The CDC Experience
Investment to Promote Prevention

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Prevent Infections: Where Do We Want To Be

• Every patient gets optimal care

• All healthcare providers are expected to practice infection control, use antibiotics correctly, and recognize sepsis as part of good clinical practices

• All initiatives in healthcare incorporates infection control and appropriate antibiotic use (e.g., sepsis)

• All healthcare facilities work with public health and have prevention of infections, appropriate antibiotic use, and sepsis management as part of their priorities
Healthcare-associated Infections in USA
Transparency and Accountability
Following Evidence-based Guidelines Reduces Healthcare-associated Infections Intensive Care Units in Pennsylvania, Michigan, 2005

Eliminating Healthcare-associated Infections

Moving toward Elimination of Healthcare-Associated Infections: A Call to Action

Denise Cardo, MD; Penelope H. Dennehy, MD; Paul Halverson, DrPH, MHSA, FACHE; Neil Fishman, MD; Mel Kohn, MD, MPH; Cathryn L. Murphy, RN, PhD, CIC; Richard J. Whitley, MD, FIDSA; HAI Elimination White Paper Writing Group

INTRODUCTION

Jointly, the Association for Professionals in Infection Control and Epidemiology (APIC), the Society for Healthcare Epidemiology of America (SHEA), the National Association of Counties (NACo), and the Healthcare Infection Control Practices Advisory Committee (HICPAC), an agency of the Centers for Disease Control and Prevention, recognize the need to eliminate healthcare-associated infections (HAIs). The statement of the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) in 2005 that \"HAIs are the leading cause of preventable death in the United States\" is a stark reminder of the importance of this issue. It is estimated that HAIs occur in approximately 2 million patients per year, resulting in 100,000 deaths and a cost of \$30 billion. In this white paper, we emphasize the importance of reducing HAIs through evidence-based prevention practices, aligning incentives, and innovation in research and emerging issues.

- Data for action
- Adherence to evidence-based prevention practices
- Aligning incentives
- Innovation research/emerging issues
## HHS HAI Prevention Action Plan:
**Moving towards Elimination**
### Five-year Prevention Targets in U.S. Hospitals

<table>
<thead>
<tr>
<th>Prevention metrics</th>
<th>National 5-year prevention target</th>
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<tbody>
<tr>
<td>Central line-associated blood stream infections (CDC)</td>
<td>50% reduction</td>
</tr>
<tr>
<td>Adherence to central-line insertion practices (CDC)</td>
<td>100% adherence</td>
</tr>
<tr>
<td>Surgical site infections (CDC)</td>
<td>25% reduction</td>
</tr>
<tr>
<td>Surgical care improvement project measures (CMS)</td>
<td>95% adherence</td>
</tr>
<tr>
<td>Catheter-associated urinary tract infections (CDC)</td>
<td>25% reduction</td>
</tr>
<tr>
<td><em>Clostridium difficile</em> infections (CDC)</td>
<td>30% reduction</td>
</tr>
<tr>
<td><em>Clostridium difficile</em> hospitalizations (AHRQ)</td>
<td>30% reduction</td>
</tr>
<tr>
<td>MRSA invasive infections (population) (CDC)</td>
<td>50% reduction</td>
</tr>
<tr>
<td>MRSA bacteremia (hospital) (CDC)</td>
<td>25% reduction</td>
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Baseline 2008-2010, New baseline in 2015
Centers for Disease Control and Prevention Strategy

- Prevent HAIs/AR and control transmission
- Improve antibiotic use
- Detect, respond, control, and contain

- Data for Action
  - NHSN
  - Emerging Infections Program (EIP)
  - Outbreaks

- Guidelines and Tools

- Programs & Partnerships for Implementation

- Innovation
Making Decisions: CDC Perspective

- Data driven and targeted approach
- Known preventable strategies
- Feasibility
- Shared goals with partners
- Investments
- Political willingness
- Impact in patients
Making Decision on Investments: Examples

- Central line-associated bloodstream infections
- Antibiotic resistance
  - *Clostridium difficile* infections
  - Containment of emerging resistant infections
  - Antibiotic Stewardship Programs
Goals for CDC Return on Investment (ROI) Analyses

- Provide information on economic benefit of preventing healthcare associated infections that can be used by decision makers to guide policy and investment decisions
  
  - State Government
  - Federal Government
  - Healthcare payers
  - Healthcare providers
  - Healthcare purchasers
Which Perspective For Analysis?

What is the point of view which the analysis of costs is based?

- Determines which benefits and costs should be included

Healthcare Facility Perspective

- Cost attributable to HAI = (Excess expenditure for care - Extra reimbursement from Payer)
- Cost of intervention= implementing preventive practice (e.g. CDC recommendations)

Payer Perspective

- Cost attributable to HAI= excess reimbursement attributable to HAI
- Cost of intervention=
  - Private payer=incentive payments or discounts
  - Federal payer=cost of investment in policy and public health prevention activities (e.g. CDC)

Societal perspective

- Burden must consider not only direct healthcare costs, but overall costs to society
  - For example: changes in insurance premiums, personal income lost from morbidity/mortality, larger cost to economy from loss of productivity, quality of life cost, etc.
Return on Investment: Central-line Associated Bloodstream Infections

  - Federal perspective
  - Historical analysis
    - Time period selected to highlight CDC-specific return on investment
Investments in CDC CLABSI prevention activities yielded important financial returns to the health insurance programs funded by the federal government.

HOSPITAL SAFETY

By R. Douglas Scott II, Ronda Sinkowitz-Cochran, Matthew E. Wise, James Baggs, Scott Goates, Steven L. Solomon, L. Clifford McDonald, and John A. Jernigan


ABSTRACT The prevention of central line–associated bloodstream infections in patients in hospital critical care units has been a target of efforts by the Centers for Disease Control and Prevention (CDC) since the 1960s. We developed a historical economic model to measure the net benefits of these efforts.
### Total Budget Costs and Net Cost Savings on CLABSI Prevention in Medicare and Medicaid ICU patients (1990 to 2008)

<table>
<thead>
<tr>
<th>Total Benefits of Infections Averted</th>
<th>$1,308 million ($804-$1,908 million)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Costs of Prevention</td>
<td></td>
</tr>
<tr>
<td>Federal (CDC) Budget</td>
<td>$33 million</td>
</tr>
<tr>
<td>Fixed Costs of CLABSI Infection</td>
<td>$87 million ($44-$131 million)</td>
</tr>
<tr>
<td>Control in hospital critical care</td>
<td></td>
</tr>
<tr>
<td>units</td>
<td></td>
</tr>
<tr>
<td>Total Budget Cost</td>
<td>$120 million ($77-$164 million)</td>
</tr>
<tr>
<td>Net Cost Savings</td>
<td>$1,188 million ($640-$1,831 million)</td>
</tr>
<tr>
<td>(total benefits – total costs)</td>
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HAI Progress:
Central Line-associated Bloodstream Infections (CLABSI)

Trends in central line-associated bloodstream infections in hospitals, 2009-2015
Source: CDC’s National Healthcare Safety Network (NHSN)
Prevention of CLABSI U.S. Hospitals

Progress varies by:
- State
- Type of hospital unit (e.g., ICUs, Neonatal ICU, Wards)
- Pathogen

- Targeted prevention approach
  - Partnerships to focus on hospitals with lower performance (NHSN TAP- Targeted Assessment for Prevention)

- Identify new interventions to prevent infections
Antibiotic Resistance
Old Challenge, New Opportunity

ANTIBIOTIC RESISTANCE THREATS IN THE UNITED STATES, 2013

Executive Summary

Antibiotic Resistance Threats in the United States, 2013 is a snapshot of the complex problem of antibiotic resistance today and the potentially catastrophic consequences of inaction. The overriding purpose of this report is to increase awareness of the threat that antibiotic resistance poses and to encourage immediate action to address the threat. This document can serve as a reference for anyone looking for information about antibiotic resistance. It is specifically designed to be accessible to many audiences. For more technical information, references and links are provided.
Projected burden of healthcare-associated invasive MRSA, healthcare-associated *Clostridium difficile* Infections, healthcare-associated CRE, and hospital-onset MDR *Pseudomonas* infections

Over 5 years prevention results in:
- 619,000 MDR-infections averted
- 37,000 MDR-infection attributable deaths averted
- $7.7B in medical costs saved
Projected Prevalence of CRE Based on Modeling

**Conclusion**: Coordinated prevention approaches assisted by public health agencies have the potential to more completely address emergence and dissemination of MDROS and in comparison to independent facility based efforts.
Understanding Epidemiology of CDI Infections in the United States

CDI

8% Community-onset with no healthcare exposures
22% Hospital-onset
33% Community-onset with recent outpatient exposures
41% Community-Associated
59% Healthcare-Associated
20% Community-onset with recent inpatient exposures
1% LTACH-onset
17% Nursing home-onset

Source: 2014 EIP data

Connectedness of Healthcare Facilities, Washington and Oregon
**Clostridium difficile Infections: Return on Investment**

- Using Mathematical Modeling to Predict the Future Economic Benefit of Investment in Prevention *Clostridium difficile* infection (CDI) in US Hospitals

  - **Objectives**
    - Quantify the economic value from the federal perspective CDC investment in CDI prevention
      - Includes the potential CDI prevention benefit of participation in National Healthcare Safety Networks Antimicrobial Use module and using those data to support antimicrobial stewardship activities

R Layton, ICHE 2015; 36:681-687
Number of *Clostridium difficile* Infections (CDI) and Deaths Averted: Cohort of >65 year olds

<table>
<thead>
<tr>
<th>Intervention Effectiveness</th>
<th>10%</th>
<th>25%</th>
<th>50%</th>
<th>75%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cohort of 1,000 hospitalized Medicare beneficiaries ≥65 years old</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total CDI infections averted over 5 years</td>
<td>7.36</td>
<td>18.59</td>
<td>36.94</td>
<td>56.06</td>
</tr>
<tr>
<td>Total CDI-attributed deaths averted over 5 years</td>
<td>1.20</td>
<td>2.93</td>
<td>5.91</td>
<td>8.97</td>
</tr>
<tr>
<td>Among all hospitalized Medicare beneficiaries ≥65 years old</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total CDI infections averted over 5 years</td>
<td>101,000</td>
<td>257,000</td>
<td>509,000</td>
<td>773,000</td>
</tr>
<tr>
<td>Total CDI-attributed deaths averted over 5 years</td>
<td>16,000</td>
<td>41,000</td>
<td>82,000</td>
<td>124,000</td>
</tr>
</tbody>
</table>

R Layton, ICHE 2015; 36:681-687
Potential Economic Benefit of *Clostridium difficile* Prevention over 5 years

(includes direct medical costs and monetization of mortality using value of statistical life)

<table>
<thead>
<tr>
<th></th>
<th>Payer Perspective (excess CMS reimbursement averted)</th>
<th>Deaths averted</th>
<th>Societal Perspective (accounting for monetization of mortality)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potential Savings</td>
<td>$2.5 Billion</td>
<td>82,000</td>
<td>$689 Billion</td>
</tr>
</tbody>
</table>

- **Issues**
  - Should value of statistical life be adjusted for age given that persons who get HAI tend to be older and have co-morbidities?
    - Value of statistical life year
    - Quality adjusted life year

- **State perspective**
Antibiotic Resistance: Containment Strategy

- Systematic approach to slow spread of novel or rare multidrug-resistant organisms or mechanisms through aggressive response to ≥1 case of targeted organisms
  - Carbapenemase-producing organisms, \textit{mcr-1}
  - Pan-resistant organisms
  - \textit{Candida auris}

- Emphasis on settings that historically are linked to amplification
  - Long term care facilities (e.g., skilled nursing)
  - Long term acute care facilities and high acuity skilled nursing (e.g., vSNF)
Why We Need a Containment Strategy

KPC, the first type of CRE found in the U.S., spread from 2 states in 2001 to 45 states, DC, and Puerto Rico in 13 years.

States with Klebsiella pneumoniae carbapenemase (KPC)-producing Carbapenem-resistant Enterobacteriaceae (CRE) confirmed by CDC
Modeling of Containment Strategy for Emerging Resistance
Prevention of *C. difficile*, MRSA, and other MDROs:

- **Traditional approach**
  - Promotion of prevention efforts independently implemented by individual health care facilities
  - Does not account for inter-facility spread through movement of colonized/infected

- **Regional Approach**
  - Recognizes that individual facilities are components of integrated and dynamic networks connected via patient movement
    - Occurrences in one healthcare facility may affect many other healthcare facilities

- All state health departments are being funded by CDC to prevent healthcare associated infections and antibiotic resistance (including state labs)

- **Prevention & Stewardship:** In 27 states and 4 cities, CDC is aggressively expanding CRE, *C. difficile*, and other MDRO prevention and antibiotic stewardship programs
Build and Expand HAI Prevention Success: AR Solutions Initiative Continues Focus on Patients

Policies – Programs – Practices
Antibiotic stewardship ensures that all patients receive antibiotics when needed, receive the right antibiotic, at the right dose, at the right time, and for the right duration.

Antibiotic stewardship interventions have been proven to improve individual patient outcomes, reduce the overall burden of antibiotic resistance, save healthcare dollars, and ultimately save lives.
Antibiotic Stewardship Programs in Hospitals

- In 2014, CDC called on all hospitals to implement an antibiotic stewardship program.
- Created the “Core Elements” to outline structures and functions associated with effective programs.
  - Core Elements adopted by The Joint Commission and other groups for their antibiotic stewardship standard.
- Worked with The National Quality Forum to develop a practical implementation “playbook”
- Assessing implementation through the annual NHSN hospital survey.
- Supporting state implementation- e.g. MO stewardship mandate
Percent of US Hospitals Reporting Implementation of All CDC Core Elements on Annual NHSN Survey

![Chart showing the percent of US hospitals reporting implementation of all CDC core elements on annual NHSN survey from 2014 to 2016, categorized by bed size and type. The data indicates an increase in reporting for both 51-200 beds and >200 beds categories, with a peak in 2016.]
## National Action Plan to Prevent Healthcare-Associated Infections Progress and Targets for 2020

<table>
<thead>
<tr>
<th>Measure</th>
<th>Data Source</th>
<th>Baseline Years</th>
<th>2013 Target</th>
<th>Progress By 2014</th>
<th>Targets for 2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduce central-line associated bloodstream infections (CLABSI) in ICU and ward-located patients</td>
<td>CDC/NHSN</td>
<td>2006-2008</td>
<td>50% reduction or .50 SIR</td>
<td>50% reduction or .50 SIR</td>
<td>50% reduction from 2015 baseline</td>
</tr>
<tr>
<td>Reduce catheter-associated urinary tract infections (CAUTI) in ICU and ward-located patients</td>
<td>CDC/NHSN</td>
<td>2009</td>
<td>25% reduction or .75 SIR</td>
<td>no change</td>
<td>25% reduction from 2015 baseline</td>
</tr>
<tr>
<td>Reduce the incidence of invasive healthcare-associated methicillin-resistant Staphylococcus aureus (MRSA) infections</td>
<td>CDC/EIP/ABC</td>
<td>2007-2008</td>
<td>50% reduction</td>
<td>36% reduction</td>
<td>50% reduction from 2015 baseline</td>
</tr>
<tr>
<td>Reduce facility-onset methicillin-resistant Staphylococcus aureus (MRSA) in facility-wide healthcare</td>
<td>CDC/NHSN</td>
<td>2010-2011</td>
<td>25% reduction or .75 SIR</td>
<td>13% reduction or .87 SIR</td>
<td>50% reduction from 2015 baseline</td>
</tr>
<tr>
<td>Reduce facility-onset Clostridium difficile infections in facility-wide healthcare</td>
<td>CDC/NHSN</td>
<td>2010-2011</td>
<td>30% reduction or .70 SIR</td>
<td>8% reduction or .92 SIR</td>
<td>30% reduction from 2015 baseline</td>
</tr>
<tr>
<td>Reduce the rate of Clostridium difficile hospitalizations</td>
<td>AHRQ/HCUP</td>
<td>2008</td>
<td>30% reduction</td>
<td>18% increase</td>
<td>30% reduction from 2015 baseline</td>
</tr>
<tr>
<td>Reduce Surgical Site Infection (SSI) admission and readmission</td>
<td>CDC/NHSN</td>
<td>2006-2008</td>
<td>25% reduction or .75 SIR</td>
<td>18% reduction or .82 SIR (2012)</td>
<td>30% reduction from 2015 baseline</td>
</tr>
</tbody>
</table>

**Abbreviations:**
- CDC/NHSN: Centers for Disease Control and Prevention’s National Healthcare Safety Network
- CDC/EIP/ABC: Centers for Disease Control and Prevention’s Emerging Infections Program Network Active Bacterial Core Surveillance
- AHRQ/HCUP: Agency for Healthcare Research and Quality Healthcare Cost and Utilization Project

**SIR** – Standardized Infection Ratio: method for measuring progress in HAI reduction. The SIR compares the actual number of healthcare-associated infections to the predicted number of infections. The predicted number of infections is a risk-adjusted estimate that is determined using national baseline data.
Moving towards HAI Elimination

- **Prevented**
- **Preventable**
- **Prevention approach unknown**

**HAI/AR**

Enhance adherence to prevention practices
National and state prevention goals

Research innovation for new strategies to:
- Patient-level interventions
- Healthcare facility interventions
- Regional interventions
CDC Point Prevalence Survey in Acute Care Hospitals, 2011
Healthcare-associated Infections Distribution

- **SSI**, 110 (22%)
- **PNEU**, 110 (22%)
- **VAP**, 43 (39% of PNEU)
- **Other**, 83 (16%)
- **UTI**, 65 (13%)
- **GI**, 86 (17%)
- **CLABSI**, 42 (84% of BSI)
- **CAUTI**, 44 (68% of UTI)

Critical care locations 34%
Wards and other non-ICU locations 66%
Conclusions

- Aggressive but achievable goals – data-driven and targeted approaches
  - Decisions are made on what we learn from data - Opportunities and gaps to increase prevention

- Several data sources are being used to assess best ways to be effective in the prevention of device- and procedure-related infections as well as of MDRO transmission across healthcare

- Additional and Innovated ways on how to analyze the information – modeling, economics...

- How to address the unknowns?

- The focus is always the patient
Thinking Holistically to Protect Patients

Prevent Infections
- Implement current recommendations
- Innovation

Early Detection
- Faster diagnostic tools
- Sepsis

Appropriate Treatment
- Antibiotic Stewardship

Emerging Resistant Bacteria
Inter-facility Transmission

Protecting Across the Patient Care Spectrum
Prevention is our Goal and Responsibility

Act to protect patients Now and Always