Hospital associated Infections

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Hospital-based programs of surveillance, prevention of nosocomial infections were developed in the 1950s and refined in 1960s and 1970s.

Infection Control programs are cost-beneficial if the program prevents >6% of HAI.

1985 cost of HAI was estimated as $4 billion.

CDC MMWR 1992/41(42):7783-87
Declines in Hospital-Acquired Conditions

National efforts to reduce hospital-acquired conditions such as adverse drug events and injuries from falls helped prevent 8,000 deaths and saved $2.9 billion between 2014 and 2016.
Table 5: Aggregate attributable patient hospital costs by site of infection

<table>
<thead>
<tr>
<th></th>
<th># of infections</th>
<th>Range of $ estimates based on 2007 CPI for all urban consumers</th>
<th>Range of $ estimates based on 2007 CPI for Inpatient hospital services</th>
<th>Range of estimate using CPI for all urban consumers (billions)</th>
<th>Range of estimate using CPI for Inpatient hospital services (billions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SSI</td>
<td>290,485</td>
<td>$11,087 - $29,443</td>
<td>$11,874 - $34,670</td>
<td>$3.22 - $8.55</td>
<td>$3.45 - $10.07</td>
</tr>
<tr>
<td>CLABSI</td>
<td>92,011</td>
<td>$6,461 - $25,849</td>
<td>$7,288 - $29,156</td>
<td>$0.59 - $2.38</td>
<td>$0.67 - $2.68</td>
</tr>
<tr>
<td>VAP</td>
<td>52,543</td>
<td>$14,806 - $27,520</td>
<td>$19,633 - $28,508</td>
<td>$0.78 - $1.45</td>
<td>$1.03 - $1.50</td>
</tr>
<tr>
<td>CAUTI</td>
<td>449,334</td>
<td>$749 - $832</td>
<td>$862 - $1,007</td>
<td>$0.34 - $0.37</td>
<td>$0.39 - $0.45</td>
</tr>
<tr>
<td>CDI</td>
<td>178,000</td>
<td>$5,682 - $8,090</td>
<td>$6,408 - $9,124</td>
<td>$1.01 - $1.44</td>
<td>$1.14 - $1.62</td>
</tr>
</tbody>
</table>

*Example calculation for SSI:
2007 CPI for all urban consumers:
Low: 290,485 x $11,087 = $3.22 billion
High: 290,485 x $29,443 = $8.55 billion
2007 CPI for hospital inpatient services:
Low: 290,485 x $11,874 = $3.45 billion
High: 290,485 x $34,670 = $10.07 billion
Estimates of Costs to the Major HAI for the US Adult Acute Care Hospitals (total cost 10 billion dollar/ year)
World Health Organization (WHO) & The Centers for Disease Control and Prevention (CDC)

WHO was established in 1948 with a mission to improve global health (not focused on healthcare initially).

CDC [Communicable Disease Center!] was established in 1946 as a one floor building in Atlanta with $10 million budget. The initial focus was on plague and malaria.
Study on the efficacy of nosocomial infection control (SENIC Project): results and implications for the future

- In 1976; 32% of HAI could be preventable with four essential components:
  - Surveillance with feedback of HAI rates to hospital staff, Enforcement of preventative practices, Infection Preventionist to collect and analyze data, a physician or microbiologist.
HAI prevention

• Horizontal
• Vertical
SURVEILLANCE
EDUCATION
AUDIT
Electronic Surveillance

- Logic built into the System
- Automation – transfer data from TheraDoc to NHSN
• In 2015, a total of 12,299 patients in 199 hospitals were surveyed, as compared with 11,282 patients in 183 hospitals in 2011.
• Fewer patients had health care–associated infections in 2015 (394 patients [3.2%; 95% confidence interval {CI}, 2.9 to 3.5]) than in 2011 (452 [4.0%; 95% CI, 3.7 to 4.4])
Surveillance Bias

IP at Hospital A

IP at Hospital B
Factors Influencing Infection Rates

- Environmental disinfection
- Hand hygiene
  - Transmission precautions
  - Decolonization
- Employee Vaccination
- Surveillance and early Identification
- Healthcare-associated infections (HAI)
- Device Sterilization & disinfection
- Antimicrobial stewardship
- Construction air & water safety
Decolonization

CHG bathing
Mupirocin nasal
Oral chlorhexidine
Targeted versus Universal Decolonization to Prevent ICU Infection


43 hospitals, 74 ICUs and 74,256 patients
Transmission Based precautions

Universal Precautions to all
Vs specific isolation for some
How can we break the chain of transmission?

Patient #1

Patient #2
Standard Precautions

- Hand hygiene
- Use of personal protective equipment
- Respiratory hygiene and cough etiquette
- Properly clean and disinfect reusable medical equipment and environment
- Follow safe injection practice
So What PPE Do I Need?

Think | Select | Don

Draining wound

Standard Precautions

Transmission-based Precautions

The Appropriate PPE

- Drainage
- Wound
Strategies for HAI Reduction: Environmental Sterilization and Disinfection

• Sterilization

Destruction or elimination – by physical or chemical methods – all forms of microbial life

Critical Items enter sterile tissue and confer a high risk for infection if they are contaminated with a microorganism
- Surgical instruments
- Implants

Semi-critical Items contact mucous membranes or nonintact skin sterile tissue and confer a moderate risk for infection if they are contaminated with a microorganism
- Endoscopes

• Disinfection

Elimination of most pathogenic microorganisms – except bacterial spores

Noncritical Items contact intact skin, which acts as an effective barrier to most microorganisms
- Bedpans
- Blood pressure cuffs
- Computers
Environmental disinfection

- Manual cleaning
  "wet time"
- Disinfection + cleaning
- Adjunctive methods
- Verification
Construction

- Air (aspergillus)
- &
- Water (Legionella)
Investigation of a Cluster of Sphingomonas koreensis Infections

Figure 1. Sphingomonas Infections at the National Institutes of Health (NIH) Clinical Center, According to Year.
A new NIH Clinical Center building was constructed in 2004 and opened in 2005.
Major Article

*Pseudomonas aeruginosa* pseudo-outbreak in portable reverse osmosis machines: Interventions to ensure safe and cost-effective hemodialysis
Legionella
! NTM
Employee Health
Exposure & Outbreak Investigation
National Health and Safety Network (NHSN)

- Infection Definitions
- Device days
- Standard Incident ratio (SIR)
- Attribution to a physician and unit
Major HAI
SURGICAL SITE INFECTION (SSI)
SSI Prevention

❖ Pre-op Prevention
   -MRSA surveillance, Decolonization, sugar control, hair removal, smoking cessation
❖ Peri-op Prevention
   -Pre-operative antibiotics, oxygenation, 75% surgery time, traffic in OR, OR Engineering
❖ Post-op Recovery
   -Dressing change, discharge instructions
Decolonization to Reduce Postdischarge Infection Risk among MRSA Carriers


ABSTRACT

BACKGROUND
Hospitalized patients who are colonized with methicillin-resistant *Staphylococcus aureus* (MRSA) are at high risk for infection after discharge.

METHODS
We conducted a multicenter, randomized, controlled trial of postdischarge hygiene education, as compared with education plus decolonization, in patients colonized with MRSA (carriers). Decolonization involved chlorhexidine mouthwash, baths or showers with chlorhexidine, and nasal mupirocin for 5 days twice per month for 6 months. Participants were followed for 1 year. The primary outcome was MRSA infection as defined according to Centers for Disease Control and Prevention (CDC) criteria. Secondary outcomes included MRSA infection, colonization, nasal Mupirocin use, and self-reported adherence.
Strategies to Prevent Surgical Site Infections in Acute Care Hospitals: 2014 Update

Deverick J. Anderson, MD, MPH; Kelly Podgorny, DNP, MS, RN; Sandra I. Berrios-Torres, MD; Dale W. Bratzler, DO, MPH; E. Patchen Dellinger, MD; Linda Greene, RN, MPS, CIC; Ann-Christine Nyquist, MD, MSPH; Lisa Saiman, MD, MPH; Deborah S. Yokoe, MD, MPH; Lisa L. Maragakis, MD, MPH; Keith S. Kaye, MD, MPH

American College of Surgeons and Surgical Infection Society: Surgical Site Infection Guidelines, 2016 Update

Kristen A Ban, MD, Joseph P Minei, MD, FACS, Christine Laronga, MD, FACS, Brian G Harbrecht, MD, FACS, Eric H Jensen, MD, FACS, Donald E Fry, MD, FACS, Kamal MF Itani, MD, FACS, E Patchen Dellinger, MD, FACS, Clifford Y Ko, MD, MS, MSHS, FACS, Therese M Duane, MD, MBA, FACS
BLOOD STREAM INFECTIONS

Central venous catheters (CVCs) are the most frequent cause of healthcare-associated bloodstream infections. CLABSI increases a patient’s chance of acquiring another disease or dying. The CDC estimates: The annual cost of CLABSI is more than $1 billion, the cost per patient is more than $16,000.

250,000 CLABSI cases occur in the U.S. each year, 80,000 in intensive care units (ICUs).

Did You Know?

Central venous catheters (CVCs) are the most frequent cause of healthcare-associated bloodstream infections.
• **Types of Central Lines**
  
  - Tunneled e.g. dialysis catheters & ports.
  
  - Non-tunneled e.g. PICC & CVC

• **Definition**

  **Central line-associated BSI (CLABSI):** A laboratory confirmed bloodstream infection where an eligible central line is present and accessed on the LCBI DOE or the day before.
CLABSI Prevention

❖ No Central Line – NO CLABSI
❖ Best Practice Bundles (insertion vs care)
  • Line care (Dressing, Biopatch, caps, scrub hub)
  • Line vs peripheral Blood cx
  • End of life
A total of 108 ICUs agreed to participate in the study, and 103 reported data. The analysis included 1981 ICU-months of data and 375,757 catheter-days.

The median rate of catheter-related bloodstream infection per 1000 catheter-days decreased from **2.7** infections at baseline to 0 at 3 months.

The mean rate per 1000 catheter-days decreased from **7.7** at baseline to **1.4** at 16 to 18 months of follow-up (P<0.002)


### Blood Culture possible contamination

**Line collection**

August 2013

<table>
<thead>
<tr>
<th>Name</th>
<th>MR#</th>
<th>Specimen #</th>
<th>Site</th>
<th>Collection Date/time</th>
<th>Organism</th>
</tr>
</thead>
<tbody>
<tr>
<td>S3637642</td>
<td></td>
<td>LIJ</td>
<td>LIJ</td>
<td>08/10/13 07:26</td>
<td>CoN Staph.</td>
</tr>
<tr>
<td>2nd S3637640</td>
<td></td>
<td>LIJ</td>
<td>LIJ</td>
<td>08/10/13 7:10</td>
<td>No growth</td>
</tr>
<tr>
<td>S3617828</td>
<td></td>
<td>Subclavian line</td>
<td>Subclavian line</td>
<td>8/03/13 12:30</td>
<td>Diphtheroids</td>
</tr>
<tr>
<td>2nd S3617829</td>
<td></td>
<td>Subclavian line</td>
<td>Subclavian line</td>
<td>8/03/13 12:45</td>
<td>Aeromonas sp. A-hemolytic Strep</td>
</tr>
</tbody>
</table>
OBJECTIVE. Reduce the frequency of contaminated blood cultures that meet National Healthcare Safety Network definitions for a central line–associated bloodstream infection (CLABSI).

DESIGN. An observational study.

SETTING. A 500-bed university-affiliated hospital.

METHODS. A new blood culture policy discouraged drawing blood samples from central lines. Phlebotomists were reeducated regarding aseptic technique when obtaining blood samples by venipuncture. The intravenous therapy team was taught how to draw blood samples by venipuncture and served as a backup when phlebotomists were unable to obtain blood samples. A 2-nurse protocol and a special supply kit for obtaining blood samples from catheters were developed. Rates of blood culture contamination were monitored by the microbiology laboratory.

RESULTS. The proportion of blood samples obtained for culture from central lines decreased from 10.9% during January–June 2010 to 0.4% during July–December 2012 (P < .001). The proportion of blood cultures that were contaminated decreased from 84 (1.6%) of 5,274 during January–June 2010 to 21 (0.5%) of 4,245 during January–June 2012 (P < .001). Based on estimated excess hospital costs of $3,000 per contaminated blood culture, the reduction in blood culture contaminants yielded an estimated annualized savings of $378,000 in 2012 when compared to 2010. In mid-2010, 3 (30%) of 10 reported CLABSI were suspected to represent blood culture contamination compared with none of 6 CLABSI reported from mid-November 2010 through June 2012 (P = 0.25).

CONCLUSIONS. Multiple interventions resulted in a reduction in blood culture contamination rates and substantial cost savings to the hospital, and they may have reduced the number of reportable CLABSI.

Infect Control Hosp Epidemiol 2013;34(10):1042-1047
"The patient in the next bed is highly infectious. Thank God for these curtains."
• Elevation of the head of the bed
• Oral Care
• Swallow eval
• Avoid PPI (may also help with C diff)
• Cuffed valve, weaning trials, avoid sedation
• Ambulate
American Thoracic Society Documents

Guidelines for the Management of Adults with Hospital-acquired, Ventilator-associated, and Healthcare-associated Pneumonia

This official statement of the American Thoracic Society and the Infectious Diseases Society of America was approved by the ATS Board of Directors, December 2004 and the IDSA Guideline Committee, October 2004.
− Remove catheter
− Avoid screening testing (Urinalysis and culture can’t differentiate UTI from AB)
− Change catheter prior to sampling
− Use reflex testing
− Catheter care
− Use alternatives to indwelling catheter
Epidemiologically significant pathogens

- COVID-19
- Influenza and other respiratory infections
  - C diff
  - MRSA, VRE
- GNR MDR (CRE)
  - C auris
- Many others
**Clostridoides difficile** Prevention

- Contact isolation precautions
- Environmental disinfection
- Hand hygiene
- Antibiotic stewardship
- Diagnostic stewardship – Clinical Decision Support
C diff surveillance

CD screening

Yes
Screen

CD (Disease or Test only)

CD Not present

NO
Clinical only

CD disease

CD Not present

CA-CDI

HA-CDI

CA-CDI

HA-CDI
Should we do C diff surveillance!

- Published data showed 14% pos on admission
- Ours is 17% (non-published)
- C diff info could reduce HA-CDI rates and possibly reduce ABX use
- CBA showed cost benefit based on either measure. Obviously more monetary benefit with higher prevalence
- Should we implement or trial CD surveillance!
- Should we develop criteria for high risk patients!
MRSA HAI

• Cause for bloodstream infections, pneumonia, surgical site infections, sepsis and death
• Usually spread by contaminated hands of a healthcare provider
• Bloodstream infection rates decreased 17% per year from 2005-2012. However no change since 2016.

https://www.cdc.gov/mrsa/healthcare/
Few Notes

• Hand hygiene, environmental disinfection, employee vaccination etc reduce all types of infection
• Elevation of the head of the bed, keep a clean dry dressing on IV access, MRSA decolonization prior to surgery effective against specific type of infection
• No specific different therapy is needed for a HAI as compared to CAI as definitive therapy (empirical therapy changes by predicted organisms)
Thank you