Toward the Elimination of Healthcare-associated Infections

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The findings and conclusions in this presentation are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.
Healthcare-associated Infections (HAIs)

- Definition: Infections that patients acquire during the course of receiving treatment for other conditions within a healthcare setting
- In US hospitals annually
  - 1.7 million HAIs
  - 1 out of 20 patients (5%) acquire an HAI
  - 99,000 deaths associated with HAIs
  - $26-33 billion in excess healthcare costs
MDRO

- Multidrug-resistant organisms
- Options for treatment are limited
- MDROs have been associated with
  - Increased lengths of stay
  - Increased cost
  - Increased morbidity and mortality
MDRO

“ESKAPE” pathogens
- Enterococcus faecium
- Staphylococcus aureus
- Klebsiella species
- Acinetobacter baumannii
- Pseudomonas aeruginosa
- Enterobacter species
Age specific Increases in Hospitalizations due to VRE, United States, 2000-2006

Ramsey AM and Zilberberg MD, ICHE 2009; 30:184-6
All ICU TYPES: Trends in %MRSA and Rates of MRSA and MSSA CLABSI—United States, 1997-2007*

*No 2005 data available from pilot year of the National Healthcare Safety Network (NHSN)
## Multidrug Resistance in Gram-Negative Bacilli

<table>
<thead>
<tr>
<th>Organism</th>
<th>Percentage of reported isolates:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Resistant to 3 or more antimicrobial classes</td>
</tr>
<tr>
<td>Pseudomonas</td>
<td>676/6,489 (10%)</td>
</tr>
<tr>
<td>Acinetobacter</td>
<td>1,201/1,987 (60%)</td>
</tr>
<tr>
<td>Klebsiella</td>
<td>679/4,527 (15%)</td>
</tr>
</tbody>
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Data from National Healthcare Safety Network 2006-2007
Increase in C. difficile Infection Incidence

The incidence of CDAD increased from 6.9 to 7.3 cases per 1000 admissions from T1 to T2 (p<0.001).

Total CDAD Hospital Discharges 2000 - 2006

<table>
<thead>
<tr>
<th>Year</th>
<th>Secondary CDAD</th>
<th>Principal CDAD</th>
<th>All CDAD Discharges</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>8,652</td>
<td>2,613</td>
<td>11,265</td>
</tr>
<tr>
<td>2001</td>
<td>15,539</td>
<td>4,419</td>
<td>19,958</td>
</tr>
<tr>
<td>2002</td>
<td>19,527</td>
<td>5,630</td>
<td>25,167</td>
</tr>
<tr>
<td>2003</td>
<td>22,732</td>
<td>6,407</td>
<td>29,139</td>
</tr>
<tr>
<td>2004</td>
<td>25,950</td>
<td>7,544</td>
<td>33,494</td>
</tr>
<tr>
<td>2005</td>
<td>30,576</td>
<td>9,829</td>
<td>40,406</td>
</tr>
<tr>
<td>2006</td>
<td>33,225</td>
<td>12,727</td>
<td>45,952</td>
</tr>
</tbody>
</table>

McDonald LC, et al. Presented at the 45th Annual Meeting of the Infectious Diseases Society of America (IDSA), October 4-7, 2007; San Diego, CA. (Premier Inc. Data)
The Iceberg Effect

Infected

Colonized
Healthcare-associated Infections in Non-hospital Settings

- **Long-term care**
  - 1.7 million beds with 2.5 million residents/year nationally

- **Ambulatory surgical centers**
  - 5,175 facilities

- **Dialysis centers**
  - 4,950 facilities
CDC’s Mission

- Collaborating to create the expertise, information, and tools that people and communities need to protect their health – through
  - health promotion
  - prevention of disease, injury and disability
  - preparedness for new health threats

- CDC seeks to accomplish its mission by working with partners throughout the nation and the world
CDC’s Division of Healthcare Quality Promotion

- Healthcare outcomes
- Outbreaks in healthcare settings
- Emerging antimicrobial-resistant infections
- Development of infection control guidelines and policies
- Efficacy of new interventions for patient safety
- Clinical microbiology laboratory quality
- Water quality in healthcare settings
- Promotion of implementation and evaluation of prevention interventions
CDC HAI Elimination Activities

- Tracking and monitoring
- Developing prevention guidelines
- Implementing prevention strategies
- Addressing gaps in knowledge
- Identifying and responding to emerging threats
Tracking and Monitoring

- National Healthcare Safety Network (NHSN)
  - Internet based reporting system through CDC’s Secure Data Network
  - 2400+ US healthcare facilities currently participate from all 50 states
    - Standard definitions, methods, and protocols used in more than 20 countries
  - Manual data entry with transition toward electronic data capture

- Emerging Infections Program
  - Population based surveillance in 10 states
  - Especially important for understanding the dynamic epidemiology of healthcare-associated infections due to MRSA and *C. difficile*, and other emerging multidrug resistant bacteria causing HAIs
State Initiatives: Public Reporting of HAIs, 2009
Prevention Guidelines: HICPAC/CDC Evidence-based Recommendations

- Guidelines are developed for each type of infection and based on systematic reviews of the medical literature

- Categories of Evidence
  - Category 1A
    - Strong recommendation/strong or moderate quality of evidence
  - Category 1B
    - Strong recommendation/weak quality of evidence or accepted practices
  - Category 1C
    - Strong recommendation required by state or federal regulation
  - Category 2
    - Weak recommendation supported by limited evidence
  - No recommendation/unresolved issue
    - Insufficient evidence to support a recommendation
Suboptimal Adherence to HICPAC/CDC Recommendations

- Hand hygiene adherence
  - 5% - 81% (overall average: 40%)
- Surgical antimicrobial prophylaxis
  - <50% adherence to recommendations
- Full compliance with major HAI guidelines
  - Among 1,256 US hospitals—30.7% to 38.5%
  - Central-line bloodstream infections prevention—35.4%

Arch Surg 2005  MMWR 2002:51(RR16);1-44  Leapfrog Group 2007
Successful Implementation of HICPAC/CDC Guidelines Prevents Bloodstream Infections

- Implementation of CDC/HICPAC Bloodstream Infection Prevention Guideline
  - For insertion and removal of intravascular catheters
- Intensive care units
  - SW Pennsylvania (66), Michigan (103)
- Interventions to increase adherence to recommendations were similar
  - Education of staff
  - Creation of a central-line cart
  - Data/feedback on adherence to practices and outcomes
  - Daily multidisciplinary rounds
  - Strategies to improve safety culture

Successful Prevention of Bloodstream Infections, Michigan & Pennsylvania

**Pennsylvania**

**Michigan**

**FIGURE.** Central line–associated bloodstream infection rate* in 66 intensive care units (ICUs), by ICU type and semiannual period — southwestern Pennsylvania, April 2001–March 2005

- All other unit types
- Medical/surgical units

- Pooled mean rate per 1,000 central line days.
- Includes cardiothoracic, coronary, surgical, neurosurgical, trauma, medical, burn, and pediatric ICUs.
- *p<0.001.

MMWR 2005;54:1013-16


103 ICUs at 67 Michigan hospitals, 18 months
Addressing Gaps in Knowledge with Research

**Prevention**
- Better understanding of HAI epidemiology: New risk factors, populations, impact on patient outcomes and healthcare costs to prioritize prevention practice development
- New evidence-based prevention practices, or combinations of existing practices
- Comparative effectiveness studies where multiple, competing prevention measures co-exist
- Improve process and outcomes data for HAI reporting and prevention

**Microbiology**
- Antimicrobial resistance: Methods and molecular epidemiology of emerging pathogens
- Environmental microbiology: Role of the healthcare environment in infection transmission
Evaluation of Progress Toward Eliminating HAIs

- Primary outcome - Have HAIs been reduced or eliminated?
  - Ultimate goal is to have sustained action to prevent infections

- Challenge for primary outcome measure
  - Infection rates vary by healthcare setting, intervention, risk group
  - Great desire to have simple metrics, that can be used at the unit, hospital, state, national level

- Standardized Infection Ratio (SIR)
  - Analogous to a Standardized Mortality Ratio
  - Compares each unit, hospital, state to a baseline rate
  - Allows combining of data from a variety of healthcare settings
  - Publicly reported SIRs by state
The Role of Hand Hygiene
Hand Hygiene

- Cornerstone to infection control
- Single most effective method to prevent the spread of many communicable diseases
- Includes
  - Hand washing
  - Alcohol-based handrubs
Evidence of Relationship Between Hand Hygiene and Healthcare-Associated Infections

- Substantial evidence that hand hygiene reduces the incidence of infections
- Historical study: Semmelweis
- More recent studies: rates lower when antiseptic handwashing was performed

Guideline for Hand Hygiene in Health-care Settings. MMWR 2002; vol. 51, no. RR-16.
Ignaz Semmelweis, 1815-1865

- 1840’s: General Hospital of Vienna
- Divided into two clinics, alternating admissions every 24 hours:
  - First Clinic: Doctors and medical students
  - Second Clinic: Midwives
The Intervention:
Hand scrub with chlorinated lime solution

Hand hygiene basin at the Lying-In Women’s Hospital in Vienna, 1847.
Hand Hygiene: Not a New Concept

Maternal Mortality due to Postpartum Infection
General Hospital, Vienna, Austria, 1841-1850

- Hand antisepsis reduces the frequency of patient infections -

Hand Hygiene in Healthcare Settings Today

- Hand hygiene widely the “leading measure” in preventing healthcare-associated infections (HAI)
- Over 20 studies examining temporal association between increased hand hygiene adherence and reduced HAIs
  - Most studies introduced alcohol-based hand sanitizer as part of multi-modal intervention strategy
  - Only 3 showed no impact

Examples of HH Studies in Healthcare Settings

- Adult ICU in England (1977)
  - Promotion of hand washing + chlorhexidine cleanser
  - Reduction in % patients colonised/infected by Klebsiella

  - Alcohol-based hand rub introduction, hand hygiene observation, training, hand hygiene protocols, posters
  - HH compliance from 43% to 80%
  - Significant reduction in HAI rates, in particular resp infections

- Urology Unit in Vietnam (2008)
  - Alcohol-based hand rub introduction, hand hygiene observation, training, posters, patient education
  - HH compliance from 0% to 28%
  - Significant reduction in HAI rates, from 13.1 → 2.1%
A Pair of Hospital Hands...
And after Hand Hygiene...

AFTER HANDWASHING WITH ANTIMICROBIAL SOAP
Hand Hygiene and Influenza

- Hendley, 2000: Respiratory viruses regularly deposited onto hands and introduced into environment

- Grayson, Feb 2009: live Influenza A virus remained stable on hands of vaccinated healthcare workers for 1 hr

- Bean, 1982: Influenza viruses can survive on and be measurably transferred from tissues (minutes) and non-porous surfaces (hours)

- Thomas, 2008: Influenza viruses can survive up to 3d on banknotes, up to 17d in presence of mucus
CDC Guidelines

• Released in 2002
• Collaborative Development (HICPAC, SHEA, APIC, IDSA)
Performance Indicators

- Monitor and record adherence to hand hygiene by ward or service
- Provide feedback to healthcare workers about their performance
- Monitor the volume of alcohol-based handrub used per 1,000 patient days
- Monitor adherence to policies on wearing artificial nails

Hand Hygiene Audits

- Auditing (monitoring) shown to enhance adherence as part of multifaceted campaigns
  - 35% to 60% in US (Lam, 2004)
  - 32% to 62% in UK (Randle, 2006)
World Health Organization

- First Global Patient Safety Challenge
- Clean Care is Safer Care program
- SAVE LIVES: Clean Your Hands initiative
- Second global hand hygiene awareness day on May 5, 2010
WHO Guidelines

- Released in 2009
Your 5 moments for HAND HYGIENE

1. Before patient contact
2. Before aseptic task
3. After body fluid exposure risk
4. After patient contact
5. After contact with patient surroundings
Hand Hygiene activities supported by CDC

- Guidelines
- Communication / education campaigns
- Surveillance
- Extramural research
- Potential future projects
Communication Campaigns

- 2002: English/Spanish promotional materials accompany guidelines
- 2008: Online training for healthcare personnel
- 2008: Partnered with Safe Care and APIC
  - Patient empowerment
  - Visual reminders
- 2008: National MRSA Education Initiative
Web Links for Resources

- Hand Hygiene Saves Lives: Patient Admission Video
- Hand Hygiene Interactive Training Course
- Promotional materials
  - http://www.cdc.gov/handhygiene/

- Hand washing After a Disaster

- Hygiene in Less Developed Countries
Surveillance Accompanied by Hand Hygiene Monitoring

• National Healthcare Safety Network (NHSN)
  - MDRO and CDAD Module
  - Primary outcomes are HAI
  - Hand hygiene adherence as a process measure

• International HAI surveillance and HH Auditing
  - Kenya infection control capacity building project
Support for Extramural Research

- Use of Radio Frequency Technology to automate and standardize hand hygiene adherence monitoring (University of Maryland)
- Explore wireless technology (motes) for monitoring
- Study various data feedback mechanisms
- Healthcare worker attitudes towards e-monitoring
Potential Future Projects and Collaborations

- Study the impact and appropriateness of patient empowerment strategies
- Qualitative exploration of legal and ethical issues associated with hand hygiene monitoring and data feedback
- Outpatient settings
  - Assess barriers to hand hygiene compliance and basic infection control
  - Targeted hand hygiene messages (e.g., dialysis)
- Develop national campaign for consistent HH messaging, measurement, and regular dissemination of information
- Develop an interactive web portal to house HH materials and resources
PREVENTION IS PRIMARY!

Protect patients…protect healthcare personnel…

promote quality healthcare!