Fundamentals of Healthcare Associated Infection Definitions
Robert Garcia, Infection Control Professional
A Webber Training Teleclass

Fundamentals of Healthcare Associated Infection Definitions (HAIs)
Robert Garcia, BS, MT(ASCP), CIC
Infection Control Professional

Robert Garcia has received educational grants in the past from the following groups:
- Bard
- Tri-State Hospital Supply
- Sage Products
- Johnson & Johnson
- Covidian
- Baxter Healthcare
- Cardinal Health

Learning Objectives
1. Explain why applying uniform definitions are necessary
2. Describe a well-accepted central line-associated bacteremia (CLAB) definition and provide case scenarios
3. Describe a well-accepted ventilator-associated pneumonia (VAP) definition and provide case scenarios
4. Provide formulas that determine rates of infection

The Pressures to Determine Accurate Rates

Prime Issue: Reduce Mortality
- Institute for Healthcare Improvement: 5,000,000 Lives Campaign
- National initiative to reduce healthcare errors, infections, and associated death
- >3200 U.S. hospitals currently participating
- Addresses specific healthcare-acquired infections
  - CLAB
  - VAP
  - SSI
  - “bundle” approach = revision of system components based on scientific evidence of effectiveness

The Local “Report Card”: Mandatory Reporting

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New CMS Guidelines:
If It’s Not POA, We Won’t Pay

- Conditions No Longer Covered
  - Catheter-associated BSI
  - Catheter-associated UTI
  - Mediastinitis (after CABG)
  - Pressure Ulcers
  - Injury to patients
- “Never Events”
  - Objects left in body during surgery
  - Air embolisms
  - Blood incompatibility
- POA Tracking to start 10/07
- Non-payment 10/08 (NOW!)

$ Reimbursement $

- Laboratory-Confirmed BSI
  - LCBI must meet one of the following three criteria (Criterion 1 and 2 may be used for patients of any age including patients ≤ 1 year of age):
    - Criterion 1: Patient has a recognized pathogen from one or more blood cultures
    - Criterion 2: Patient has at least one of the following signs or symptoms:
      - Fever (>38°C), chills, or hypotension
      - Signs and symptoms and positive laboratory results are not related to an infection at another site
      - Common skin contaminant (e.g., Staphylococcus epidermidis, Propionibacterium acnes, coagulase-negative staphylococci)
      - Group A streptococci, enterococci, Micrococcus spp., Micrococcus spp.

Definitions Applying to Bloodstream Infection (BSI)

- Laboratory-Confirmed BSI
  - LCBI must meet one of the following three criteria (Criterion 1 and 2 may be used for patients of any age including patients ≤ 1 year of age):
    - Criterion 1: Patient has a recognized pathogen from one or more blood cultures
    - Criterion 2: Patient has at least one of the following signs or symptoms:
      - Fever (>38°C), chills, or hypotension
      - Signs and symptoms and positive laboratory results are not related to an infection at another site
      - Common skin contaminant (e.g., Staphylococcus epidermidis, Propionibacterium acnes, coagulase-negative staphylococci)
      - Group A streptococci, enterococci, Micrococcus spp., Micrococcus spp.

Reference: www.cms.hhs.gov
Available at http://www.cdc.gov/ncidod/dhqp/pdf/nnis/NosInfDefinitions.pdf

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**Laboratory-Confirmed BSI (cont’d)**

Criterion 3: Patient ≤1 year of age has at least one of the following signs or symptoms: fever (>38°C, rectal), hypothermia (<37°C, rectal), apnea, or bradycardia

and signs and symptoms and positive laboratory results are not related to an infection at another site

and common skin contaminant (i.e., diptheroids [Corynebacterium spp.], Bacillus [not B.anthracis] spp., Propionibacterium spp., coagulase-negative staphylococci [including S.epidermidis], viridans group streptococci, Aerococcus spp., Micrococcus spp.) is cultured from two or more blood cultures drawn on separate occasions.

**LCBI Notes**

- In criterion 1, the phrase “one or more blood cultures” means that at least one bottle from a blood draw is reported by the laboratory as having grown organisms (i.e., a positive blood culture) **Note: a blood culture set usually is comprised of one aerobic and one anaerobic blood culture bottle.**

- In criterion 1, the term “recognized pathogen” does not include organisms considered common skin contaminants (see Criterion 2 and 3). A few of the recognized pathogens are S.aureus, Enterococcus spp., E.coli, Pseudomonas spp., Klebsiella spp., Candida spp., etc. **Note: add Serratia spp., Acinetobacter spp.**

**Surveillance Tip 1**

When conducting surveillance rounds, especially if performed with a team (e.g., IHI Rounds)

- Review initial results on all BCs as reported by the Microbiology Lab and take immediate investigative action before the organism is definitively identified

- E.g., patient has CL in MICU and after five days has a positive BC tentatively identified as “gram negative rods”. This is the time to decide to order cultures from other sites, e.g., urine, (UTI?), sputum (pneumonia?), decubitus ulcers, other drainage, etc.

**Surveillance Tip 2**

When a BC is initially reported as growing “gram positive cocci” it will most likely mean

- Patient is growing Staph aureus, perhaps MRSA (a pathogen under Criterion 1), or

- Patient is growing Streptococcus which could be Group D enterococci, i.e., Enterococcus, perhaps VRE (again a pathogen under Criterion 1), or

- Patient is growing another Staphylococcus sp., e.g., S. epidermidis, if which case Criterion 2 would have to be met in order for the event to be a CLAB.

**Gram Positive Bacteria:**

**Staphylococcus**

<table>
<thead>
<tr>
<th><strong>Species</strong></th>
<th>Description</th>
<th>Infections</th>
<th>Lab note</th>
</tr>
</thead>
<tbody>
<tr>
<td>S. aureus</td>
<td>GP cocci in clusters</td>
<td>Abscess, pneumonia, osteomyelitis, bactemia, endocarditis</td>
<td>May be reported as MRSA, Coagulase-positive</td>
</tr>
<tr>
<td>S. epidermidis</td>
<td>GP cocci in clusters; normal flora of skin and mucous membranes</td>
<td>Prosthetic devices, including catheters, sepsis, sepsis, meningitis, endocarditis</td>
<td>Coagulase-negative</td>
</tr>
<tr>
<td>S. haemolyticus, saprophyticus</td>
<td>GP cocci in clusters</td>
<td>UTIs, urethritis, meningitis, endocarditis</td>
<td>Coagulase-negative</td>
</tr>
</tbody>
</table>

**Enterococcus**

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</thead>
<tbody>
<tr>
<td>E. faecalis</td>
<td>GP cocci in pairs</td>
<td>Pharyngitis, respiratory ear infections, skin infections, soft tissue infections, endocarditis, meningitis</td>
<td>Grp. A Strep</td>
</tr>
<tr>
<td>E. faecium</td>
<td>GP cocci in pairs</td>
<td>Neutropenic sepsis, meningitis, pneumonia, urinary tract infections, endocarditis, skin soft tissue infections</td>
<td>Grp. B Strep</td>
</tr>
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**Gram Positive Bacteria:**

**Streptococcus**

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<tr>
<td>S. Pyogenes</td>
<td>GP cocci in chains or pairs</td>
<td>Pharyngitis, respiratory ear infections, skin infections, soft tissue infections, endocarditis, meningitis</td>
<td>Grp. A Strep</td>
</tr>
<tr>
<td>S. Agalactiae</td>
<td>GP cocci in chains or pairs; normal flora of female and male genital tract</td>
<td>Neonatal sepsis, meningitis, pneumonia, sepsis, endocarditis, skin soft tissue infections</td>
<td>Grp. B Strep</td>
</tr>
<tr>
<td>S. Dysgalactiae</td>
<td>GP cocci; normal skin flora, nasopharynx, GI and GU tracts</td>
<td>Bacillary, endocarditis, septic arthritis, skin infections</td>
<td>Grp. C Strep</td>
</tr>
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**Enterococcus**

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<tr>
<td>E. faecalis</td>
<td>GP cocci in pairs; normal GI and female genital tract flora</td>
<td>UTI, bloodstream, wound infections, intra-abdominal/pelvic wounds</td>
<td>Grp. D Strep, E. Faecalis, S. Agalactiae. Either can be VRE</td>
</tr>
</tbody>
</table>

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Surveillance Tip 2 (cont’d)

Consider the following:

- If BC positive for *Staph aureus* …..order additional cultures from other sites
- If BC positive for *Enterococcus*, …..order additional cultures from other sites (Don’t wait for final species!)
- If BC positive for *S. epidermidis*, remember that other parts of Criterion 2 must be met for the case to be a CLAB.

LCBI Notes (cont’d)

In criterion 2 and 3, the phrase “two or more blood cultures drawn on separate occasions” means:

1. that blood drawn from at least two blood draws were collected within two days of each other (bloods drawn Monday and Wednesday = good!; Monday and Thursday = bad!) and
2. that at least one bottle from each blood draw is reported by the laboratory as having grown the same common skin contaminant organism (for a pediatric draw it may consist of a single bottle due to volume constraints).

“Sameness of Organisms”

If the common skin contaminant is identified to the species level from one culture, and a companion culture is identified with only a descriptive name (i.e., to the genus level), then it is assumed that the organisms are the same.

<table>
<thead>
<tr>
<th>Culture</th>
<th>Companion Culture</th>
<th>Report as…</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>S. epidermidis</em></td>
<td>Coagulase-negative staphylococci</td>
<td><em>S. epidermidis</em></td>
</tr>
<tr>
<td>Bacillus spp. (not anthracis)</td>
<td><em>B. cereus</em></td>
<td><em>B. cereus</em></td>
</tr>
<tr>
<td><em>S. salivarius</em></td>
<td>Strep viridens</td>
<td><em>S. salivarius</em></td>
</tr>
</tbody>
</table>

Definition of Laboratory Confirmed BSI: ANY PATIENT

<table>
<thead>
<tr>
<th>Criterion 1:</th>
<th>Criterion 2:</th>
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<tr>
<td>Patient has a recognized pathogen cultured from one or more blood cultures</td>
<td>Organism cultured from blood is not related to an infection at another site</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Criterion 2:</th>
<th>Organism cultured from blood is not related to an infection at another site</th>
</tr>
</thead>
<tbody>
<tr>
<td>Signs &amp; symptoms &amp; positive lab results are not related to an infection at another site</td>
<td>Common Skin Contaminant (e.g., diphtheroids, Bacillus sp., Propionibacterium sp., <em>S. epidermidis</em>, coagulase-negative staphylococci, or micrococci) is cultured from two or more blood cultures drawn on separate occasions</td>
</tr>
</tbody>
</table>

Scenario #1

- 54 y/o male, DM, A-FIB, obese, complains chest pain
- Day 0: admit ER, RFM CL inserted
- Day 1: admit MICU, RFM removed, LIJ placed
- Day 5: T101.8, blood culture coag-neg Staph, cath tip coag-neg Staph, WBC 13.1
- Is it a CLAB?

Scenario #2

- 72 y/o male, MVA, broken ribs, leg injury, abdominal trauma
- Day 0: admit ER, transfer to OR, RSC inserted, abd surgery to repair liver laceration
- Day 1: admit SICU, urinary cath, chest tube
- Day 8: T102.2, WBC 14.3, RSC changed over guidewire, abdominal pain, CT scan shows abd abscess
- Day 10: blood culture reported as GPC in chains (final: *Enterococcus faecalis* Grp D)
- Is it a CLAB?

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Gastrointestinal Infection Definition
Gastrointestinal tract (esophagus, stomach, small and large bowel, and rectum) excluding gas-tointestinal and appendicitis:
1. Patient has an abscess or other evidence of infection seen during a surgical operation or histopathologic examination.
2. Patient has at least two of the following signs or symptoms with no other recognized cause and compatible with infection of the organ or tissue involved: fever (>38°C), nausea, vomiting, abdominal pain, or tenderness and at least one of the following:
   a. Organisms cultured from drainage or tissue obtained during a surgical operation or endoscopy or from a surgically placed drain
   b. Organisms seen on gram stain or multiradualated giant cells seen on microscopic examination of drainage or tissue obtained during a surgical operation or endoscopy or from a surgically placed drain
   c. Organisms cultured from blood
   d. Evidence of pathologic findings on radiographic examination
   e. Evidence of pathologic findings on endoscopic examination (e.g. Candida esophageal or proctitis)

Scenario #3
- 66 y/o female, DM, cellulitis, GI bleed
- Day 0: admit ER, PIV inserted
- Day 1: admit medical unit, PICC placed
- Day 5: Hypotension, resp failure, intubated, transferred to MICU
- Day 6: T99.5, WBC 12.1, blood culture *E.coli* ESBL+, line removed, cath tip *S.epi*
- Day 7: urine culture *E.coli* ESBL+, 100,000cfu

Is it a CLAB?

Urinary Tract Infection Definition
A symptomatic UTI must meet at least 1 of the following criteria:
1. Patient has at least 1 of the following signs or symptoms with no other recognized cause: fever (>38°C), frequency, dysuria, or suprapubic tenderness and at least one of the following:
   a. Positive dipstick for esterase and/or nitrate
   b. Pyuria (100 WBC/mm³ or ≥3 WBC/high-power field of unspun urine)
   c. Organisms on gram stain of unspun urine
   d. Evidence of pathologic findings on endoscopic examination
   e. Organisms cultured from drainage or tissue obtained during a surgical operation or histopathologic examination.
2. Patient has at least two of the following signs or symptoms with no other recognized cause: fever (>38°C), dysuria, or suprapubic tenderness and at least one of the following:
   a. Positive dipstick for esterase and/or nitrate
   b. Pyuria (100 WBC/mm³ or ≥3 WBC/high-power field of unspun urine)
   c. Organisms on gram stain of unspun urine
   d. Evidence of pathologic findings on radiographic examination
   e. Organisms cultured from drainage or tissue obtained during a surgical operation or histopathologic examination.

Scenario #4
- 49 y/o female, cervical CA, Hickman catheter inserted 3 mths prior to hospitalization, pain and weakness
- Day 0: admit ER, admit medical unit
- Day 6: Resp failure, intubated, transferred to MICU
- Day 7: T100.4, BP 100/55, bld cult coag-neg Staph (1/2 bottles)
- Day 8: bld cult neg
- Day 9: T100.8, WBC 12.7, blood culture *S.epi* (1/2 bottles)
- Day 11: bld cult Staph haemolyticus
- Day 11: bld cult Staph haemolyticus

Is it a CLAB?

Scenario #5
- 32 y/o male, ruptured appendix
- Day 0: admit ER, OR, abd surgery, admit SICU
- Day 5: T99.4
- Day 6: T101.2, BP 105/82, bld cult *K.pneumoniae*
- Day 7: T100.3, WBC 10.1
- Day 8: CXR no infiltrates, consolidation, or congestion
- Sputum culture *K.pneumoniae*

Is it a CLAB?

Pneumonia Definitions
- **HAP:** Hospital-acquired pneumonia
  - Defined as pneumonia that occurs ≥48 hours after admission and was not incubating at the time of admission
- **VAP:** Ventilator-associated pneumonia
  - Defined as pneumonia that arises more than 48-72 hours after endotracheal intubation
- **HCAP:** Healthcare-associated pneumonia
  - Includes any patient who was hospitalized in an acute care hospital for two or more days within 90 days of the infection; resided in an extended-care facility; received recent IV antibiotics, chemotherapy or wound care within the past 30 days of the current infection; or attended a hospital or hemodialysis center


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Definitions Applying to VAP

NHSN: Pneumonia 1

1. 2 or more serial X-rays with one of the following:
   - New or progressive and persistent infiltrate
   - Consolidation
   - Cavitation
   - Pneumocyes, in <1 y.o.
2. At least 1 of the following:
   - Fever (>38 C/100.4 F) with no other cause
   - Leukopenia (<4000 WBC/mm³) or leukocyctosis (>12,000 WBC/mm³)
   - Altered mental status
3. At least 1 of the following:
   - New onset of purulent sputum or change in character of sputum, or resp secretions, or suctioning requirements
   - New onset or worsening cough, or dyspnea, or tachypnea
   - New onset or worsening gas exchange (e.g. PaO2/FiO2 ≤ 240) req. or increase ventilation demands

VAP Q&A

Question I: If the patient is intubated pre-admission, how should we determine the VAP?
   - If the patient was symptom free at the time of the intubation by the paramedic or emergency department, and meets the CDC NHSN criteria/algorithm for VAP, it is a positive device-associated pneumonia. However, if the patient was intubated and received care at another hospital and subsequently transferred to your facility, then you need to apply the 48 hour rule. Only pneumonias appearing 48 hours post admission would be considered a VAP.

Questions and Answers are posted in response to questions asked by participants in a Quality Improvement Project in New York State. Ventilator Associated Pneumonia Prevention (VAPP) Project FAQs
http://jeny.ipro.org/showthread.php?t=2025

Question II: If a VAP occurs within 48 hours of intubation, it is considered hospital-acquired?
   - Yes, the development of a VAP can occur within 48 hours of intubation.

Question III: What is the minimum time frame?
   - There is no minimum period of time that the ventilator must be in place in order for the pneumonia to be ventilator-associated except for the transferred in example in question #2.

Question IV: Do we call it a VAP if the patient aspirated on intubation?
   - If the patient was symptom free and had obvious aspiration at the time of the intubation, it is a hospital-associated event. If the patient met VAP criteria, the answer is yes.

Question V: What is the definition of a VAP?
   - It is a pneumonia that occurs in a patient who was intubated and ventilated at the time of or within 48 hours before the onset of pneumonia

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VAP Q&A

Question VI: I rarely have a VAP defined as a PNEU 2 or PNEU 3, what am I doing wrong?
- You are not doing anything wrong. In general, the majority of VAPs identified through surveillance fall into PNU1. This is because most ventilator-associated pneumonias are clinically diagnosed without specific lab findings to confirm the exact etiology that would place them into the PNEU-2 category.

Question VII: Why do we use PNU1, PNU2, and PNU3?
- PNU1 is the domain where all the “clinically” defined pneumonias are tracked. Clinically defined meaning the use of chest x-rays along with the patients signs and symptoms. PNEU2 tracks the pneumonias with specific lab confirmation (positive blood or pleural cultures, quantitative cultures, PCR, or antibodies, etc.) and PNEU 3 tracks the pneumonias in immunocompromised patients.

VAP Q&A

Question VII: Regardless, is it correct that the first step is a chest x-ray finding?
- Correct, you are looking for a new or progressive and persistent infiltrate, consolidation, cavitary or pneumatoceles in <1 y.o. per chest x-rays. The other clarification comes with determining if the patient is with or without underlying disease. If the patient does not have underlying disease, one or more serial x-rays with one of the findings is enough. If the patient does have underlying disease, two or more serial x-rays with findings is necessary.

Note: underlying disease includes patients with pulmonary or cardiac disease (e.g., interstitial lung disease or congestive heart failure). Also, radiologists may report pneumonia as “air-space disease,” “focal opacification,” or “patchy areas of increased density.”

VAP Case Scenarios

Patient is 62 y/o male, Hx bypass surgery, COPD, renal failure, admitted to MICU

<table>
<thead>
<tr>
<th>Day</th>
<th>Temp</th>
<th>WBC</th>
<th>Spct</th>
<th>BP</th>
<th>CXR</th>
</tr>
</thead>
</table>
| 1   | 101.4| 11.1| Thick| 114/72| CT Scan: diffuse infiltrates across both lung fields with consolidation. Bilateral pleural effusion. Status post left hemi-thoracotomy with evacuation of air.
| 2   | 101.3| 13.5| Thick| 113/65| CT Scan: diffuse infiltrates across both lung fields with consolidation and left pleural effusion.
| 3   | 101.2| 14.6| Thick| 113/65| CT Scan: diffuse infiltrates across both lung fields with consolidation.
| 4   | 101.1| 15.4| Thick| 113/65| CT Scan: diffuse infiltrates across both lung fields with consolidation.

VAP Case Scenarios

Patient is 67 y/o female, Hx emphysema, recent bypass surgery, diabetes, admitted to CICU

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<tr>
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| 0   | 101.2| 15.0| Clear| 112/72| Bilateral infiltrates both lower and upper lobes. CT Scan: diffuse infiltrates across both lung fields with consolidation.
| 1   | 100.8| 15.0| Clear| 112/72| Bilateral infiltrates both lower and upper lobes. CT Scan: diffuse infiltrates across both lung fields with consolidation.
| 2   | 100.8| 15.0| Clear| 112/72| Bilateral infiltrates both lower and upper lobes. CT Scan: diffuse infiltrates across both lung fields with consolidation.
| 3   | 100.7| 15.0| Clear| 112/72| Bilateral infiltrates both lower and upper lobes. CT Scan: diffuse infiltrates across both lung fields with consolidation.

VAP Case Scenarios

Patient is 67 y/o female, Hx emphysema, recent bypass surgery, diabetes, admitted to CICU

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| 3   | 100.7| 15.0| Clear| 112/72| Bilateral infiltrates both lower and upper lobes. CT Scan: diffuse infiltrates across both lung fields with consolidation.

VAP Case Scenarios

Patient is 62 y/o male, Hx HBP, renal disease, patient intubated 4 days prior at another facility, admitted to MICU

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| 2   | 101.2| 14.6| Thick| 113/65| CT Scan: diffuse infiltrates across both lung fields with consolidation.
| 3   | 101.1| 15.4| Thick| 113/65| CT Scan: diffuse infiltrates across both lung fields with consolidation.

VAP Case Scenarios

Patient is 67 y/o female, Hx emphysema, recent bypass surgery, diabetes, admitted to CICU

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VAP Case Scenarios

Patient is 62 y/o male, Hx bypass surgery, COPD, renal failure; admitted to MICU

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| 4   | 101.1| 15.4| Thick| 113/65| CT Scan: diffuse infiltrates across both lung fields with consolidation.

VAP Case Scenarios

Patient is 48 y/o female, Hx HBP, renal disease, patient intubated 4 days prior at another facility, admitted to MICU

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Thank you for listening. Questions?

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