Objectives

• Discuss basic principles of epidemiology and how they apply to surveillance
• Describe surveillance process and outcome measures for infection prevention
• Review basic surveillance practices: data collection, recording, analysis, interpretation, and communication of surveillance findings
Epidemiology

• Definition: Study of disease in populations

Clinical care: focus on the individual

— VS —

Epidemiology: focus on the group

• In healthcare, answers questions such as:
  • Does care result in best outcome?
  • What % of the time?

• Allows assessment of trends over time
Infection Prevention and Hospital Epidemiology

• “The discipline concerned with preventing...healthcare-associated infection

• A practical (rather than academic) sub-discipline of epidemiology

• An essential, though often under-recognized and under-supported, part of the infrastructure of health care

• Akin to public health practice, practiced within the confines of a particular health-care delivery system rather than directed at society as a whole”

Wikipedia, 2011
Epidemiologic Surveillance

Defined as

• The ongoing, **systematic** collection, **recording**, analysis, **interpretation** and **dissemination** of data

• Reflects current health/disease status of a community or population (e.g. healthcare patients)

• Used for public health **action** to reduce morbidity and mortality, and to improve health.
Basic Terminology

- Mean, median
- Surveillance
- Lab-based surveillance
- Case finding
- Incidence vs. prevalence
- p-value, confidence interval

What do all of these terms mean???
Mean

- Measure of central tendency used to describe a data set
- The average value of a set of numbers
- Most affected by outliers
- To calculate:
  - Add the values in the data set
  - Divide by total number of variables

Example:

\[
0 + 0 + 2 + 0 + 0 + 3 + \\
7 + 2 + 12 + 0 + 0 + 1 = 27
\]

\[
27 \div 12 = 2.25
\]
Median

- Another measure of central tendency used to describe a data set
- The midpoint of a distribution of values
- Same number of values above the median as below it

To calculate:
- Order the values in the data set (low to high, or vice versa)
- Identify middle value

Example:
0, 0, 0, 0, 0, 0, 1, 2, 2, 3, 7, 12

Median: 0.5

CLABSI in 2009
Surveillance Terms

• **Case definition (also called surveillance definition)**
  ▫ the clinical and laboratory characteristics that a patient must have to be counted as a case for surveillance purposes

• **Universal case reporting**
  ▫ a surveillance system in which all cases of a disease are supposed to be reported

• **Laboratory-based reporting**
  ▫ a surveillance method in which the reports of cases come from clinical laboratory data (forgoing case review)
Incidence

Number of persons in a population who develop a disease or condition within a specified period of time

Measure of new infections

Prevalence

Proportion of persons in a population who have a disease or condition at a given point in time

Measure of infections that are present
Infection Rates

**Incidence rate** =

\[
\frac{\text{# of new cases of disease in a population}}{\text{# of people at risk for getting the disease}}
\]

Example: 10 HCWs out sick with influenza = 10%
100 unvaccinated HCWs

**Prevalence rate** =

\[
\frac{\text{# of existing cases of disease in a population}}{\text{# of people in the population}}
\]

Example: 17 SNF pts TB skin test+ on admission = 17%
100 SNF patients
Surveillance

- A surveillance system is an **information** loop or cycle
- Starts and ends with communication and action

Flow of Surveillance Data

- Collection
- Dissemination and utilization
- Analysis and interpretation
- Collation and recording (reporting)
Endpoint of HAI Surveillance?

Data that demonstrate progress in HAI Prevention!

CLABSI, 2009-2011
Recommended practices for surveillance: Association for Professionals in Infection Control and Epidemiology (APIC), Inc.

Terrie B. Lee, RN, MS, MPH, CIC, Ona G. Montgomery, RN, MSHA, CIC, James Marx, RN, MS, CIC, Russell N. Olmsted, MPH, CIC, and William E. Scheckler, MD

Surveillance in public health is defined as “the ongoing systematic collection, analysis, interpretation, and dissemination of data regarding a health-related event for use in public health action to reduce morbidity and mortality and to improve health.” Infection control professionals apply this definition to both reduce and prevent healthcare-associated infections (HAIs) and enhance patient safety. Surveillance, as part of infection prevention and control programs in healthcare facilities, contributes to meeting the processors' frequency of adverse events such as infection or injury. Although the goal of contemporary infection prevention and control programs is to eliminate HAIs, epidemiologic surveillance is still required for accurate quantification of events and demonstration of performance improvement.

Although there is no single or “right” method of surveillance design or implementation, sound epidemiologic principles must form the foundation of effective systems. In the healthcare setting, surveillance is an integral part of infection prevention and control programs.
Quality HAI Surveillance

Key tenets

• A **written plan** should serve as the foundation
  • What HAI's am I tracking? Why?
  • How will data be used?
  • If only to meet mandates, how **can** data be used?
  • Where are opportunities to prevent HAI in **MY** facility?

• The **intensity** of surveillance needs to be maintained over time

• Stay **consistent** over time; apply same surveillance definitions
Recommended Practices for Surveillance

I. Assess the population
II. Select the outcome or process for surveillance
III. Use surveillance definitions
IV. Collect surveillance data
V. Calculate and analyze infection rates
VI. Apply risk stratification methodology
VII. Report and use surveillance information

AJIC Am J Infect Control 2007; 35:427-40
Recommended Practices for Surveillance

1. Assess the population
Patient Population at Risk for Infection

Do you know…

• What infections occur most commonly?
• What infections are likely to occur?
• Where are greatest opportunities to prevent infections?
• What are our most frequently performed surgical or procedures?
• What types of patients increase liability and/or costs for our facility?
Procedure-associated Risk

- Infection risk varies by type of procedure
Device-associated Risk

- Infection risk increases with use of invasive devices
  - Higher risk with longer duration
Incidence Density Rate

- Rate calculation that accounts for variation in time of exposure
- For HAI surveillance: days of exposure

Incidence density rate =

\[
\frac{\text{# of new cases of infection or disease in population}}{\text{# of exposure periods (e.g. patient days or line days)}}
\]

Examples:
- # hospital onset CDI
- # of patient days
- # CLABSI
- # central line days
Patient- or Care-level Risk

- Infection risk varies by patient-specific risk factors
- Infection rates vary by patient care unit

---

**NHSN 2009 Data Summary, published 2011**

<table>
<thead>
<tr>
<th>Type of Location</th>
<th>No. of locations+</th>
<th>No. of CLABSI</th>
<th>Central line-days</th>
<th>Pooled mean</th>
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<tbody>
<tr>
<td>Critical Care Units</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Burn</td>
<td>33</td>
<td>193</td>
<td>36,355</td>
<td>5.3</td>
</tr>
<tr>
<td>Medical Major teaching</td>
<td>135 (134)</td>
<td>740</td>
<td>335,840</td>
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</tr>
<tr>
<td>Medical All other</td>
<td>191 (183)</td>
<td>461</td>
<td>293,177</td>
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<tr>
<td>Medical Cardiac</td>
<td>252 (246)</td>
<td>556</td>
<td>330,123</td>
<td>1.7</td>
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<tr>
<td>Medical/Surgical Major teaching</td>
<td>192</td>
<td>760</td>
<td>446,751</td>
<td>1.7</td>
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<tr>
<td>Medical/Surgical All other &lt;= 15 beds</td>
<td>837 (771)</td>
<td>982</td>
<td>693,747</td>
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<tr>
<td>Medical/Surgical All other &gt; 15 beds</td>
<td>324 (323)</td>
<td>1,111</td>
<td>871,750</td>
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<td>Neurologic</td>
<td>23</td>
<td>67</td>
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<tr>
<td>Neurosurgical</td>
<td>79 (78)</td>
<td>194</td>
<td>129,732</td>
<td>1.5</td>
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<tr>
<td>Pediatric Cardiothoracic</td>
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<td>161</td>
<td>65,419</td>
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</tr>
<tr>
<td>Pediatric Medical</td>
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<tr>
<td>Pediatric Medical/Surgical</td>
<td>142 (135)</td>
<td>504</td>
<td>228,206</td>
<td>2.2</td>
</tr>
</tbody>
</table>
Recommended Practices for Surveillance

II. Select the outcome or process for surveillance
Outcomes vs. Process Measures

• **Outcome** - the result of care or performance
  ▫ **Infection**
  ▫ **Length of stay**
  ▫ **Patient satisfaction**

• **Process** - series of steps that result in an outcome; adherence to polices and recommended practices
  ▫ **Immunization**
  ▫ **Central line insertion practices**
  ▫ **Hand hygiene**
Outcome Measures

Examples:

- CAUTI per 1000 Foley catheter days (or patient days-?)
- CLABSI per 1000 central line days
- VAP per 1000 ventilator days
- CDI per 10,000 patient days
  - Hospital Onset (HO) cases for incidence of CDI
  - Community Onset (CO) cases for prevalence of CDI
Process Measures

Examples:

- **CAUTI prevention:** % foley catheters with appropriate indication
- **CLABSI prevention:** % adherence to CLIP bundle (all or none)
- **CDI prevention:** thoroughness of environmental cleaning
Recommended Practices for Surveillance

III. Use surveillance definitions
Surveillance Definitions

- Always refer to **written definitions** to ensure accuracy of applying case definitions
  - Use standardized, published, validated definitions where available
  - Where not available, prepare written definitions to ensure intra-facility standardization
- For accurate and valid comparisons, use the **same definitions**
  - If definitions change, the comparability of rates over time will be compromised
CDC/NHSN surveillance definition of health care–associated infection and criteria for specific types of infections in the acute care setting

Teresa C. Horan, MPH, Mary Andrus, RN, BA, CIC, and Margaret A. Dudeck, MPH
Atlanta, Georgia

BACKGROUND

Since 1988, the Centers for Disease Control and Prevention (CDC) has published 2 articles in which nosocomial infection and criteria for specific types of nosocomial infection for surveillance purposes for use in acute care settings have been defined.\(^1\)\(^2\) This document population for which clinical sepsis is used has been restricted to patients ≤ 1 year old. Another example is that incisional SSI descriptions have been expanded to specify whether an SSI affects the primary or a secondary incision following operative procedures in which more than 1 incision is made. For additional information about how these criteria are used for NHSN surveillance, refer
Alternative Surveillance Definitions

Surveillance definitions also exist for settings that may not yet be covered by NHSN definitions:

- Home care
- Clinics
- Dental offices

See [www.apic.org/AM](http://www.apic.org/AM) or google “APIC surveillance definitions”
Recommended Practices for Surveillance

IV. Collect surveillance data
Collecting Surveillance Data

- Data collectors should include IP staff and others with responsibility or interest
- Limit collection to only what is needed
- Be involved in efforts that advance the electronic health record
Prospective vs. Retrospective

**Concurrent or prospective** surveillance

- Initiated when patient is still under the care
- Advantages
  - ability to capture information in real time
  - interview caregivers
  - observe findings not recorded in patient record
Prospective vs. Retrospective

**Retrospective** surveillance

- Closed record review after patient has been discharged.
- Advantages:
  - allows for comprehensive review of sequential events
  - efficient
- Disadvantage:
  - does not allow for prompt intervention
- Avoid reliance administrative data, i.e. abstracted billing
  - may be useful for identifying possible HAI's
  - not reliable or valid for HAI surveillance
Numerator Data Collection

Numerator = the “Event” being measured

Examples:

- HAIs identified through **active** surveillance: CLABSI, CAUTI, SSI, VAP
- HAIs identified by **laboratory** finding alone: CDI, MRSA BSI, VRE BSI
- Care **practices, processes**, observations: CLIP, hand hygiene compliance
Denominator Data

• Denominator = Population at risk or total of all possible events

• Denominator data collection may involve collection of risk factor data necessary for risk adjustment
  • e.g. age, birthweight, ASA score
Recommended Practices for Surveillance

V. Calculate and analyze infection rates
VI. Apply risk stratification methodology
Calculating Rates/Ratios by Denominator Type

- **Total population at risk**
  - Used to calculate a raw rate or incidence density rate
  - **Examples:**
    - \(\frac{5 \text{ SSI}}{300 \text{ APPY procedures}} \times 100 = 1.67\)
    - \(\frac{2 \text{ CLABSI}}{1500 \text{ line days}} \times 1000 = 1.33\)

- **Total number of events possible**
  - Used to calculate a ratio or proportion (a comparison of two numbers)
  - **Examples:**
    - \(\frac{90 \text{ CLIPs with 100\% adherence}}{100 \text{ line insertions}} = 0.9 \text{ or } 90\%\)
    - \(\frac{31 \text{ hand hygiene (HH) observations}}{50 \text{ opportunities for HH}} = 0.62\)
    - \(\frac{218 \text{ patient days with central line}}{360 \text{ patient days}} = 0.61\)
NHSN published data can help you interpret Your HAI Data


Jonathan R. Edwards, MStat, Kelly D. Peterson, BBA, Yi Mu, PhD, Shailendra Banerjee, PhD, Katherine Allen Bridson, RN, BSN, CIC, Gloria Morrell, RN, MS, MSN, CIC, Margaret A. Dudeck, MPH, Daniel A. Pollock, MD, and Teresa C. Horan, MPH
Atlanta, Georgia

Published by the Association for Professionals in Infection Control and Epidemiology, Inc.

This report is a summary of Device-Associated (DA) and Procedure-Associated (PA) module data collected and reported by hospitals and ambulatory surgical centers participating in the National Healthcare Safety Network (NHSN) from January 2006 through December 2008 as reported to the Centers for Disease Control and Prevention (CDC) by July 6, 2009. This report updates previously pub-

- Estimation of the magnitude of HAIs
- Monitoring of HAI trends
- Facilitation of interfacility and intrafacility comparisons with risk-adjusted data that can be used for local quality improvement activities
- Assistance to facilities in developing surveillance and analysis methods that permit timely recognition of

NHSN 2006-2008 Summary Data (referent period), published Dec 2009

Dudeck MA, Horan TC, Peterson KD, Bridson KA, Morell GC, Pollock DA, Edwards JR

This report is public domain and can be copied freely.

NHSN 2009 Summary Data, published 2011
- Compare your **CLABSI rate** to pooled mean rate of same unit type
- Assess where your CABSI rate falls in the **percentile distribution** among all the same unit types that submitted CLABSI data to NHSN
- Compare your **Central line use or utilization ratio** to pooled mean of same unit type
- Assess where your line utilization ratio falls in the percentile distribution among all the same unit types that submitted data to NHSN
Tests of Significance

• Answers questions such as
  • Are my infection rates different (higher or lower) than the national rates?
  • Are changes in my rate over time meaningful?

• **p value**
  ▫ If value greater than *0.05*, difference is not statistically significant

• **Confidence interval**
  ▫ If the range of values includes 1.0, your data are not statistically different
Recommended Practices for Surveillance

**VII.** Report and use surveillance information
Reporting and Using Surveillance Data

“The demonstrable power of surveillance is in sharing findings with those who need to know and who can act on the findings to improve patient safety.”

AJIC Am J Infect Control 2007; 35:427-40

- Plan for distribution of findings
- Report to health care providers most able to impact patient care
- Report in a manner to stimulate process improvement
- Use visual displays of data
  - charts, graphs, tables, or other graphics data
# Tables and Line Lists

National Healthcare Safety Network

**Line Listing for All Central Line-Associated BSI Events**

*As of: November 3, 2009 at 9:04 AM*

*Date Range: All CLAB_EVENTS*

<table>
<thead>
<tr>
<th>orgID</th>
<th>patID</th>
<th>dob</th>
<th>gender</th>
<th>admitDate</th>
<th>eventID</th>
<th>eventDate</th>
<th>eventType</th>
<th>spcEvent</th>
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<td>M</td>
<td>06/06/2005</td>
<td>1676</td>
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<td>LCBI</td>
<td>BMT</td>
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<td>F</td>
<td>05/30/2005</td>
<td>1678</td>
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<td>M</td>
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<td>07/13/2005</td>
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<td>LCBI</td>
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<td>1927</td>
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<td>LCBI</td>
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</tbody>
</table>
Pie Charts

Missing Line Day Counts by Unit
(# months missing)

- ICU
- Med-Surg
- Telemetry
- NICU

6
1
1
10
Line Graphs or Histograms

**CLABSI, 2009-2011**

Make sure to demonstrate “surveillance to prevention!”
Questions?