance the brush through it.
- Remove the plug at its tip and insert the catheter into the infected area. Collect the sample and remove the catheter.
- Place the entire brushing unit in a transport medium, which can be lactated Ringer's solution or saline (1ml).
- Send to the laboratory.
- For pediatric patients, proceed as with adults.

Lung Biopsy:

Histopathological studies of the lung have been considered the gold standard by a majority of studies that have evaluated the success of diverse diagnostic methods for ventilator-associated pneumonia (2). Notwithstanding, the reproducibility of this method has been drawn into question given the lack of agreement in the histopathological results produced by the same operator or those of three different technicians (8). The method can be performed through a needle biopsy or an open biopsy. In the former, either a computerized tomography or thoracic cavity x-ray can be used to identify the exact location of the biopsy. The latter takes place in an operating room under general anesthesia.

Appendix 7. **Specimen Collection** *(Continued)*

Needle Biopsy:

If the biopsy is conducted using computerized tomography, the patient must remain horizontal during the exam. A lung biopsy can also be conducted by pricking the patient during a bronchoscopy or mediastinoscopy.

The skin is cleansed and local anesthesia injected. The patient is asked to remain still and without coughing for the duration of the biopsy. A small incision of approximately 3 mm is made in the skin. The biopsy needle is inserted into the pulmonary tissue.

A small tissue sample is collected with the needle and sent to a laboratory for analysis. Send one pulmonary tissue fragment in formaldehyde (10%) for histopathological study and another in saline solution for microbiological study.

Pressure is applied to the site and, once the bleeding has stopped, a bandage is applied. An x-ray of the thoracic cavity is taken immediately after the biopsy.

The procedure normally takes between 30 and 60 minutes. The laboratory analysis can take a few days.

Open Biopsy:

A catheter is inserted throught the patient´s oral cavity to the airways. After cleaning the patient's skin, the surgeon makes an incision in the thorax, removes a small amount of lung tissue, and sutures the incision. Chest tubes may remain in place for one or two days in order to prevent the lungs from collapsing. There is both a risk of infection, and a risk that air may leak into the thorax through a puncture, which depends on whether the patient does or does not already have pulmonary disease.

Transport and Conservation of Respiratory Samples:

Endotracheal aspirate samples should be sent to the laboratory in a DeLee trap; BAL samples should be sent in Lukens traps; mini-BAL samples should be sent in a sterilized container; and bronchial brushing samples sent protected in 1 ml saline solution or lactated Ringer's solution. If no traps are available, samples may be sent in sterilized, well-sealed, screw-top containers within two hours of having been collected. Biopsy tissue samples should be divided into two; one fraction should be sent to the laboratory in 10% formaldehyde for histopathological study, and the other, in saline solution for microbiological study (9).

URINARY TRACT INFECTION

Patients with bladder catheter:

In patients with an indwelling catheter, urine will be taken with a sterile needle and syringe. The catheter and the closed system are emptied and then clamped for 5 minutes, subsequently disinfecting with alcohol an appropriate area to puncture. The area is punctured with the needle and syringe, and approximately 10 ml of urine are extracted. Urine should be taken by aspiration with a needle from a disinfected point in the connection, but not from the collection bag, or by disconnecting the catheter from the collection tube. If no place for puncturing exists on the extension, the catheter is punctured at its softest spot with a needle and syringe. Approximately 10 ml of urine are extracted. If a catheter is used, do not send the tip of the Foley catheter for culture (10).

It is preferable to obtain the sample from the first urine voided in the morning (1). At this time the bacterial count will be higher, since bacteria can multiply as they incubate overnight (every 20 minutes). Otherwise, wait 4 hours after the patient's last voiding before collecting the sample. Urination should not be forced with liquids, but if it is, it should be stated on the order sheet. Urine collected

Appendix 7. **Specimen Collection** *(Continued)*

without the precaution of cleansing the genitals beforehand can lead to false positive results. For adults, the possible sampling methods are:

Spontaneous urination:

This method can be used with adults and children who already have sphincter control. The following collection method is suitable for adult women:

1. Personnel collecting the sample must wash their hands.
2. The patient´s external genitalia are washed gently using soapy, wet compress or gauze; antiseptics should be avoided since they can mix with the urine and give false negative results. Wash by spreading the legs and spreading the labia with one hand while washing the area gently with the other hand from front to back using one gauze at a time.
3. After washing, rinse with water and dry with a towel using the same movements detailed above.
4. Keeping the labia separated, the patient should start urinating, discarding the initial stream of urine, which mechanically flushes the urethral channel. The second part of urination (midstream) (11) will be collected in a sterile wide-mouth container, which will be immediately closed and will be delivered to the laboratory for processing.

In males, urine collection is simpler. Instruct uncircumcised males to retract the foreskin. Once the glans has been cleansed and then dried with a gauze or compress, urine is also collected midstream, discarding the first portion of the urine.

Caterización:

Urethral catheterization is recommended as a routine sampling method for urine culture.

1. Personnel taking the sample must wash their hands.
2. External genitalia are washed gently using a wet, soapy compress or gauze.
3. After washing, genitalia are rinsed with water and dried with sterile gauze.
4. The catheter is inserted using aseptic technique.

Sample Transport:

Once the urine sample is collected it should be processed immediately. If this is not possible, the sample may be stored in a refrigerator at 4ºC for a maximum of 24 hours. Refrigeration prevents bacterial growth. Collection containers that include preservatives in tablet form are commercially available. If this commercial method is not available, the sample can be preserved in boric acid. Any of these methods can be used if it is inevitable that the sample remain at room temperature for several hours prior to or during transport to the laboratory. Thus, the organism can be preserved without facilitating the growth of contaminants that might have been introduced into the sample.

Appendix 7. **Specimen Collection** *(Continued)*

BLOOD CULTURE

The blood culture sample is taken through venipuncture following proper cleansing of the site where the skin is to be punctured.

Materials needed for the drawing should be prepared on a work tray and should include:

- Alcohol al 70%,
- 70% alcohol
- Antiseptic solution
- 10 or 20 ml syringes or Vacutainer® system
- Needles for venipuncture
- Gauze or cotton balls
- Examination gloves
- Adhesive tape
- Adhesive bandages
- Blood culture bottles for aerobes and anaerobes previously labeled with the patient's name, bed number, room, time of blood drawing, and chart number. If an automated system is being used, avoid writing on or placing stickers over the bottle bar code.

Each blood sample will be obtained from a different venipuncture, the points for which will be selected beforehand. The veins of the forearm are usually used for this purpose.

Routine blood extraction should not be done through a catheter, except in cases where catheter-associated sepsis is suspected, in which case it is important to obtain peripheral blood samples at the same time. The procedure for drawing blood is as follows:

1. Whenever possible, inform the patient about the procedure.
2. Wash and dry hands properly.
3. Thoroughly cleanse the selected site on the skin with 70% isopropyl or ethyl alcohol.
4. Spread an antiseptic on the site (1-2% iodine tincture, or povidone iodine, or 2% chlorhexidine). Cleansing is done in a circular motion, starting towards the center and moving outward. It is important to allow time for the antiseptic to dry for it to work; do not wipe the area while still wet.
5. Disinfect the rubber stopper on the bottle with alcohol or another antiseptic before puncturing the bottle. Wait for it to dry.
6. Put on sterile gloves.
7. Do not palpate the venipuncture site with fingers, and do not speak or cough while drawing blood. Sometimes palpating the vein cannot be avoided; if is the case, the collector's finger must undergo the same cleansing and disinfection procedure, or sterile gloves must be worn to perform the procedure.
8. Insert the needle into the selected vein to extract the required volume of blood.
9. Once the blood is withdrawn, inoculate the bottle immediately by perforating it vertically with the needle in order to avoid co-agulation of the blood in the syringe. Inoculate slowly to prevent hemolysis. If a vacuum extraction system is being used, the blood can directly inoculate the bottles of the automated system. The vacuum in this type of bottle rapidly extracts the contents of the syringe; once the patient has stopped bleeding, withdraw the needle.
10. It is not necessary to replace the needle before inoculating the blood in the bottle (11).
11. Place the cotton ball on the puncture site, maintain pressure for a few minutes, and then apply an adhesive bandage.

The blood sample should be sent to the microbiology laboratory immediately. If this is not possible, it should be incubated at 35°C-37°C. If no stove is available for incubation, it should be left at room temperature (do not refrigerate) until transferred to the laboratory. Samples are transported at room temperature.

Appendix 7. **Specimen Collection** *(Continued)*

The quantity of blood is currently regarded as one of the most critical variables in the increase in positivity of blood cultures (13,14, 15). Because the majority of bacteremias are of low magnitude (<1-10 CFU/ml), higher sample volume leads to greater sensitivity of the blood culture. For each additional ml of sample that is inoculated in the bottle, positivity increases 2%-5%. Mermel and Maki (16) demonstrated a significant reduction ($p < 0.001$) in blood culture positivity when an average of 2.7 ml (69%) were obtained in comparison with 8.7 ml (92%). The importance of the volume of blood holds even when using automated equipment (15,17,18).

The generally accepted volume of culture blood is 10 ml per extraction for adults. In newborns and premature babies, 1 ml; in infants, between 2 and 3 ml; in preschool children and schoolchildren, 3 to 5 ml; and in adolescents, 10 ml (12).

If the patient is taking antimicrobial drugs, blood culture bottles containing resins (automated systems) should be used in order to neutralize the drugs administered to the patient.

The recommendation is for growing two blood cultures in 24 hours with a 30-90 minute interval between them (19,20). In cases of meningitis or septic shock, a set of two blood cultures with an interval of 30 minutes or less can be taken. If the patient is going to require immediate antimicrobial treatment, two blood cultures can be obtained at the same time, but from different puncture sites.

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