The CDC Experience
Investment to Promote Prevention

Denise Cardo, M.D.

Director
Division of Healthcare Quality Promotion
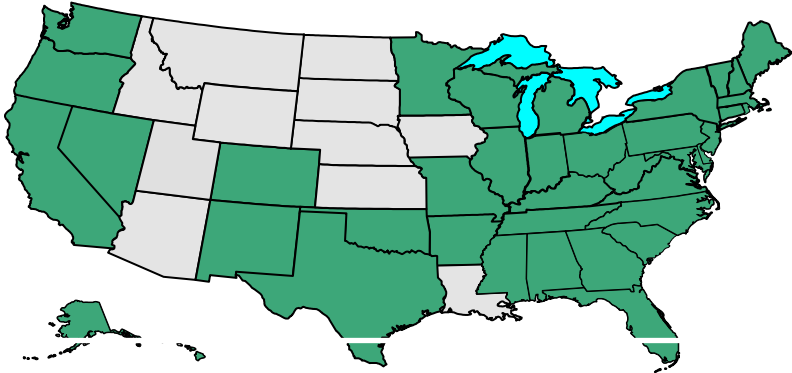**Centers for Disease Control and Prevention**

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 <u>good clinical practices</u>

- <u>All initiatives</u> in healthcare incorporates infection control and appropriate antibiotic use (e.g., sepsis)

- <u>All healthcare</u> 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

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

Rate

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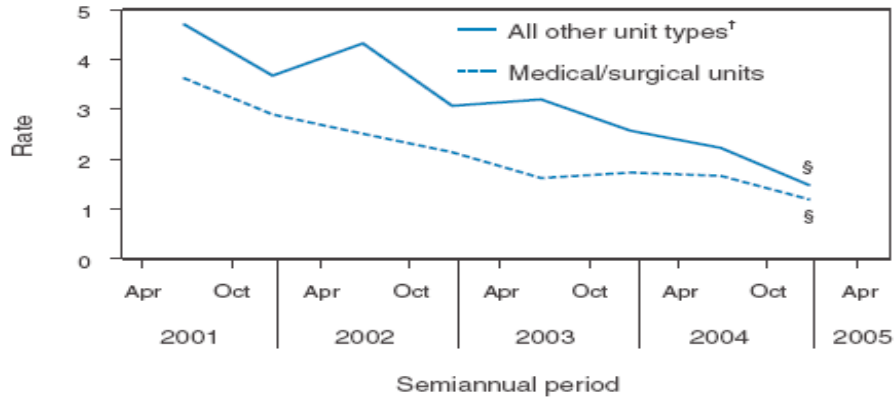
* Pooled mean rate per 1,000 central line days.
[†] Includes cardiothoracic, coronary, surgical, neurosurgical, trauma, medical, burn, and pediatric ICUs.
[§] p<0.001.

ICUs at 103 Michigan hospitals, 18 months

BSIs/1,000 catheter days
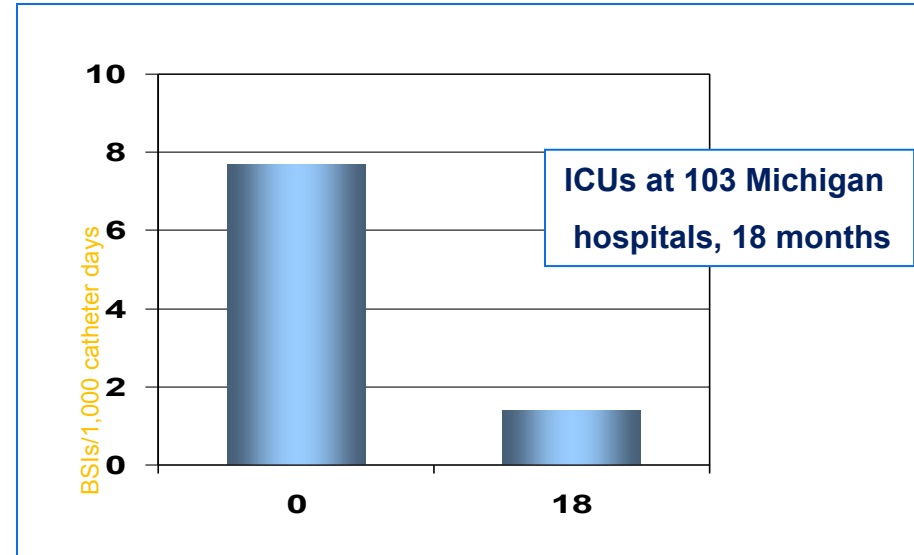
Pronovost P. New Engl J Med 2006;355:2725-32.

Eliminating Healthcare-associated Infections

WHITE PAPER

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 Epi-

clinicians attending the Fifth Decennial International Conference on Healthcare-Associated Infections 2010 is that now is the time to advance the cause of HAI elimination.[4] In this

- 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

Prevention metrics	National 5-year prevention target
Central line-associated blood stream infections (CDC)	50% reduction
Adherence to central-line insertion practices (CDC)	100% adherence
Surgical site infections (CDC)	25% reduction
Surgical care improvement project measures (CMS)	95% adherence
Catheter-associated urinary tract infections (CDC)	25% reduction
Clostridium difficile infections (CDC)	30% reduction
Clostridium difficile hospitalizations (AHRQ)	30% reduction
MRSA invasive infections (population) (CDC)	50% reduction
MRSA bacteremia (hospital) (CDC)	25% reduction

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**

5

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 activites (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

❑ The Net Cost-Savings Associated with Prevention of Central Line-Associated Bloodstream Infections (CLABSI) in Medicare and Medicaid Patients in Adult Critical Care: 1990-2008

- Federal perspective
- Historical analysis
  - Time period selected to highlight CDC-specific return on investment

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

CDC Central-Line Bloodstream Infection Prevention Efforts Produced Net Benefits Of At Least $640 Million During 1990–2008

R. Douglas Scott II (DScott1@
cdc.gov) is an economist in
the Division of Healthcare
Quality Promotion, Centers for
Disease Control and
Prevention (CDC), in Atlanta,
Georgia.

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

Health Affairs 2014 33;6:1040-47

Total Budget Costs and Net Cost Savings on CLABSI Prevention in Medicare and Medicaid ICU patients (1990 to 2008)

Total Benefits of Infections Averted	**$1,308 million ($804-$1,908 million)**
Costs of Prevention	
Federal (CDC) Budget	$33 million
Fixed Costs of CLABSI Infection Control in hospital critical care units	$87 million ($44-$131 million)
Total Budget Cost	$120 million ($77-$164 million)
Net Cost Savings (total benefits – total costs)	$1,188 million ($640-$1,831 million)

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)
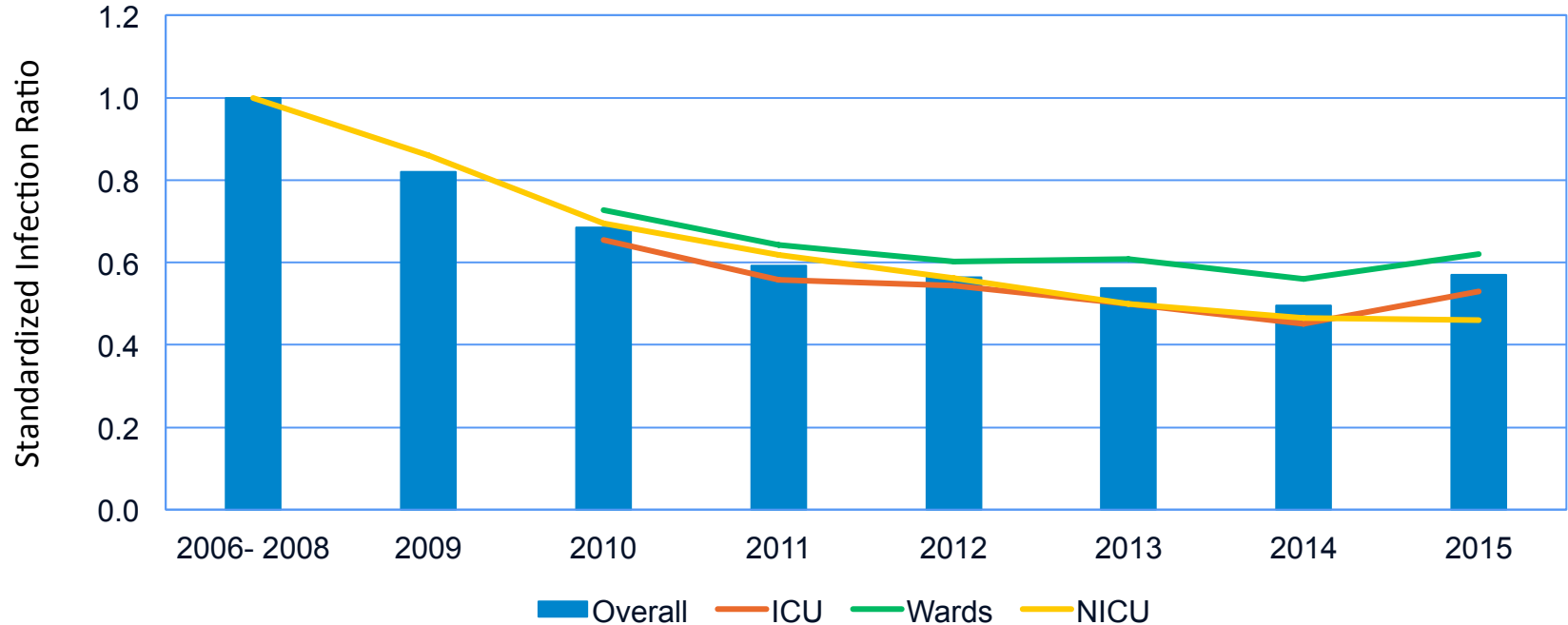
Prevention of CLABSI U.S. Hospitals

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

CDC — U.S. Department of Health and Human Services, Centers for Disease Control and Prevention

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.

HAZARD LEVEL
URGENT

These are high-consequence antibiotic-resistant threats because of significant risks identified across several criteria. These threats may not be currently widespread but have the potential to become so and require urgent public health attention to identify infections and to limit transmission.

Clostridium difficile (C. difficile), Carbapenem-resistant Enterobacteriaceae (CRE), Drug-resistant *Neisseria gonorrhoeae* (cephalosporin resistance)

HAZARD LEVEL
SERIOUS

These are significant antibiotic-resistant threats. For varying reasons (e.g., low or declining domestic incidence or reasonable availability of therapeutic agents), they are not considered urgent, but these threats will worsen and may become urgent without ongoing public health monitoring and prevention activities.

Multidrug-resistant *Acinetobacter*, Drug-resistant *Campylobacter*, Fluconazole-resistant *Candida* (a fungus), Extended spectrum β-lactamase producing Enterobacteriaceae (ESBLs), Vancomycin-resistant *Enterococcus* (VRE), Multidrug-resistant *Pseudomonas aeruginosa*, Drug-resistant Non-typhoidal *Salmonella*, Drug-resistant *Salmonella* Typhi, Drug-resistant *Shigella*, Methicillin-resistant *Staphylococcus aureus* (MRSA), Drug-resistant *Streptococcus pneumonia*, Drug-resistant tuberculosis (MDR and XDR)

HAZARD LEVEL
CONCERNING
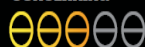
These are bacteria for which the threat of antibiotic resistance is low, and/or there are multiple therapeutic options for resistant infections. These bacterial pathogens cause severe illness. Threats in this category require monitoring and in some cases rapid incident or outbreak response.

Vancomycin-resistant *Staphylococcus aureus* (VRSA), Erythromycin-resistant *Streptococcus* Group A, Clindamycin-resistant *Streptococcus* Group B
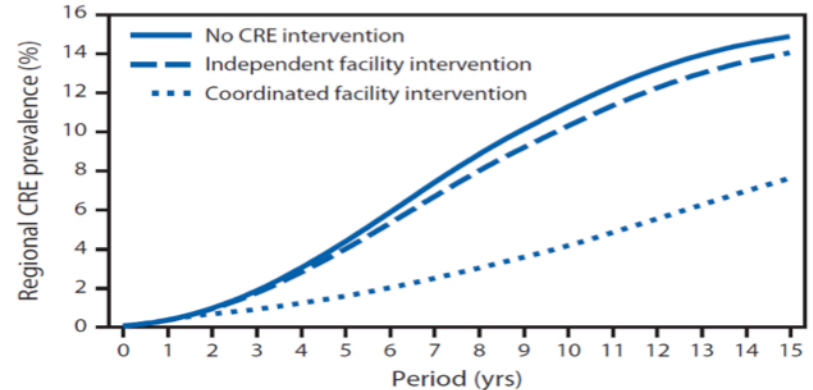
Projected burden of healthcare-associated invasive MRSA, healthcare-associated *Clostridium difficille* Infections, healthcare-associated CRE, and hospital-onset MDR *Pseudomonas* infections

Aggressive multisectoral intervention

Over 5 years prevention results in:
- 619,000 MDR-infections averted
- 37,000 MDR-infection attributable deaths averted
- $7.7B in medical costs saved
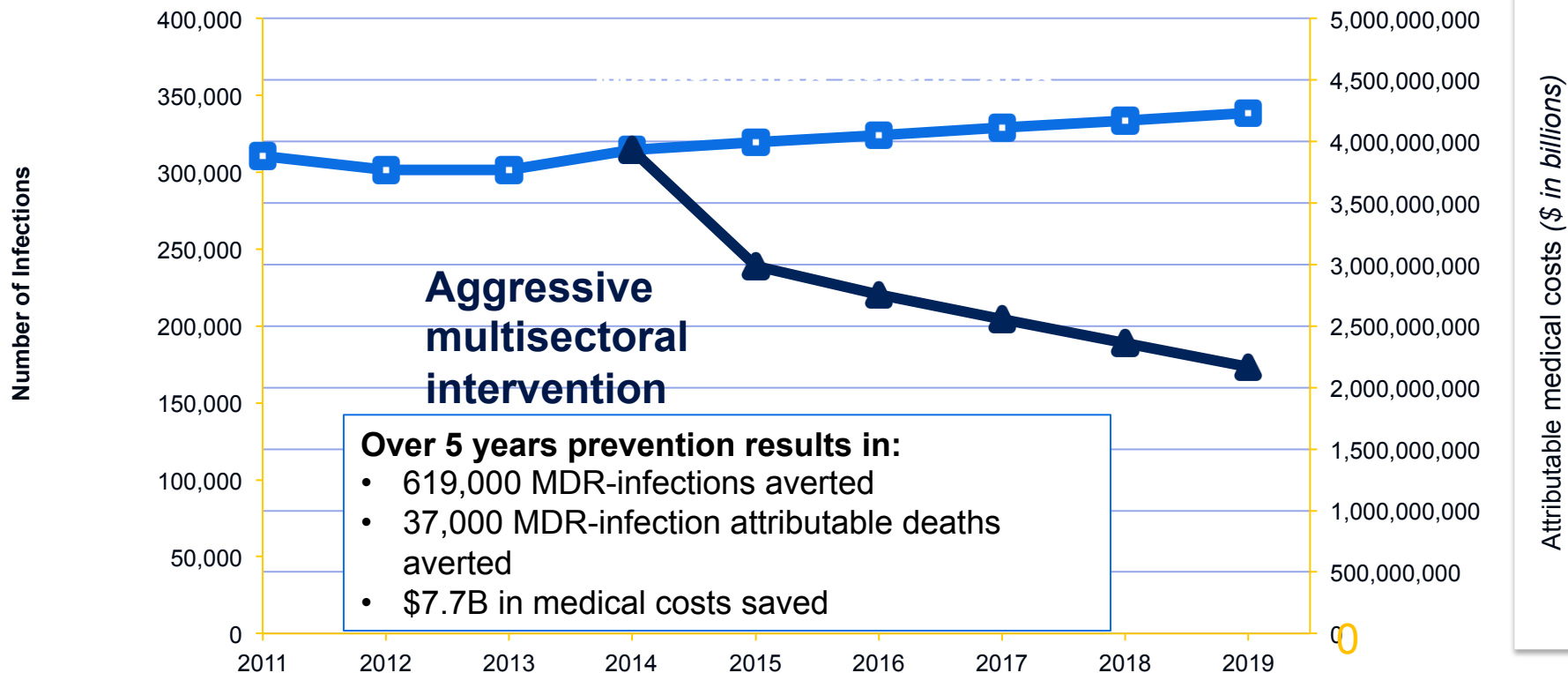
Projected Prevalence of CRE Based on Modeling
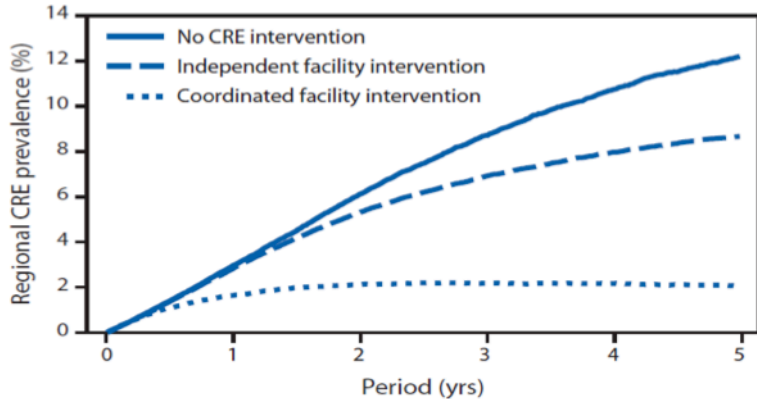
* Additional information available at http://www.cdc.gov/drugresistance/resources/publications.html. A video of the model simulations is available at http://www.cdc.gov/drugresistance/resources/videos.html.

* Additional information available at http://www.cdc.gov/drugresistance/resources/publications.html.

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[1]

22% Hospital-onset

33% Community-onset with recent outpatient exposures[1]

41% Community-Associated

59% Healthcare-Associated

17% Nursi... home-ons...

1% LTACH-onset

20% Community-onset with recent inpatient exposures
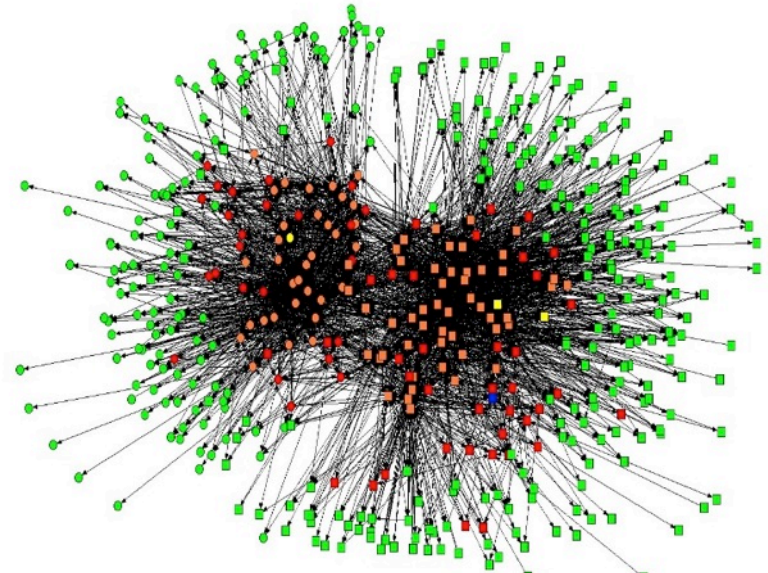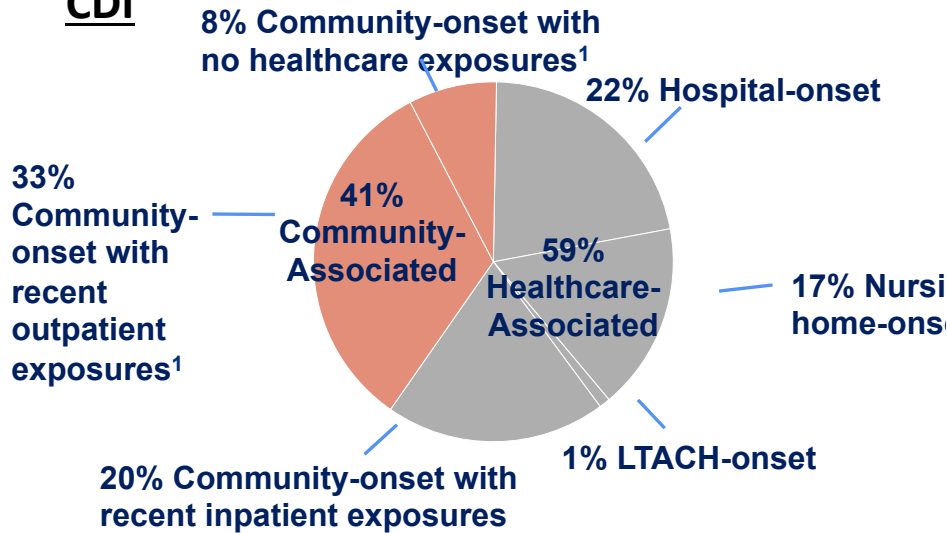
Connectedness of Healthcare Facilities, Washington and Oregon

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

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

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)

	Payer Perspective (excess CMS reimbursement averted)	Deaths averted	Societal Perspective (accounting for monetization of mortality)
Potential Savings	**$2.5 Billion**	**82,000**	**$689 Billion**

- 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, *mcr-1*
  - Pan-resistant organisms
  - *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.
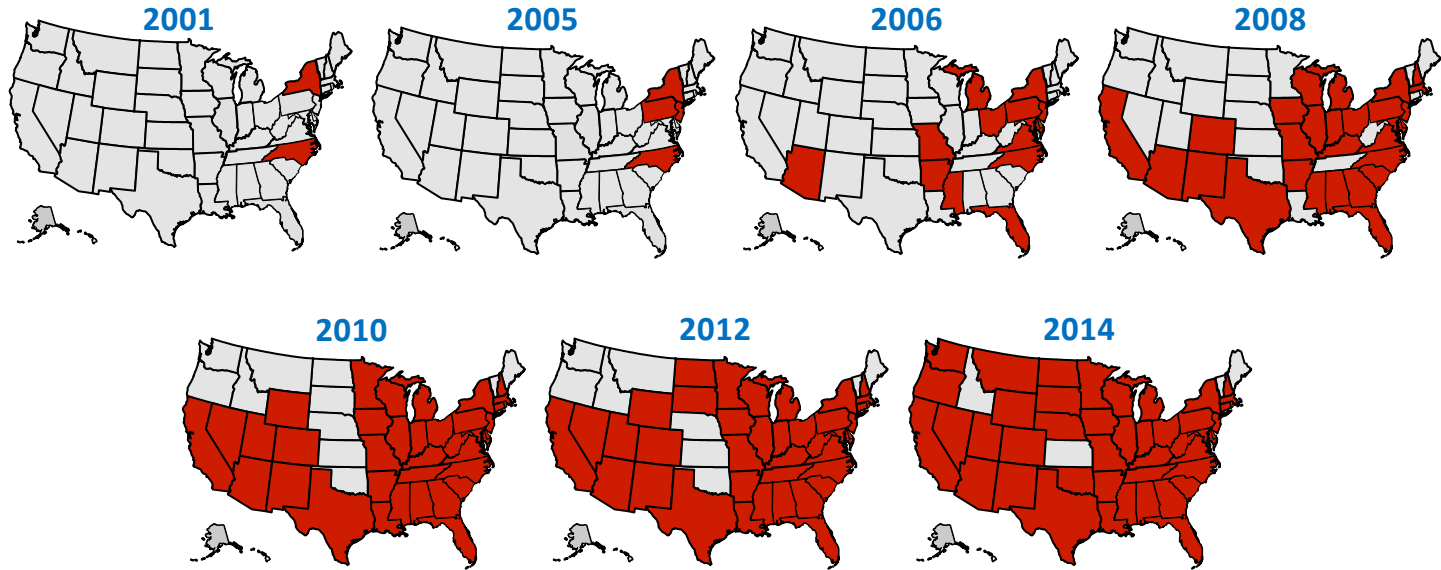

States with *Klebsiella pneumoniae* carbapenemase (KPC)-producing Carbapenem-resistant Enterobacteriaceae (CRE) confirmed by CDC

# Modeling of Containment Strategy for Emerging Resistance
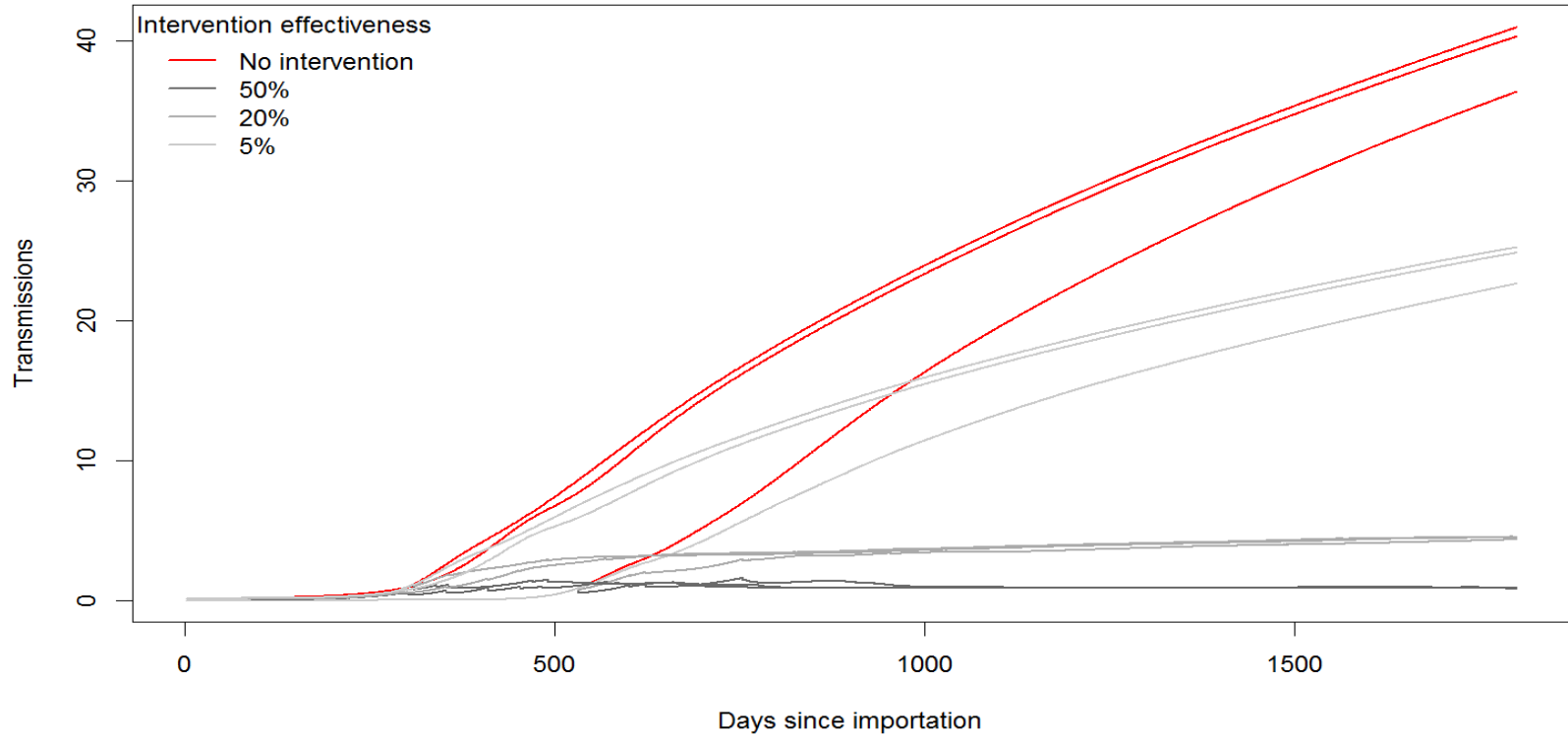
Prevention of *C. difficile*, MRSA, and other MDROs:

- 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
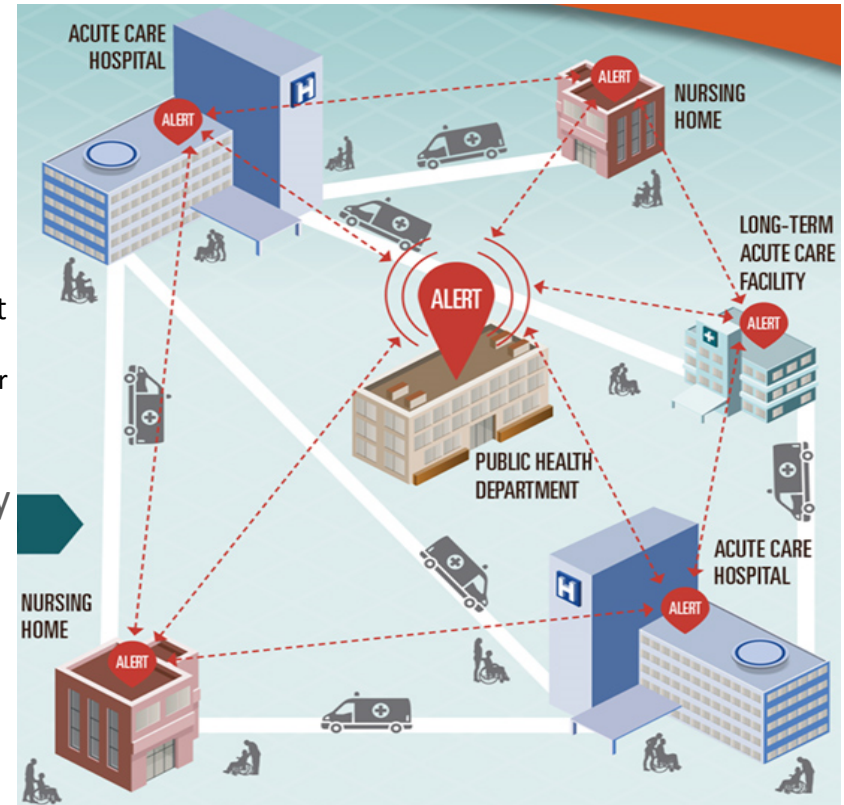
Build and Expand HAI Prevention Success:
AR Solutions Initiative Continues Focus on Patients
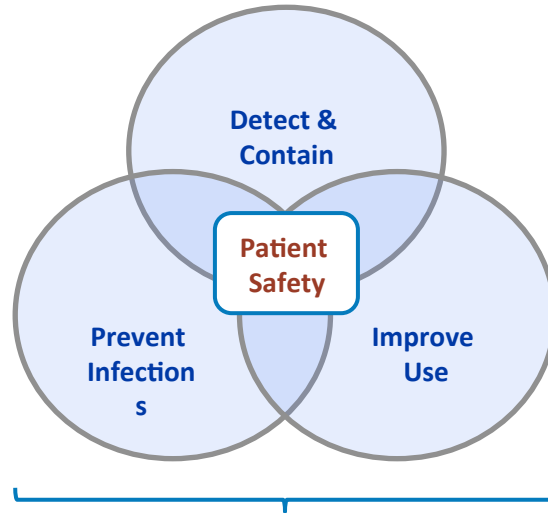
Policies – Programs – Practices

Antibiotic Stewardship Programs
A Public Health "Best Buy"

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

DECREASE
- ANTIBIOTIC RESISTANCE
- C. DIFFICILE INFECTIONS
- COSTS

INCREASE
- GOOD PATIENT OUTCOMES

PROMOTE ANTIBIOTIC BEST PRACTICES—A FIRST STEP IN ANTIBIOTIC STEWARDSHIP
- ENSURE ALL ORDERS HAVE DOSE, DURATION, AND INDICATIONS
- GET CULTURES BEFORE STARTING ANTIBIOTICS
- TAKE AN "ANTIBIOTIC TIMEOUT" REASSESSING ANTIBIOTICS AFTER 48–72 HOURS

**ANTIBIOTIC STEWARDSHIP PROGRAMS ARE A "WIN-WIN" FOR ALL INVOLVED**

A UNIVERSITY OF MARYLAND STUDY SHOWED ONE ANTIBIOTIC STEWARDSHIP PROGRAM **SAVED A TOTAL OF $17 MILLION** OVER EIGHT YEARS

ANTIBIOTIC STEWARDSHIP HELPS **IMPROVE PATIENT CARE AND SHORTEN HOSPTIAL STAYS,** THUS **BENEFITING PATIENTS AS WELL AS HOSPITALS**

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
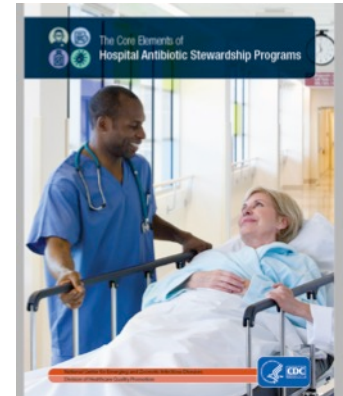
Percent of US Hospitals Reporting Implementation of All CDC Core Elements on Annual NHSN Survey
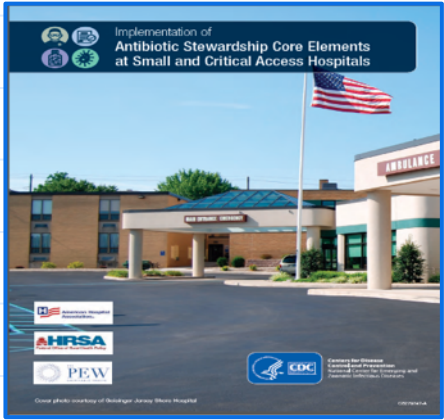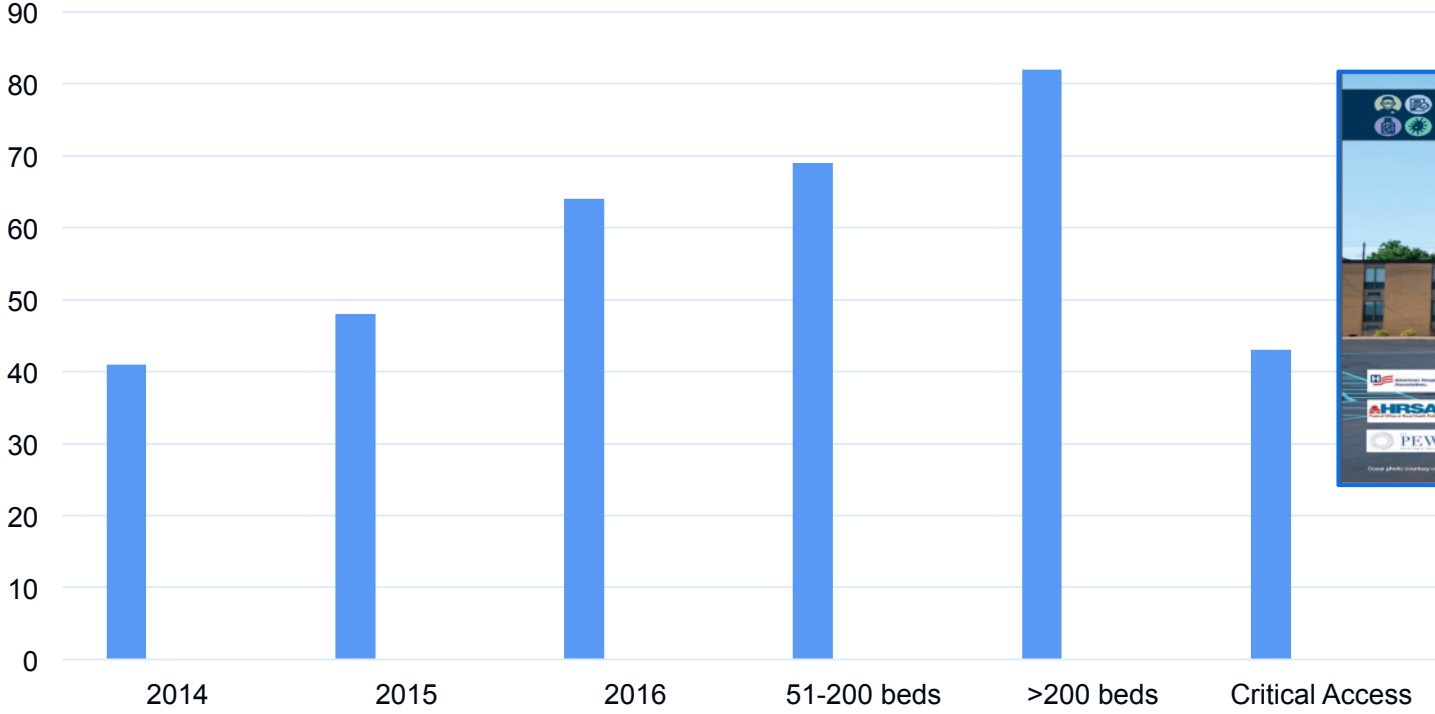
National Action Plan to Prevent Healthcare-Associated Infections Progress and Targets for 2020

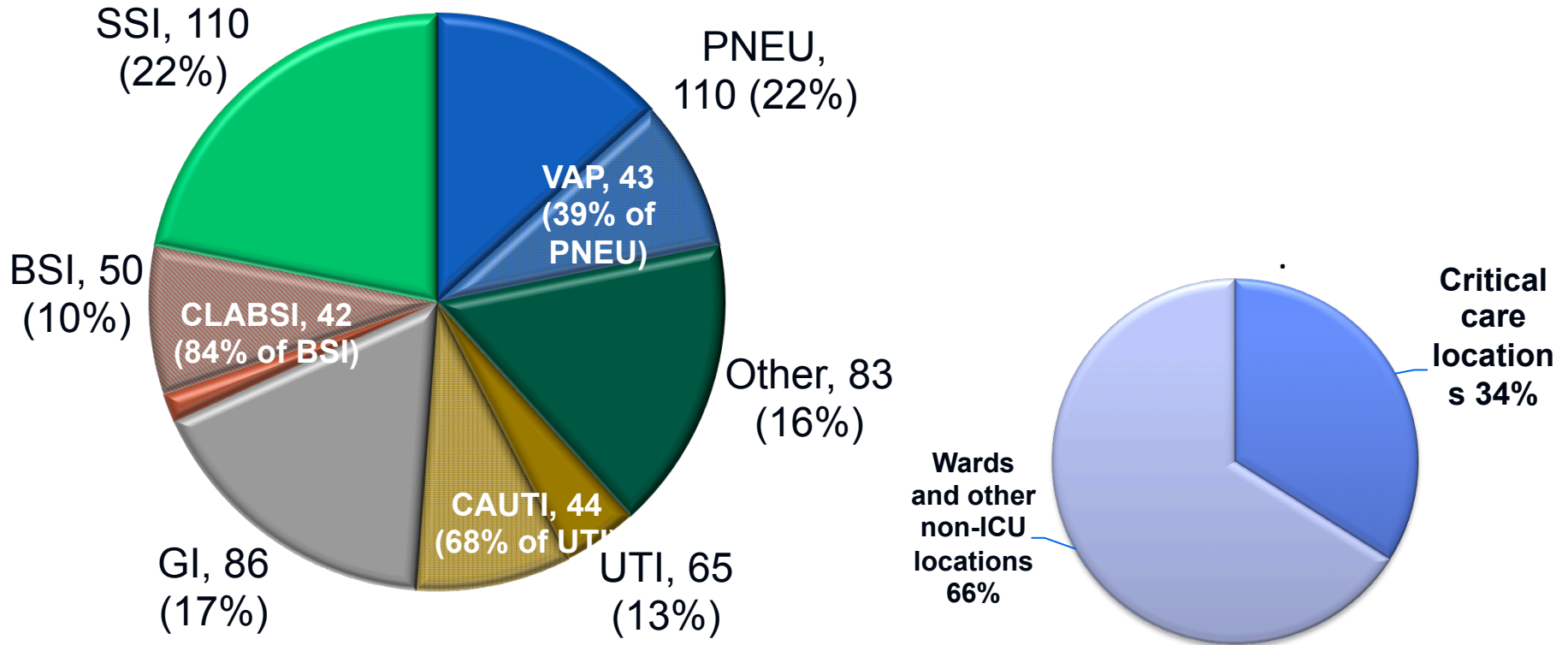| Measure	Data Source	Baseline Years	2013 Target	Progress By 2014	Targets for 2020
Reduce **central-line associated bloodstream infections (CLABSI)** in ICU and ward-located patients	CDC/ NHSN	2006-2008	50% reduction or .50 SIR	50% reduction or .50 SIR	**50% reduction** from 2015 baseline
Reduce **catheter-associated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

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
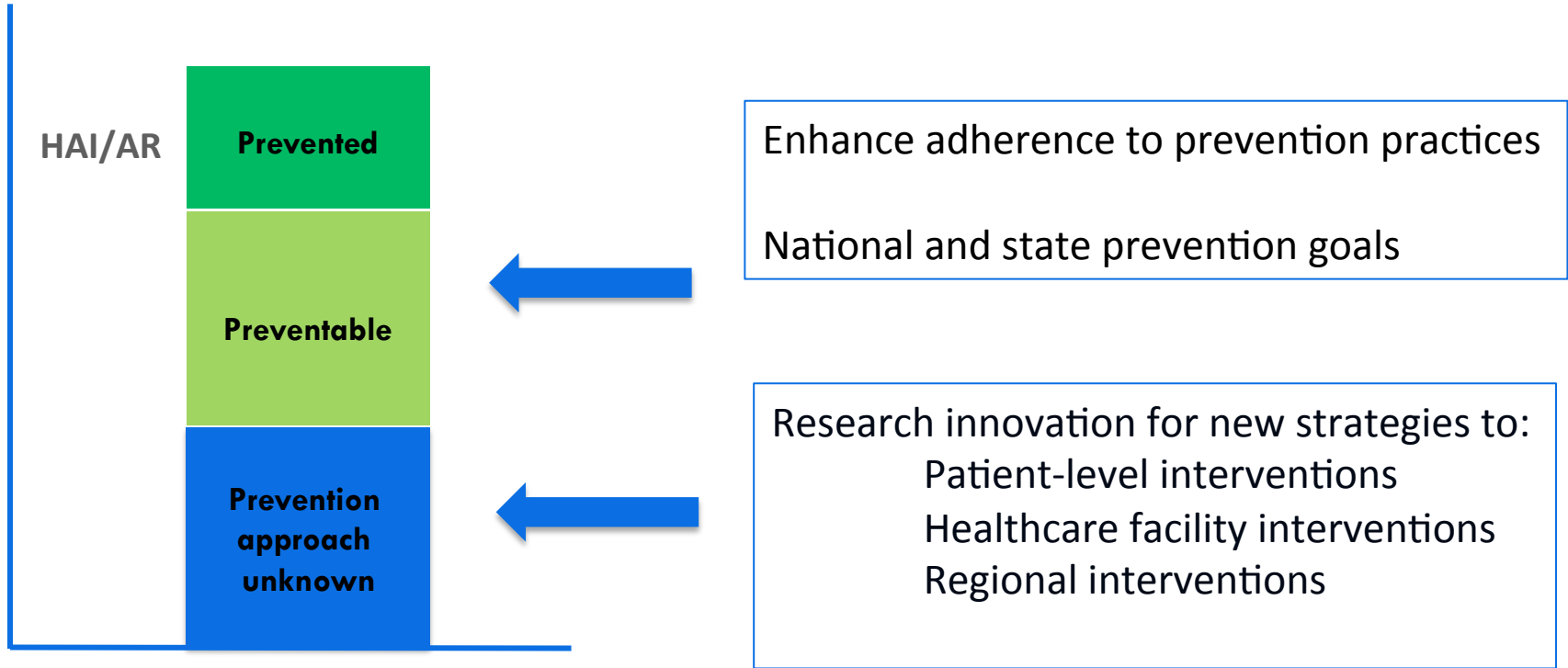
CDC Point Prevalence Survey in Acute Care Hospitals, 2011
Healthcare-associated Infections Distribution

SSI, 110 (22%)

PNEU, 110 (22%)

VAP, 43 (39% of PNEU)

BSI, 50 (10%)

CLABSI, 42 (84% of BSI)

Other, 83 (16%)

GI, 86 (17%)

CAUTI, 44 (68% of UTI)

UTI, 65 (13%)

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	Early Detection	Appropriate Treatment
• Implement current recommendations • Innovation	• Faster diagnostic tools • Sepsis	• Antibiotic Stewardship

- Emerging Resistant Bacteria
- Inter-facility Transmission

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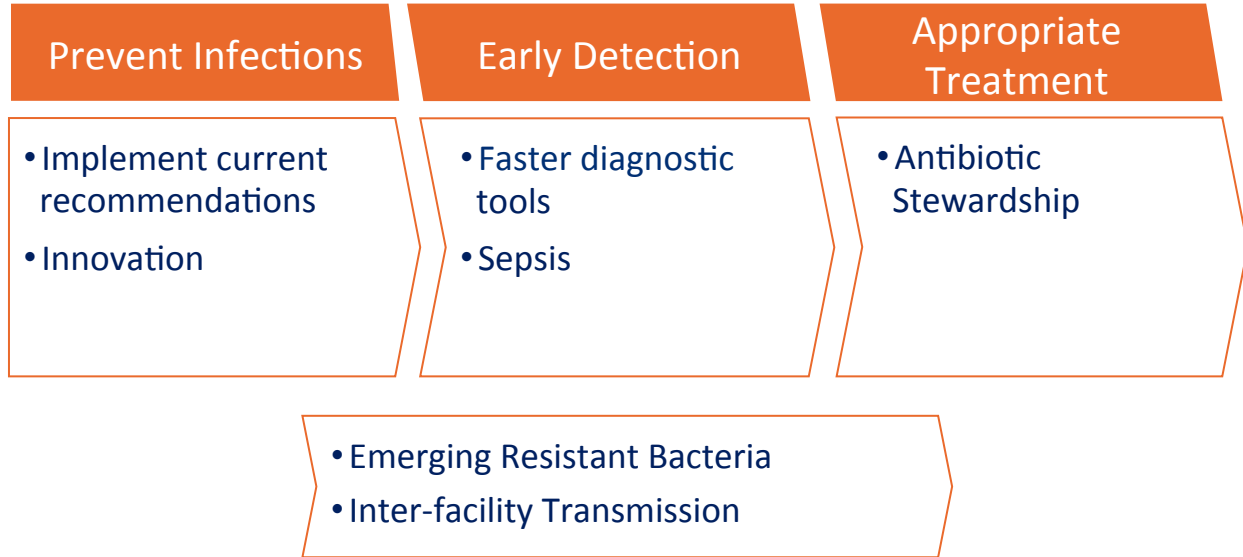
Prevention is our Goal and Responsibility

Act to protect patients
Now and Always