



American Recovery and Reinvestment Act
Epidemiology and Laboratory Capacity (ELC)
for Infectious Disease Program
Healthcare-Associated Infections (HAIs)
Grantee Meeting

CDR Arjun Srinivasan, MD

October 19-20, 2009



Healthcare-associated Infections (HAIs)

- ❑ Definition: Infections that patients acquire during the course of receiving treatment for other conditions within a healthcare setting
- Settings: hospitals (Intensive Care Units, Special Care Units, other hospital settings), long-term care facilities (LTCFs), outpatient facilities such as ambulatory surgical clinics, dialysis centers



HAI Burden

What is known: Acute Care Settings

- 1.7 million HAIs (5% of all admissions)
- \$26-33 billion in excess costs
- 99,000 associated deaths.
- Most common infections are:
 - bloodstream infections
 - urinary tract infections
 - pneumonia
 - surgical site infections



Estimated Annual Hospital Cost of HAI by Site of Infection



| Major Site of Infection | Total infections | Hospital Cost per Infection (2002 \$) | Total annual hospital cost (in millions \$) | Deaths Per year |
|---|------------------|---------------------------------------|---|-----------------|
| Surgical Site Infection | 290,485 | \$25,546 | 7,421 | 13,088 |
| Central line associated-Bloodstream Infection | 248,678 | \$36,441 | 9,062 | 30,665 |
| Ventilator-associated Pneumonia | 250,205 | \$9,969 | 2,494 | 35,967 |
| Catheter associated-Urinary Tract Infection | 561,667 | \$1,006 | 565 | 8,205 |

Stone PW, et al. *Am J Infect Control* 2005;33:501-9.

Roberts RR, et al. *Clin Infect Dis* 2003;36:1424-32.





Emerging Threats in Healthcare



The NEW ENGLAND
JOURNAL of Medicine

ESTABLISHED IN 1812

DECEMBER 8, 2009



An Epidemic, Toxin Gene-Variant S

L. Clifford McDonald, M.D., George E. Killgore, Dr.
Robert C. Owens, Jr., Pharm.D., Sophia V. Kazakova, M.D.
Stuart Johnson, M.D., and Dale N

Guidance f
Carbapene

JAMA®

Online article and related content
current as of September 25, 2009.

An Outbreak of
baumannii As
Treatment

Lisa L. Maragakis; S

JAMA. 2004;292(24):3006-3011 (doi:10.1001/jama.292.24.3006)

<http://jama.ama-assn.org/cgi/content/full/292/24/3006>

ORIGINAL CONTRIBUTION

JAMA®

The Journal of the American Medical Association

Invasive Methicillin-Resistant *Staphylococcus aureus* Infections in the United States

R. Monina Klevens, DDS, MPH

Melina A. Morrison, MPH

Joelle Nadle, MPH

Susan Petit, MPH

Ken Cershman, MD, MPH

Susan Ray, MD

Lee H. Harrison, MD

Ruth Lynfield, MD

Chinwa Dumyati, MD

Context As the epidemiology of infections with methicillin-resistant *Staphylococcus aureus* (MRSA) changes, accurate information on the scope and magnitude of MRSA infections in the US population is needed.

Objectives To describe the incidence and distribution of invasive MRSA disease in 9 US communities and to estimate the burden of invasive MRSA infections in the United States in 2005.

Design and Setting Active, population-based surveillance for invasive MRSA in 9 sites participating in the Active Bacterial Core surveillance (ABCs)/Emerging Infections Program Network from July 2004 through December 2005. Reports of MRSA were investigated and classified as either health care-associated (either hospital-onset or community-onset) or community-associated (patients without established health care exposure).



Emerging Threats in Healthcare

Estimate of *Clostridium difficile* Cases, by Setting

Hospital-acquired, hospital-onset cases:

- 165,000, \$1.3 billion in excess costs, and 9,000 deaths annually

Hospital-acquired, post-discharge (up to 4 weeks)

- 50,000, \$0.3 billion in excess costs, and 3,000 deaths annually

➤ Nursing home-onset cases

- 263,000, \$2.2 billion in excess costs, and 16,500 deaths annually

Campbell RJ Infect Control Hosp Epidemiol. 2009

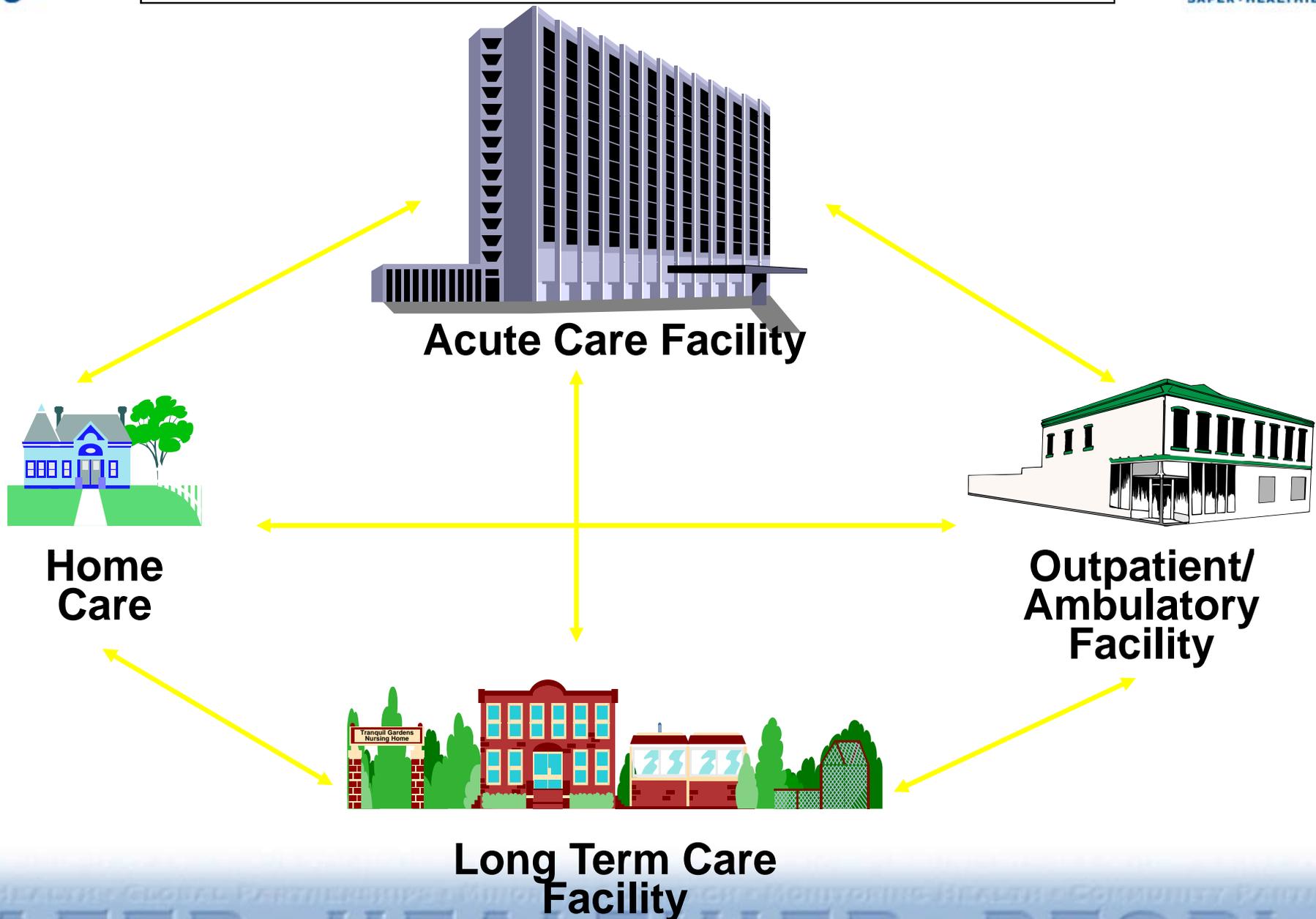
Dubberke, Emerg Infect Dis. 2008

Dubberke, Clin Infect Dis. 2008

Elixhauser, et al. HCUP Statistical Brief #50. 2008



The Healthcare System— More than Just Hospitals





HAI Burden Outside of Acute Care

- We know much less about this.
- We are learning more.
- What we are learning indicates that HAIs are a significant problem outside of acute care settings.



Growth of Outpatient Medicine

- Between 1990-2000, number of Ambulatory Surgical Centers (ASCs) in the US has more than doubled and number of procedures done in ASCs more than tripled:
 - 5000 ASCs
 - 6 million procedures



THE REVIEW JOURNAL

www.reviewjournal.com

50 CENTS ONE DOLLAR NEVADA'S LARGEST NEWSPAPER **** MARCH 14, 2008

Lawyers: 100 fear infection

Health official: By ANNETTE WILLS and BRIAN RAYNES **PUBLIC HEALTH CRISIS** sent about 25 such clients. Most of the positive tests were officials say, at least six people contracted hepatitis C because

Re-use of syringes resulted in multiple Hepatitis C infections and notification of 40,000 people to get tested





Viral Hepatitis Outbreaks in Outpatient Care Settings



| State | Setting | Year | Type | Cases |
|-------|-------------------------------|------|---------|-------|
| NY | Endoscopy clinic | 2001 | HCV | 19 |
| NY | Private MD office | 2001 | HBV | 38 |
| NE | Oncology clinic | 2002 | HCV | 99 |
| OK | Pain remediation clinic | 2002 | HBV+HCV | 102 |
| NY | Endoscopy clinic | 2002 | HCV | 4 |
| CA | Pain remediation clinic | 2003 | HCV | 4 |
| MD | Nuclear imaging | 2004 | HCV | 16 |
| FL | Chelation therapy | 2005 | HBV | 7 |
| CA | Alternative medicine infusion | 2005 | HCV | 7 |
| NY | Endoscopy/surgery clinics | 2006 | HCV | 6 |
| NY | Anesthesiologist office | 2007 | HCV | 3 |
| NV | Endoscopy clinic | 2008 | HCV | 6 |
| NC | Cardiology clinic | 2008 | HCV | 7 |



Infection Control in Outpatient Settings

- Infection control infrastructure and oversight has long been sub-optimal.
- Approximately half ambulatory surgical centers surveyed by CMS and CDC had condition-level, i.e. serious, noncompliance with the Medicare ASC health and safety standards
 - 28% had breaches in safe injection practices



HAI Burden in Hemodialysis: MRSA BSI



| Population | Incidence per 100,000 | | Percent Change (Modeled) | <i>P-value</i> |
|---|--------------------------|------|--------------------------------|----------------|
| | 2005 | 2007 | | |
| Hospital-onset | 8.8 | 7.1 | -21.0% | <0.01 |
| Healthcare- associated community- onset* | 14.0 | 12.1 | -16.9% | 0.01 |
| Dialysis | 6000 | 5500 | -7.2% | 0.65 |



HAIs in Long Term Care



□ Long-term care

- **1.7 million beds with 2.5 million residents/year (2004)¹**
- **1/3 of long-term care residents affected by respiratory disease outbreaks (Canada)²**
- **Veterans Healthcare System³**
 - **133 nursing homes, 11,475 residents**
 - **HAI prevalence: 5.2%**
 - **Indwelling medical device: 25% of all residents**

¹ NCHS, 2009

²Loeb, CMAJ, 2006

³Tsan, AJIC, 2008



State of prevention knowledge/science

- Evidence-based prevention recommendations- CDC and others
 - for all major device and procedure associated HAIs (CLABSI, VAP, CAUTI, SSI)
 - to prevent pathogen transmission (e.g. MRSA, *C. difficile*)
- Suboptimal adherence to key prevention recommendations



Current State of Affairs



- Hand hygiene compliance for HCP is consistently around 40-50%.
- Compliance with timing of surgical prophylaxis was ~40% in SCIP data from 2005.
- Many facilities have yet to implement proven BSI prevention measures.
- Very few facilities have implemented proven UTI prevention measures.



What's been missing in the past to promote HAI prevention?

- Robust data on HAI prevention
- Focused attention on HAI prevention from policymakers
- Incentives/disincentives to promote systems change for HAI prevention that can be sustained
- Framework to extend local/regional successes to the nation



Preventability of Infections

- Study on the Efficacy of Nosocomial Infection Control (SENIC): Effective infection control programs were associated with 32% reduction of infections
 - Surveillance
 - Infection control
 - 1 infection control professional for every 250 beds
- 2003: 20-70% of infections are preventable

J Hosp Infection 2003;54:258



Estimates of preventable infections, deaths, and costs based on existing published literature

| Infection type | Preventable fraction | Preventable infections (thousands) | Preventable deaths (thousands) | Cost avoided (millions of 2009 dollars) |
|----------------|----------------------|------------------------------------|--------------------------------|---|
| CABSI | 18%–66% | 45-164 | 6-20 | \$960-\$18,200 |
| VAP | 38%–55% | 95–138 | 14–20 | \$2,200-3,300 |
| CAUTI | 17%–69% | 95–388 | 2–9 | \$115-\$1,820 |
| SSI | 26%–54% | 75–157 | 2–4 | \$166-\$345 |



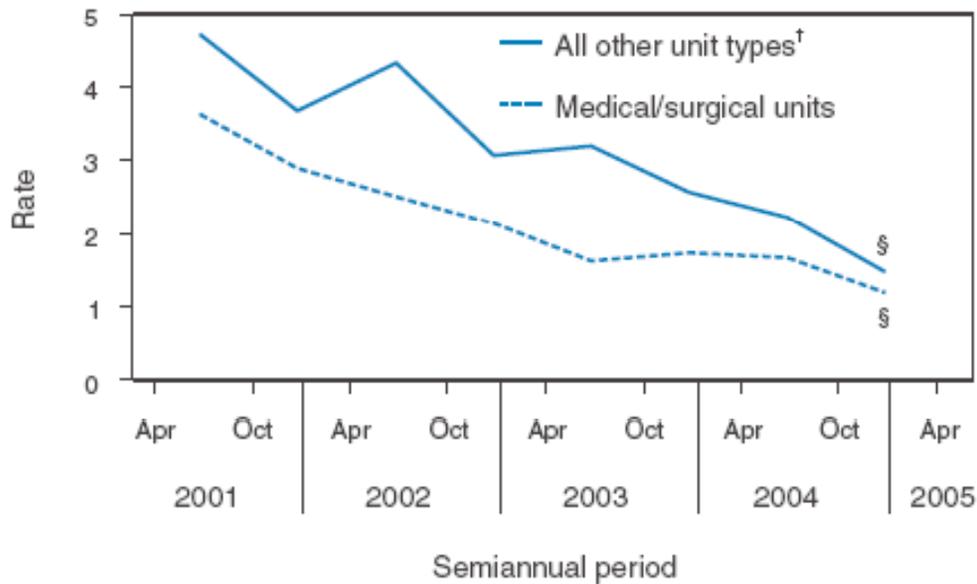


Regional Prevention Collaboratives

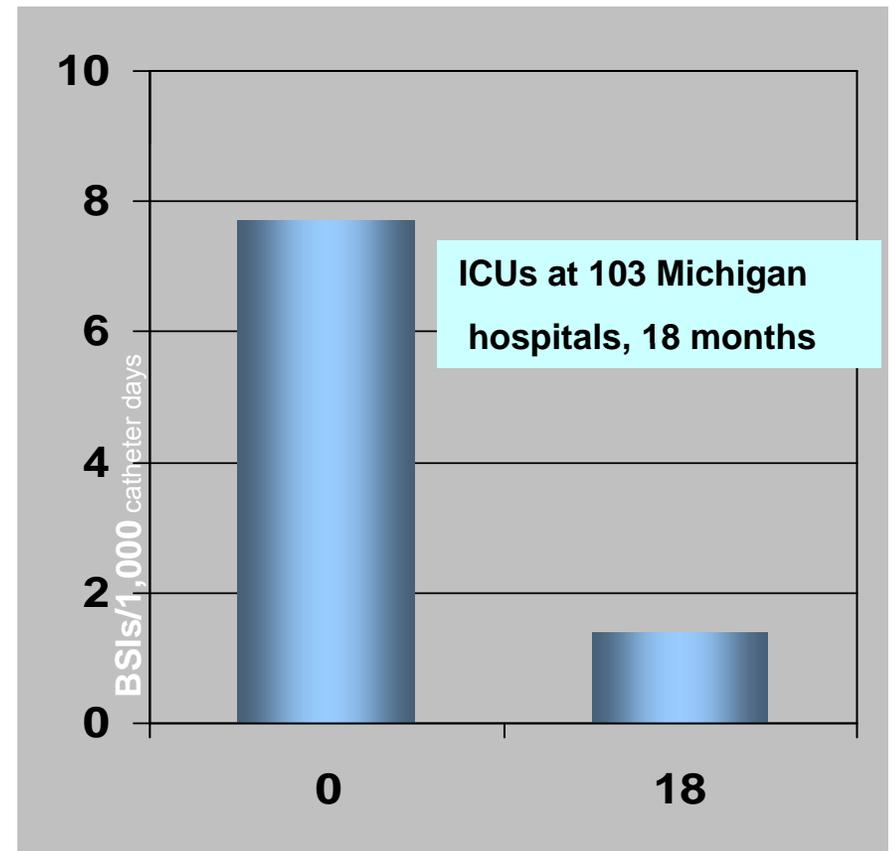
Examples of Success: Pennsylvania, Michigan



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



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

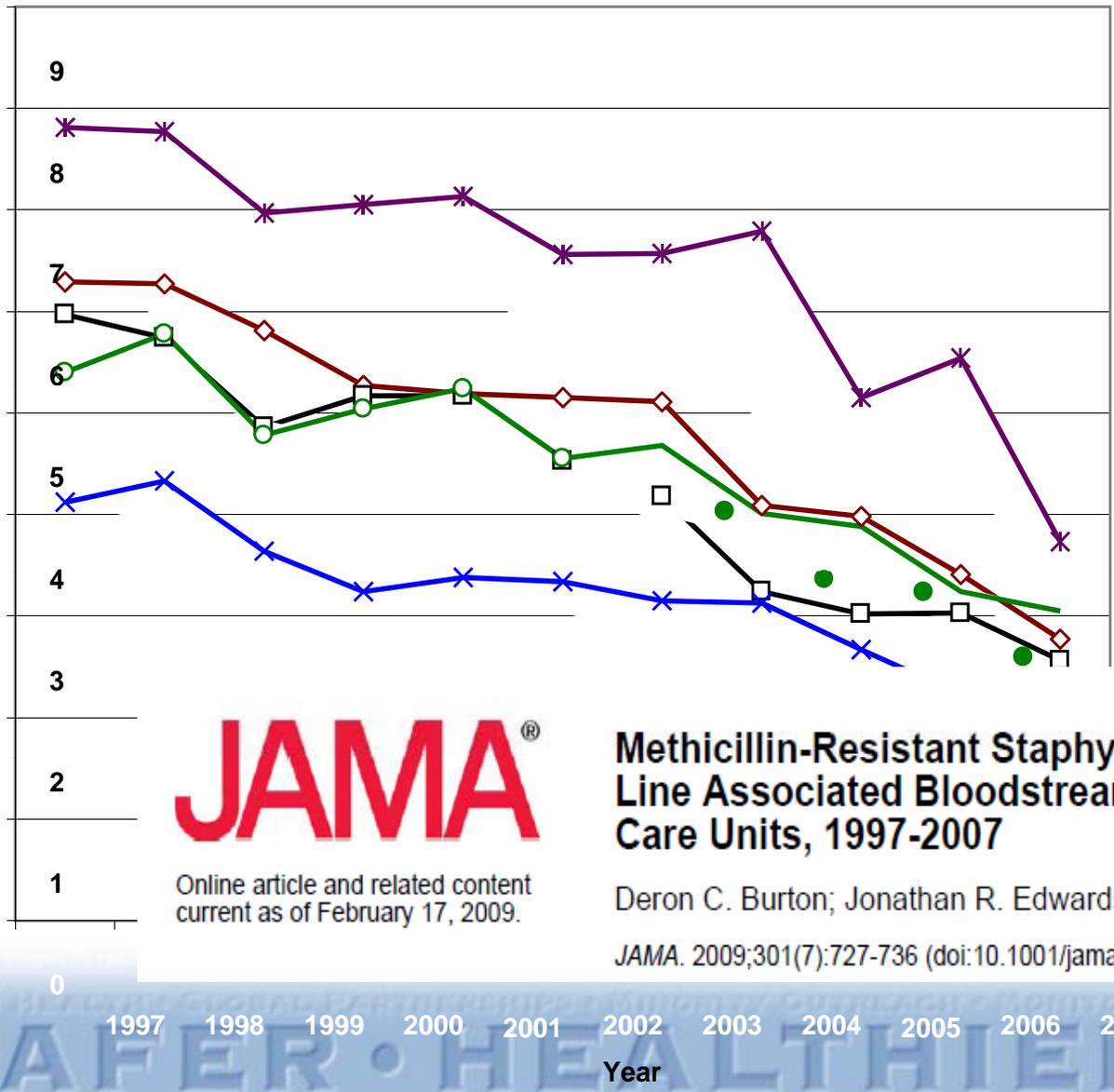


Pronovost P. New Engl J Med 2006;355:2725-32.

MMWR 2005;54:1013-16



Trends in MRSA Bloodstream Infections by ICU Type, NHSN hospitals, 1997-2007



- estimated 7000 BSIs prevented
- 1800 lives saved
- \$50-180 M in costs averted annually

JAMA®

Online article and related content current as of February 17, 2009.

Methicillin-Resistant Staphylococcus aureus Central Line Associated Bloodstream Infections in US Intensive Care Units, 1997-2007

Deron C. Burton; Jonathan R. Edwards; Teresa C. Horan; et al.

JAMA. 2009;301(7):727-736 (doi:10.1001/jama.2009.153)



SPECIAL ARTICLE

A Surgical Safety Checklist to Reduce Morbidity
and Mortality in a Global Population

- Significant reductions in:
- SSIs
- Unplanned returned to OR
- Death
- All complications



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Federal Movement on HAI Prevention

- CMS
 - Reduced payment for hospital-acquired conditions (HACs) including HAIs
 - Pay for reporting/performance
- FY 2009 Omnibus spending bill- requires states to develop HAI prevention plans
- ARRA- money to states for HAI prevention
- HHS Action Plan on HAIs

News Release

FOR IMMEDIATE RELEASE
Tuesday, January 6, 2009

Contact: OPHS Press Office
(202) 205-0143

HHS Issues Action Plan to Prevent Health Care-Associated Infections

The U.S. Department of Health and Human Services (HHS) unveiled a plan that establishes a set of five-year national prevention targets to reduce and possibly eliminate health care-associated infections (HAIs).

Health care-associated infections are infections that patients acquire while undergoing medical treatment or surgical procedures. These infections are largely preventable.

The Action Plan to Prevent Health Care-Associated Infections lists a number of areas in which HAIs can be prevented, such as surgical site infections. The plan also outlines cross-agency efforts to save lives and reduce health care costs through expanded HAI prevention efforts.

"This plan will serve as a public health and patient safety issue," HHS Secretary Berenson said. "This collaborative interagency plan will help the nation build a safer, more affordable health care system."

The plan establishes a research agenda, including development of new prevention practices, a coordinated national messaging plan, and a national research agenda.

The plan also identifies key areas for research and development.

HHS intends to update the plan, and instruct the Centers for Disease Control and Prevention (CDC) to lead the effort.

The Department addresses this important public health and patient safety issue through this collaborative interagency plan.

The plan includes actions for enhancing and coordinating HHS-supported efforts, such as prioritized recommended clinical practices, a coordinated national messaging plan, and a national research agenda.

The plan will be implemented in coordination with national, state, tribal and local organizations.

The plan is based on public input and new recommendations for infection prevention. The plan, can be found online at <http://www.hhs.gov/ophs>.

United States Government Accountability Office

GAO
Testimony
Before the Committee on Oversight and Government Reform, House of Representatives

For Release on Delivery Expected at 11:00 a.m. EDT Wednesday, April 15, 2008

HEALTH-CARE-ASSOCIATED INFECTIONS IN HOSPITALS

Leadership Needed from HHS to Prioritize Prevention Practices and Improve Data on These Infections

Statement of Cynthia A. Bascetta
Director, Health Care



GAO-08-673T



HHS Steering Committee for the Prevention of Healthcare-associated Infections

- Charge: Develop an Action Plan to reduce, prevent, and ultimately eliminate HAIs
- Plan will:
 - Establish national goals for reducing HAIs
 - Include short- and long-term benchmarks
 - Outline opportunities for collaboration with external stakeholders
 - Coordinate and leverage HHS resources to accelerate and maximize impact



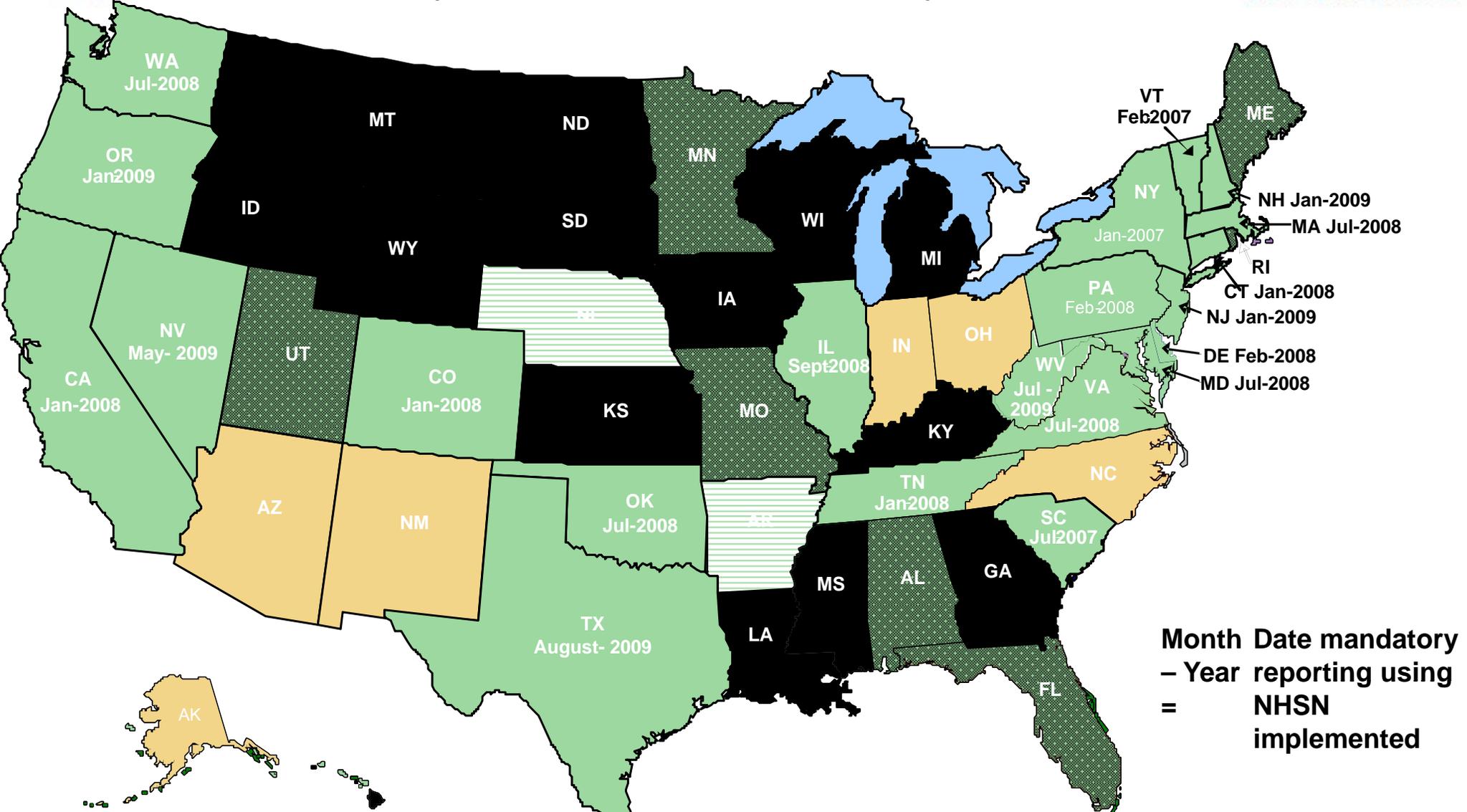
HHS Action Plan for HAI Prevention: National Metrics

| HAI Comparison Metric | Measurement System | National Baseline | National 5-Year Prevention Target | Coordinator |
|--------------------------|--------------------|-------------------|---|-------------|
| CLABSI SIR | NHSN | 2006-2008 | 50% reduction | CDC |
| CLIP Adherence | NHSN | 2009 | 100% adherence with central line bundle | CDC |
| C. Diff Hospitalizations | Admin data | 2008 | 30% reduction | CDC/AHRQ |
| <i>C. difficile</i> SIR | NHSN | 2009-2010 | 30% reduction | CDC |
| CAUTI SIR | NHSN | 2009 | 25% reduction | CDC |
| MRSA | CDC EIPs | 2007-2008 | 50% reduction | CDC |
| MRSA bacteremia SIR | NHSN | 2009-2010 | 25% reduction | CDC |
| SSI SIR | NHSN | 2006-2008 | 25% reduction | CDC |
| SCIP Measures | CMS SCIP | To be determined | 95% adherence | CMS |

SIR = standardized infection ratio



State Legislative Activity for HAIs (as of October 6, 2009)



Month Date mandatory
 – Year reporting using
 = NHSN
 implemented

- Mandates public reporting using NHSN
- States with no legislation
- Mandates public reporting of infection rates
- States with study laws
- Mandates reporting only to state government
- Mandatory data collection, Voluntary reporting

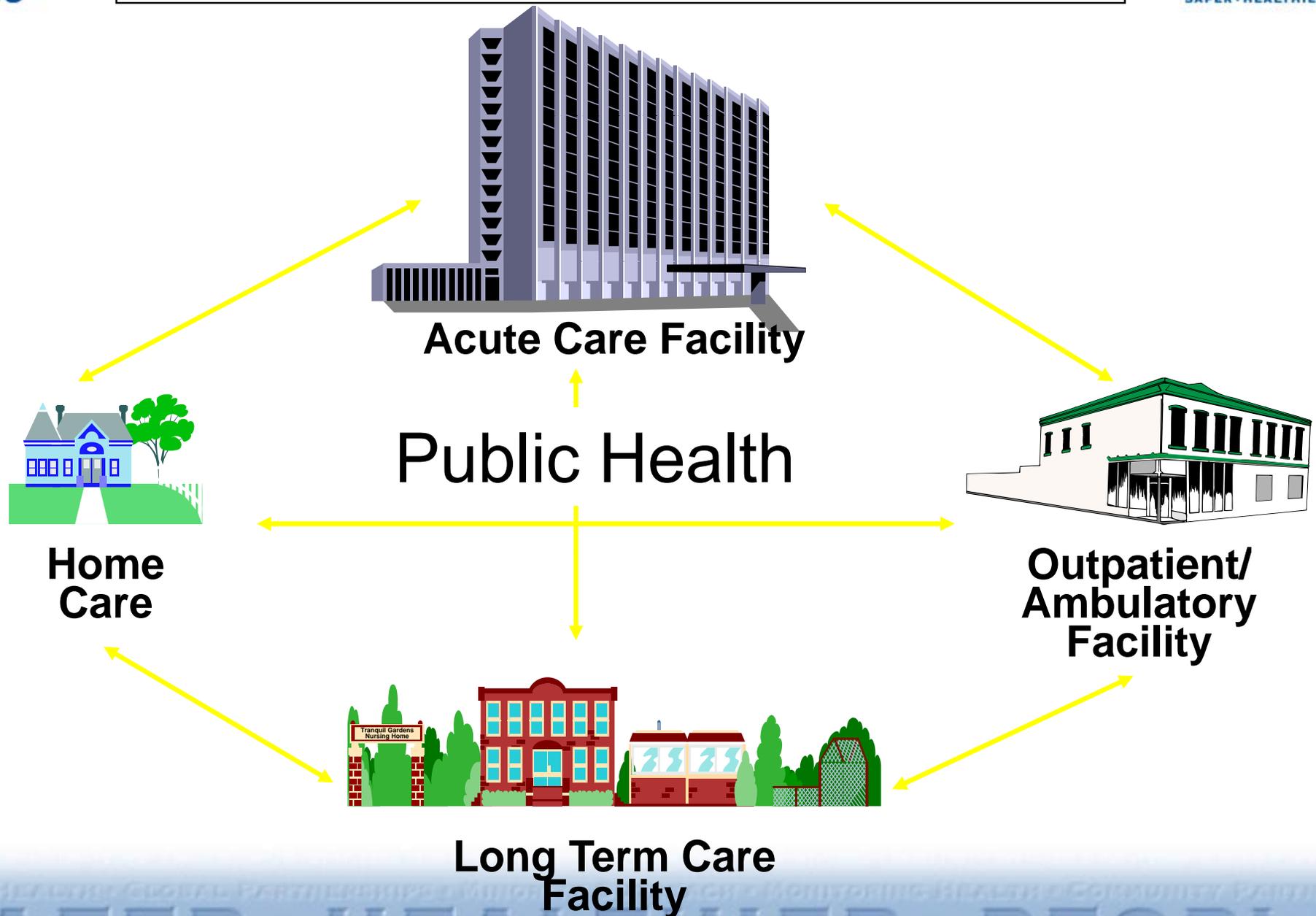


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The Healthcare System— in need of a population approach





A New Paradigm

- Historically, public health has not been viewed as a key partner in preventing HAIs.
- That has begun to change, and it is our hope that ARRA will help further this paradigm shift.



State Activity on HAI Prevention

NEW YORK STATE

Department of Health
Information for a Healthy New York

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New York State Department of Health Funds Projects to Reduce Hospital-Acquired Infections

ALBANY, N.Y. (May 9, 2008) – Seven non-profit health organizations will share in more than \$1.2 million in funding for demonstration projects that focus on the prevention of infections acquired in hospitals, the state Department of Health announced today.

"Hospital-acquired infections are a major public health problem in the United States, affecting 5 to 10 percent of hospitalized patients nationally each year," said state Health Commissioner Richard F. Daines, M.D. "More than 1.7 million infections are estimated to be contracted in U.S. hospitals each year, responsible for 99,000 reported deaths."

"We are committed to the prevention and reduction of infections acquired in hospitals across the state," said Commissioner Daines. "Each of these projects involves multiple healthcare facilities collaborating to increase patient safety, and ultimately to the reduction of

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Methicillin-Resistant *Staphylococcus aureus* (MRSA) Infections

**Progress Report and Recommendations of the
Tennessee Department of Health and the Infections Taskforce
January 2008**





Using ARRA to Further the Paradigm Shift

- ARRA funds will allow states to develop infrastructure and expertise dedicated to HAI prevention.
- ARRA funds will help facilities realize that health departments want to play a central role in HAI prevention.



A New Model For Prevention- Prevention Collaboratives



- Experience is showing that multi-facility collaborative projects are the gold standard in HAI prevention.
- There are many “change methods” that have demonstrated success:
 - Comprehensive Unit-based Patient Safety Program (CUSP)
 - Positive deviance
 - Six-sigma



Strengths of a Collaborative

- Opportunities to share experiences on what works and does not.
- Ability to get advice from others who are working on the same project.
- Peer pressure is also a motivator.



Common Elements for Successful Infection Prevention

- Simple
- Patient-centered, integrated with care
- Evidence-based recommendations
- Part of a “package” for prevention
- Engaging and empowering clinicians
- Protocols and systems in place
- Standardized ways for recording information about infections (e.g., NHSN)
- Regular feed-back of information to providers
- Changing to a pro-safety culture
- Leadership support

Sources: Muto et al, MMWR, Oct 14 2005; Pronovost et al, NEJM 2006



Using HAI Data to Drive Prevention

- Ultimately, the goal of collecting HAI data is to drive prevention efforts.
- HAI data can help identify:
 - Types of HAIs where attention is needed
 - Specific facilities where more prevention work might be needed
 - Specific units within facilities where more prevention work might be needed



Challenges with Using HAI Data

- We often want to look at some aggregate measures of HAIs across multiple settings to get a big picture sense of prevention efforts.
- But, it's not really valid to aggregate data from many different unit types where the risks of infections may be very different.



BSI Rates- 2008 NHSN Report

612 Vol. 36 No. 9

Edwards et al AJIC

Table 3. Pooled means and key percentiles of the distribution of central line-associated BSI rates and central line utilization ratios, by type of location, DA module, 2006 through 2007

| Type of location | Central line-associated BSI rate* | | | | Percentile | | | | |
|----------------------------------|-----------------------------------|---------------|-------------------|-------------|------------|-----|--------------|-----|------|
| | No. of locations | No. of CLABSI | Central line-days | Pooled mean | 10% | 25% | 50% (median) | 75% | 90% |
| Critical care units | | | | | | | | | |
| Burn | 22 | 239 | 42,452 | 5.6 | 0.0 | 1.5 | 3.8 | 8.2 | 13.5 |
| Coronary | 121 | 373 | 181,079 | 2.1 | 0.0 | 0.0 | 1.3 | 2.8 | 5.3 |
| Surgical cardiothoracic | 97 | 397 | 275,194 | 1.4 | 0.0 | 0.0 | 1.2 | 1.9 | 3.4 |
| Medical | 144 | 1073 | 454,839 | 2.4 | 0.0 | 0.6 | 1.9 | 3.6 | 5.3 |
| Medical/surgical, major teaching | 104 | 692 | 342,214 | 2.0 | 0.0 | 0.5 | 1.5 | 3.0 | 4.2 |
| Medical/surgical, all others | 343 | 972 | 662,489 | 1.5 | 0.0 | 0.0 | 0.6 | 2.0 | 3.6 |
| Medical/surgical, major teaching | | 672 | 372,217 | 2.0 | | | | | |
| Medical/surgical, all others | | 972 | 662,489 | 1.5 | | | | | |

Edwards JR et al. Am J Infect Control 2008;36:609-26.





Aggregate Comparisons



- To get the high-level view, it would be ideal to find a way to aggregate data from all different unit types to yield a single number.
- The Standardized Infection Ratio (SIR) is a way to do just that.



Standardized Infection Ratio?

- Standardized Infection Ratio, SIR, is a summary measure used to compare the HAI experience among one or more groups of patients to that of a standard population's
- Indirect standardization method
- Accounts for differences in risk of HAI among the groups



Calculating an SIR

$$\text{SIR} = \frac{\text{Observed (O) HAIs}}{\text{Expected (E) HAIs}}$$

- To calculate O, sum the number of HAIs among a group
- To calculate E, requires the use of the appropriate aggregate data (risk-adjusted rates)



Potential Applications for the SIR

- Can provide public health policy makers (and others) with an overview of HAI rates across several units or facilities.
- Is a measure with some “built-in” risk adjustment.
- Might be useful in helping direct us to facilities with particular problems.



Using the SIR to Direct Prevention Interventions

| Facility | Facility SIR for CLABSI |
|----------|-------------------------|
| A | 2.0 |
| B | 1.2 |
| C | 0.75 |



Limitations of the SIR

- Like any aggregate measure, the SIR does not tell the whole story.



Details on Facility A

| Unit type | Pooled mean CLABSI rate | Unit SIR |
|-----------------|-------------------------|----------|
| Facility A MICU | 10.3 | 4.0 |
| Facility A SICU | 2.3 | 1.0 |

Though the overall facility SIR is elevated, the bigger need for prevention efforts is in the SICU



Using the SIR

| Facility | Facility SIR for CLABSI |
|----------|-------------------------|
| A | 2.0 |
| B | 1.2 |
| C | 0.75 |



Details on Facility B

| Unit type | Pooled mean CLABSI rate | Unit SIR |
|------------------|-------------------------|----------|
| Facility B PICU | 3.7 | 2.5 |
| Facility B CCU 1 | 0.0 | 0.0 |
| Facility B CCU 2 | 1.9 | 1.0 |

Though the overall facility SIR is near “expected”, prevention efforts are warranted in the PICU



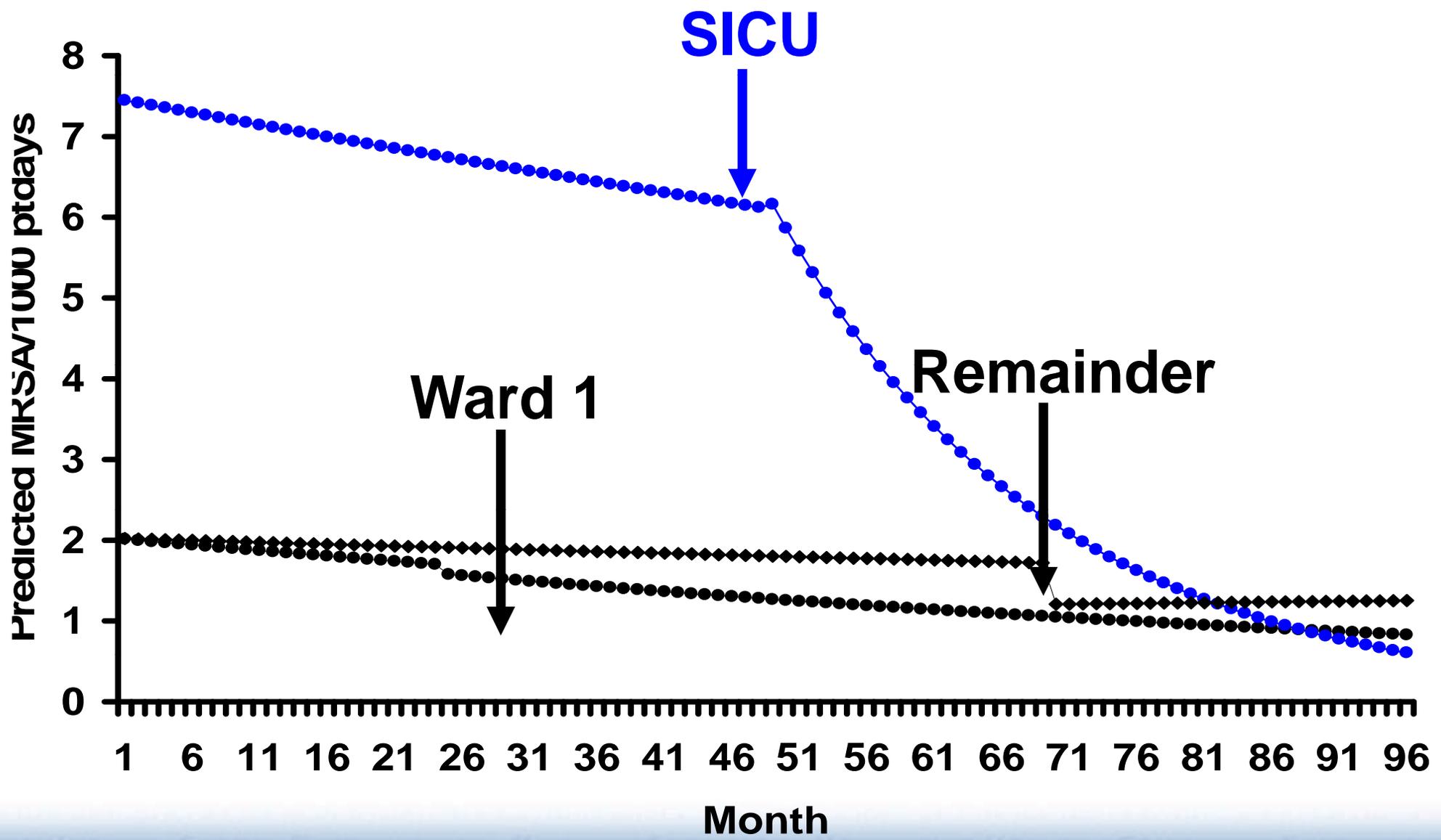
Other Key Factors in Prioritizing Interventions



- Burden of the HAI
 - Cost
 - Clinical outcomes
- Preventability
 - Are there interventions that are known to work?
 - What's the likely return on prevention investment?



Prioritizing Interventions- Impact of Current Rates





Next Steps Towards Elimination

- Work on CLABSIs in ICU settings has been, and remains, important.
- However, we also must recognize that:
 - These are a small fraction of all of the HAIs that we need to prevent.
 - They likely represent “low-hanging” fruit
- Given our goal of eliminating HAIs, we need to “move higher up the tree”.
- ARRA collaborations create opportunities to do this.



Next Steps Towards Elimination

- Expand to other settings- CLABSI in non-ICU settings.
- Expand to other infection types- CAUTI
- Expand success to new problem pathogens- drug-resistant gram negatives.
- Expand efforts in outpatient infection control.
- We are eager to partner with you to address these unmet needs.