



Healthcare-associated Infections Prevention and Control

An overview of the past and perspectives for the future

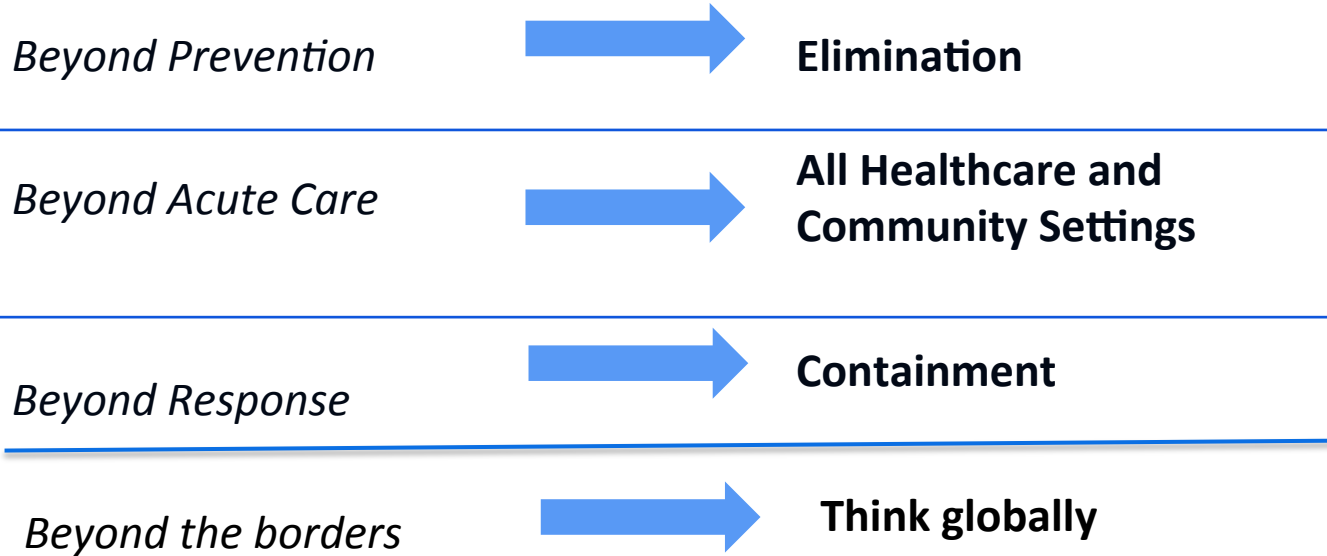
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Centers for Disease Control and Prevention**

17th Congress of International Federation of Infection Control
APECIH-IFIC 2017

Cultural Change in Expectations



- SENIC (1980's)
 - Up to 30% of infections are preventable when you have an effective program
- 2000's
 - At least 70% of Central-line associated bloodstream infections can be prevented when following guidelines using bundle approach

WHITE PAPER

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

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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

Transparency and Accountability



Alignment of goals, metrics, policies

Data available for several groups

Medicare.gov | Hospital Compare
The Official U.S. Government Site for Medicare

Healthcare Associated Infections - details

Table 1 of 6 Central line-associated blood stream infections (CLABSI)

	No. of Infections Reported (A)	Central Line Days (CLDs) ¹	Predicted No. Infections (B)	Standardized Infection Ratio (SIR) ² (A/B)	Evaluation
GEORGE WASHINGTON UNIV HOSPITAL	20	6983	15,230	1.313	No Different than U.S. National Benchmark
CHILDREN'S HOSPITAL NMC	Not Available	Not Available	Not Available	Not Available ⁵	Not Available
MEDSTAR GEORGETOWN UNIVERSITY HOSPITAL	13	9769	24,425	0.532	Better than the U.S. National Benchmark

Standardized infection ratio (SIR) national benchmark = 1.
Lower SIRs are better. A score of (0) – meaning no CLABSIs – is best.

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

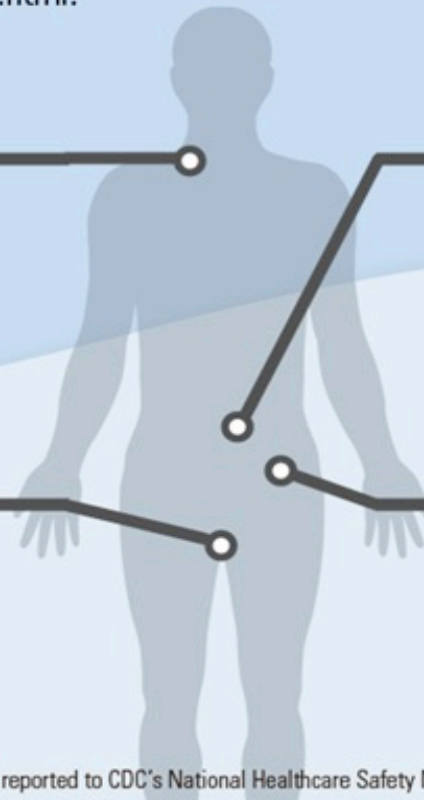
Abbreviations:

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.



Healthcare-associated infections (HAI) are infections patients can get while receiving medical treatment in a healthcare facility. Working toward the elimination of HAIs is a CDC priority. For more information on HAI prevention progress, visit: www.cdc.gov/hai/progress-report/index.html.



CLABSIs

CENTRAL LINE-ASSOCIATED
BLOODSTREAM INFECTIONS

- **1 in 6** CLABSIs were caused by urgent or serious antibiotic-resistant threats.

SSIs

SURGICAL SITE INFECTIONS

- **1 in 7** SSIs were caused by urgent or serious antibiotic-resistant threats.

CAUTIs

CATHETER-ASSOCIATED
URINARY TRACT INFECTIONS

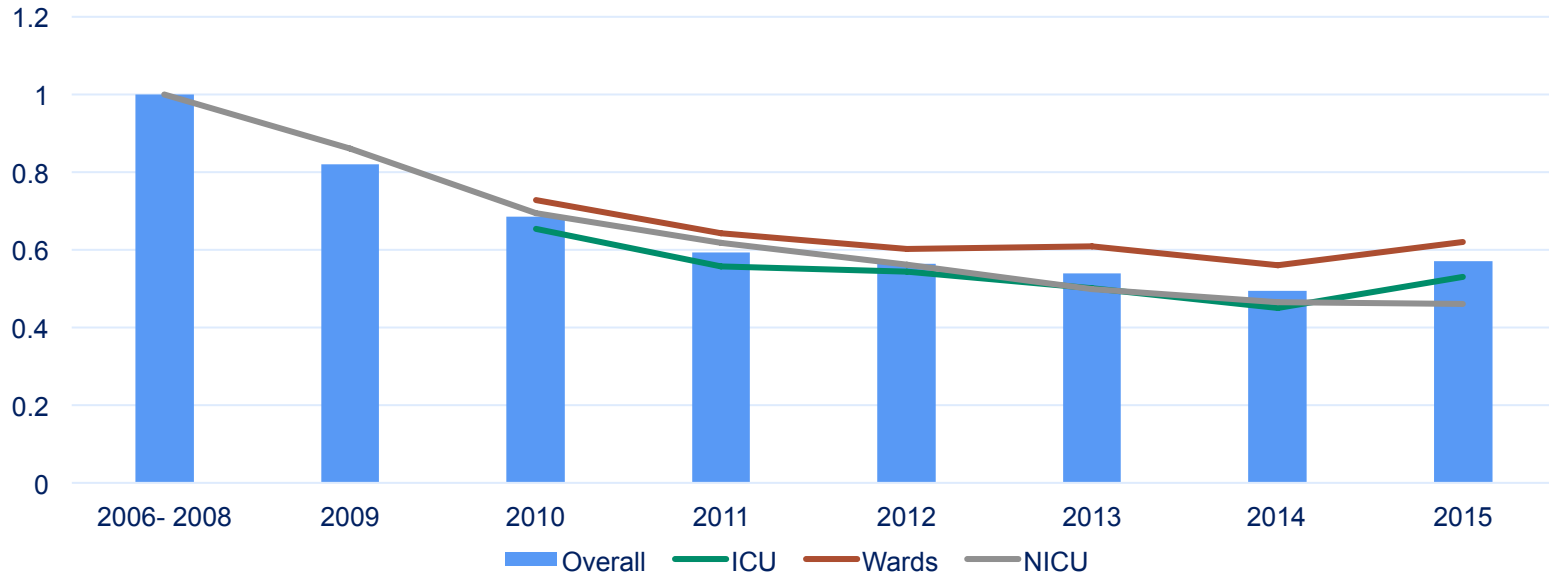
- **1 in 10** CAUTIs were caused by urgent or serious antibiotic-resistant threats.

C. difficile Infections

- **9 in 10** patients diagnosed with *C.difficile* are related to healthcare.

Trends in central line-associated bloodstream infections in U.S. 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

Targeted Assessment for Prevention (TAP) Strategy

Target → Assess → Prevent

- Target
- Assess
- Prevent
gaps

HAI: CAUTI ▼ Target SIR: 0.75

Number of Infections: 67

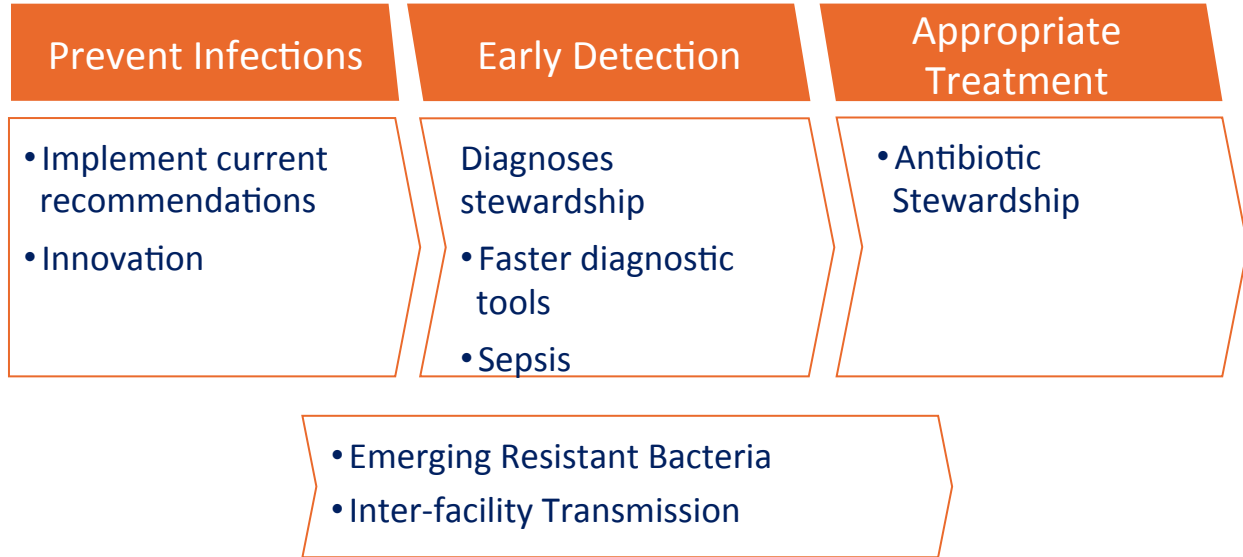
Number Predicted: -OR- Current SIR: 1.3

Compute

Need to prevent 29 infections to reach target SIR of 0.75

Clear Form

Thinking Holistically to Protect Patients



Protecting Across the Patient Care Spectrum

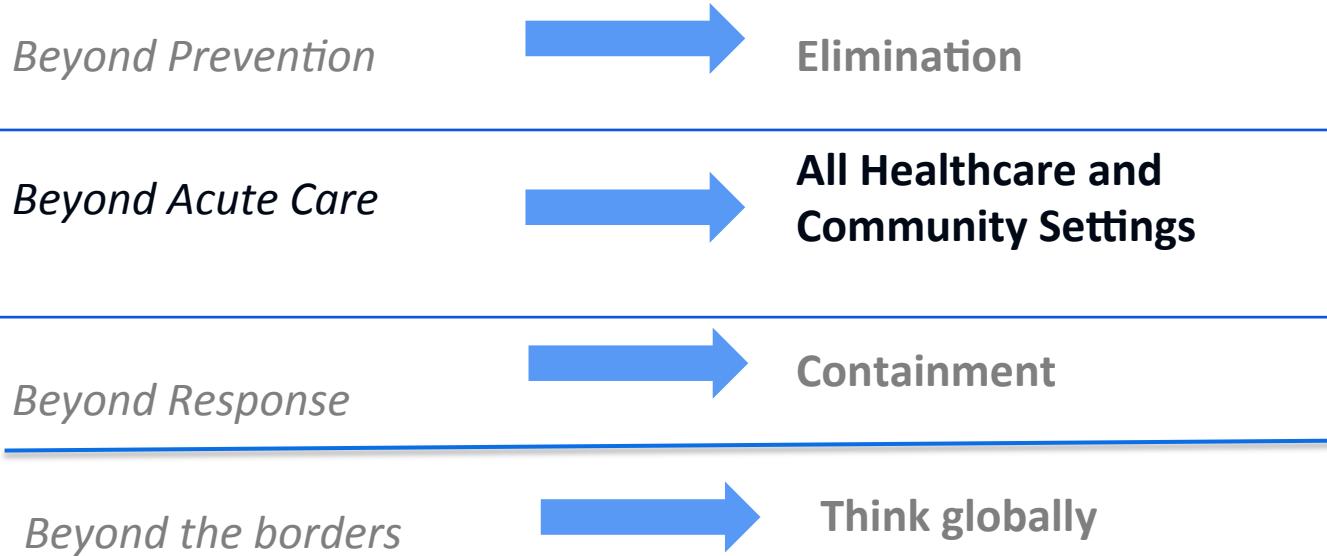


How to Engage Patient Advocates

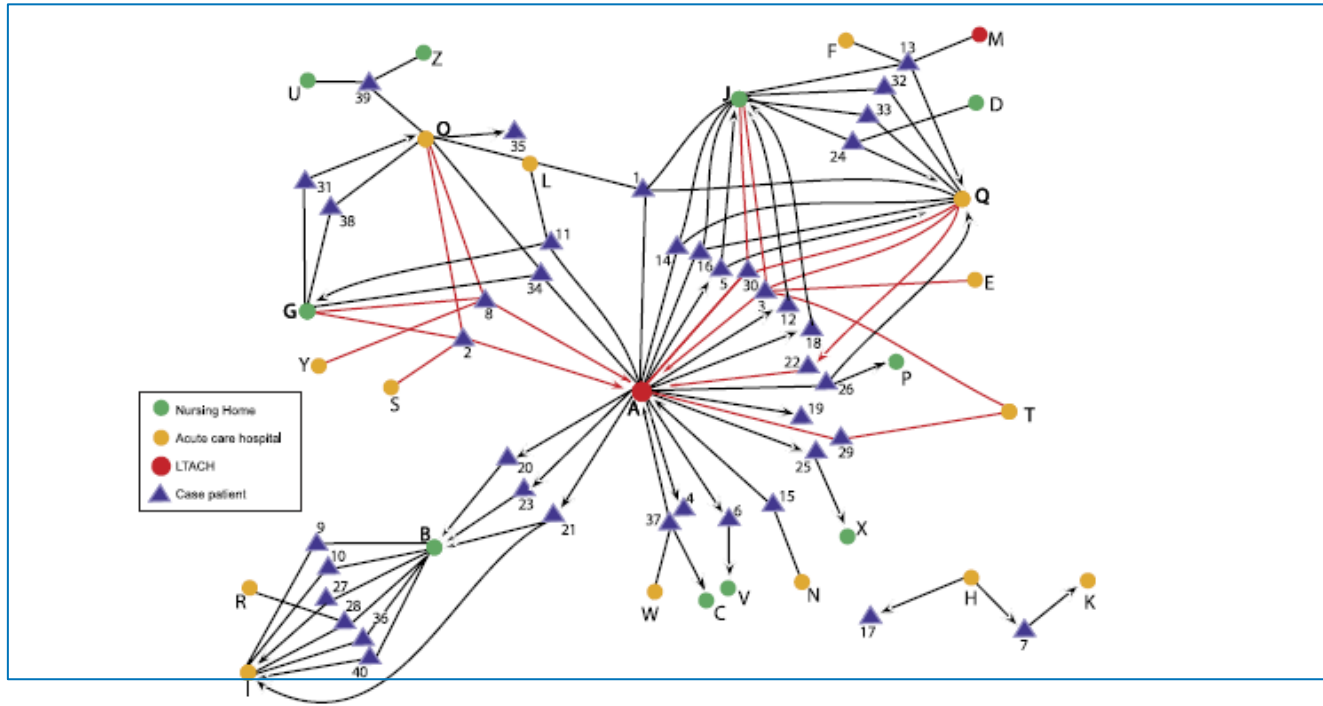
- ❑ **Engaging consumers can be an opportunity**
 - Educate about prevention efforts
 - Correct myths and increase awareness
 - Build trust & instill confidence



Cultural Change in Expectations

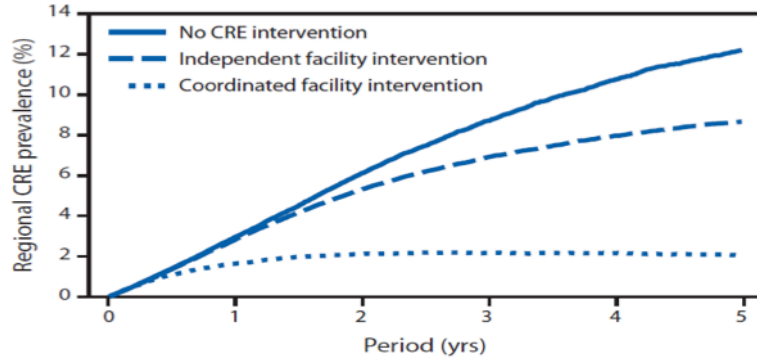


CRE Outbreak: Several Healthcare Facilities in More than a County, Illinois, 2008

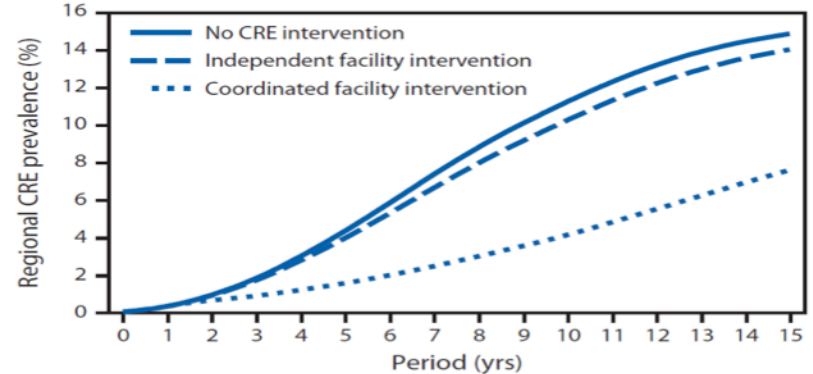


Won S, Munoz-Price S, Lolans K, Hota B, Weinstein R, Hayden M. for the Centers for Disease Control and Prevention Epicenter Program. Rapid and Regional Spread of *Klebsiella pneumoniae* Carbapenemase-producing CID 2011:53

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>.



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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

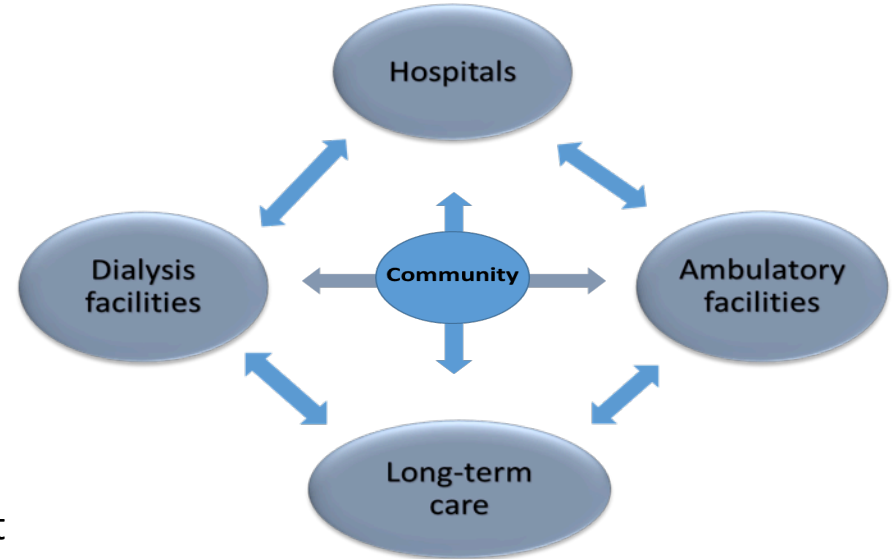
Preventing Transmission: Regional Approach to Controlling *C. difficile* and other Multidrug-Resistant Organisms

❑ Traditional approach

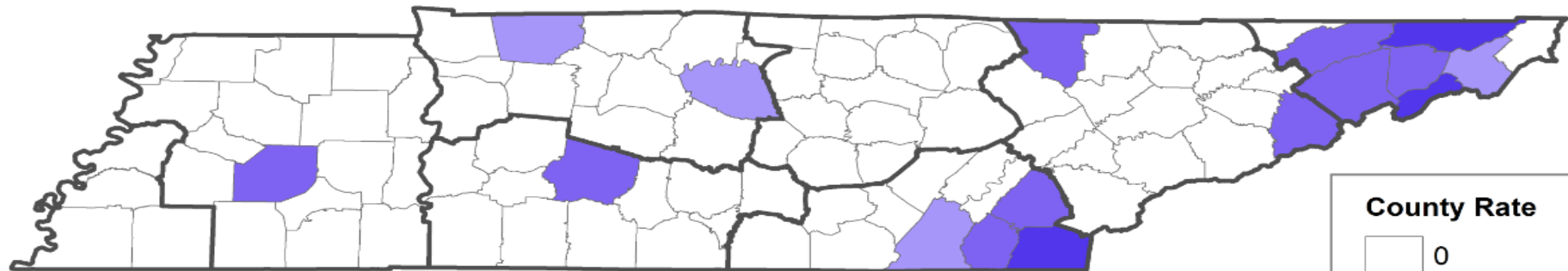
- Promotion of prevention efforts independently implemented by individual health care facilities
- Does not account for inter-facility spread through movement of colonized/infected

❑ 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



Annual Incidence Rate of *Klebsiella* spp. Cases, by County, Tennessee 2014



0 25 50 100 Miles

Cases are assigned to a county based on the county of residence. Rates are calculated at the county level using the Census estimates for July 1, 2014, and based on the base estimates from the April 1, 2010 Census counts. Rates are calculated per 100,000 persons in the county population.

County Rate

0

1-2

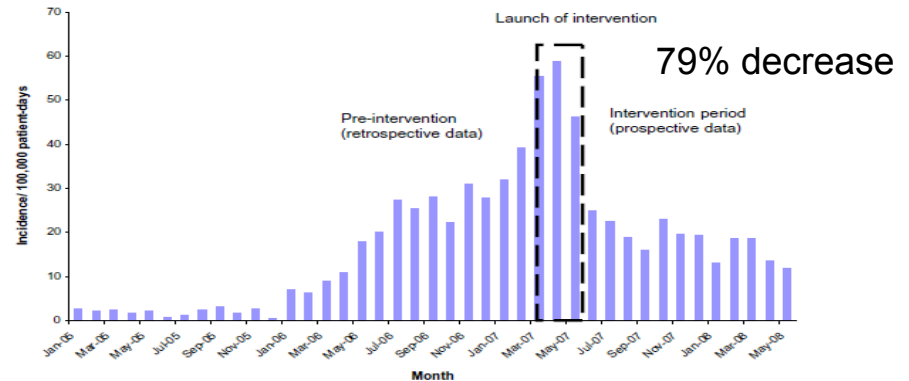
3-5

6-10



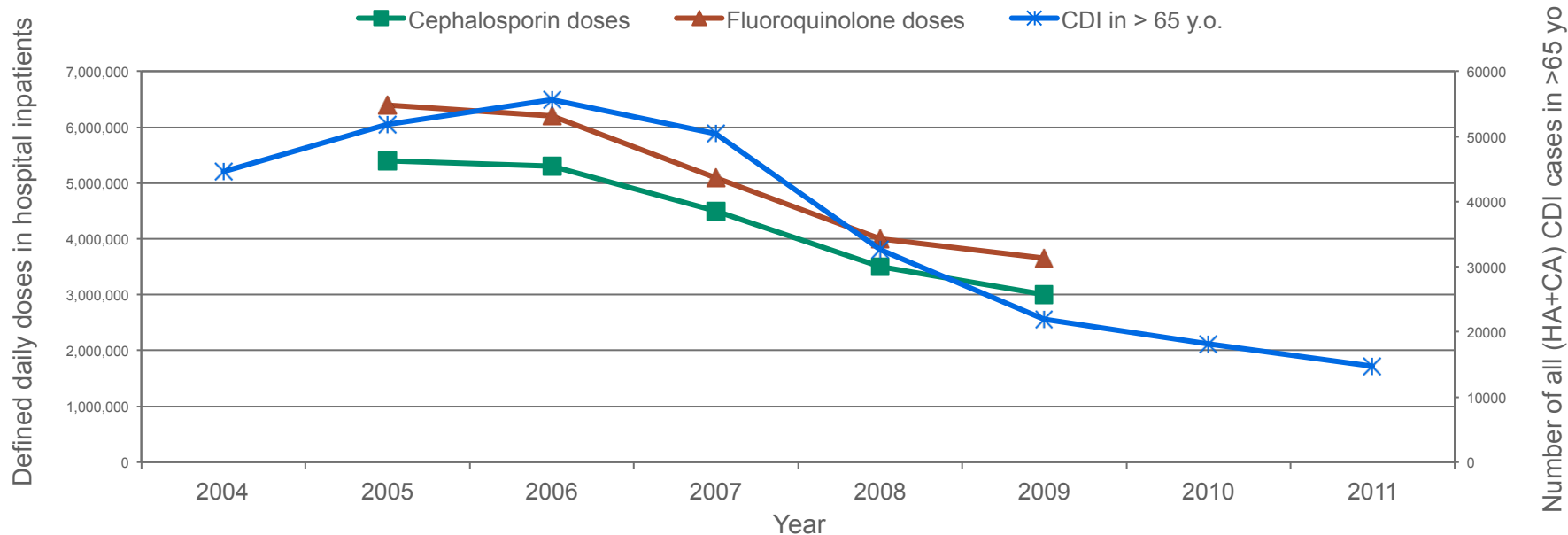
Control of CRE Infections: Israel Experience

- KPC-producing CRE likely originally from US identified in Israel beginning in late 2005
- By early 2006, increase in cases (epidemic)
- Initiated National coordinated effort to control CRE in acute care hospitals
 - Mandatory reporting of patients with CRE
 - Mandatory isolation (CP) of CRE patients
 - Staff and patient cohorting
 - Task Force developed to collect data



Schwaber et al. CID 2011; 848-855

Clostridium difficile Infections Prevention in England



Ashiru-Oredope et al. J Antimicrob Chemother 2012; 67 Suppl 1: i51–i63

Wilcox MH et al. Clinical Infectious Diseases 2012;55(8):1056–63

<http://www.hpa.org.uk/web/HPAweb&Page&HPAwebAutoListName/Page/1179745282408>

Number of *Clostridium difficile* Infections (CDI) and Deaths Averted: Cohort of >65 year olds

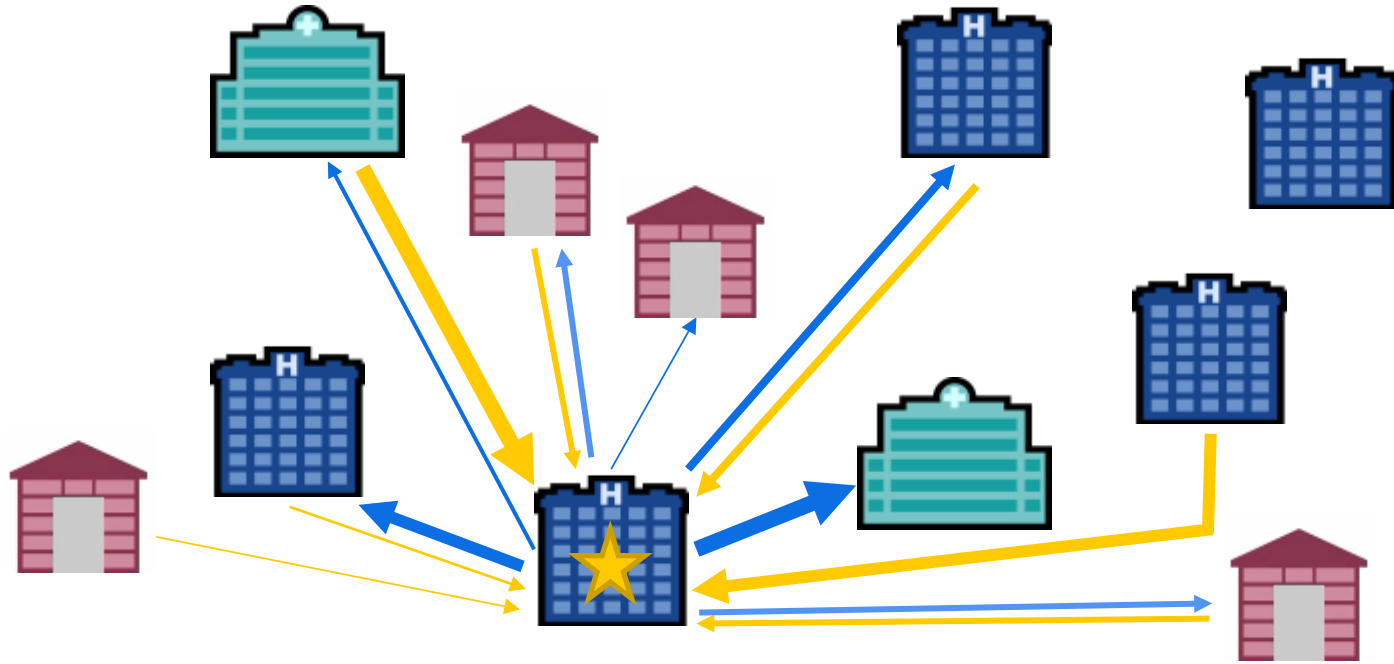
	Intervention Effectiveness			
	10%	25%	50%	75%
Cohort of 1,000 hospitalized Medicare beneficiaries ≥65 years old				
Total CDI infections averted over 5 years	7.36	18.59	36.94	56.06
Total CDI-attributed deaths averted over 5 years	1.20	2.93	5.91	8.97
Among all hospitalized Medicare beneficiaries ≥65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

Potential Economic Benefit of *Clostridium difficile* Prevention over 5 years

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

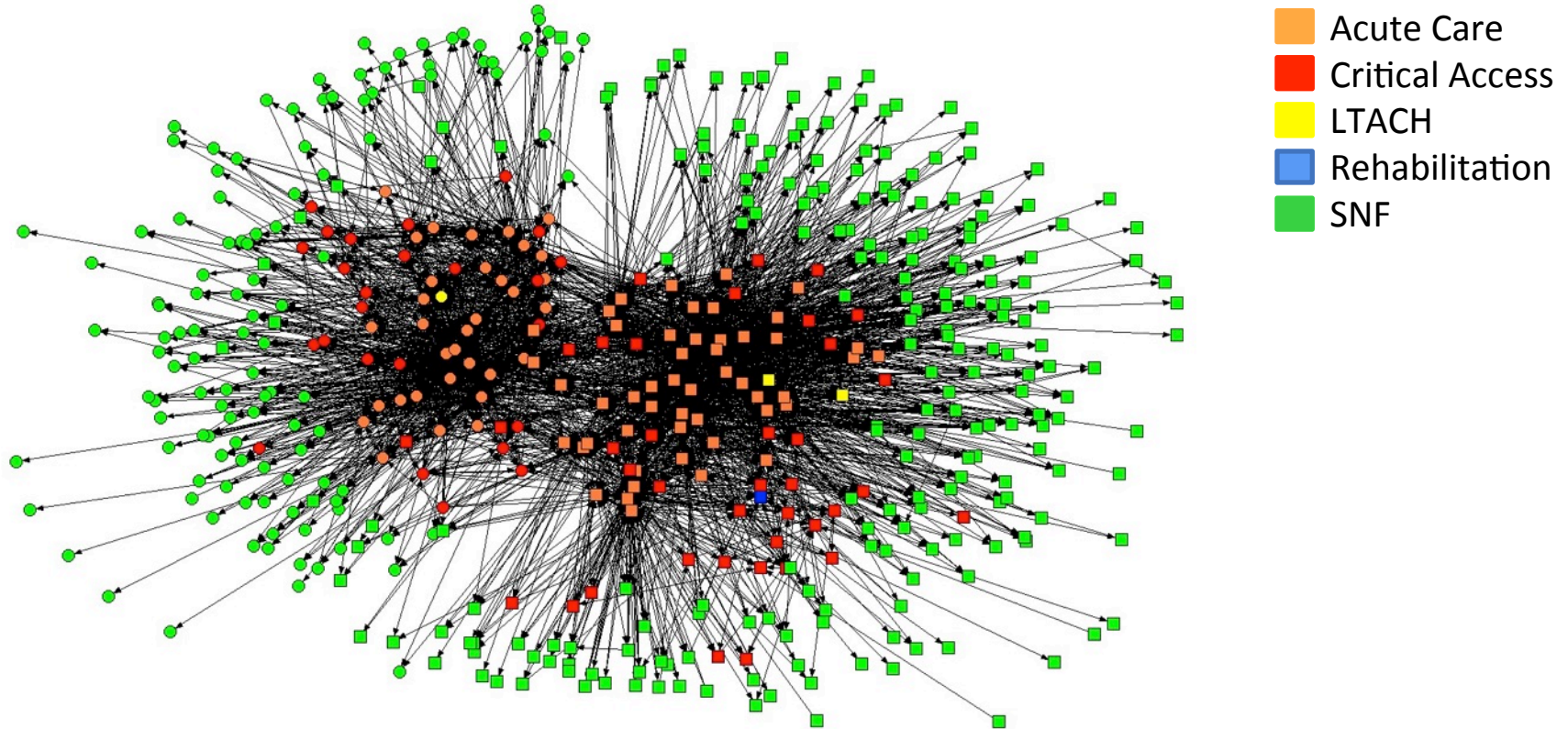
	Payer Perspective (excess CMS reimbursement averted)	Deaths averted	Societal Perspective (accounting for monetization of mortality)
Potential Savings	\$2.5 Billion	82,000	\$689 Billion

One More Tool: Social Network Analysis



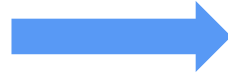
Weighted Indegree: Sum of patients (**yellow arrows**), into the index facility
Weighted Outdegree: Sum of patients (**blue arrows**), out of the index facility

C. difficile: Connectedness of Healthcare Facilities, Washington and Oregon



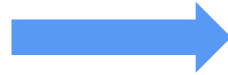
Cultural Change in Expectations

Beyond Prevention



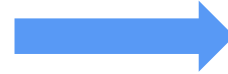
Elimination

Beyond Acute Care



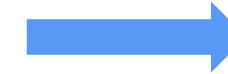
**All Healthcare and
Community Settings**

Beyond Response



Containment

Beyond the borders

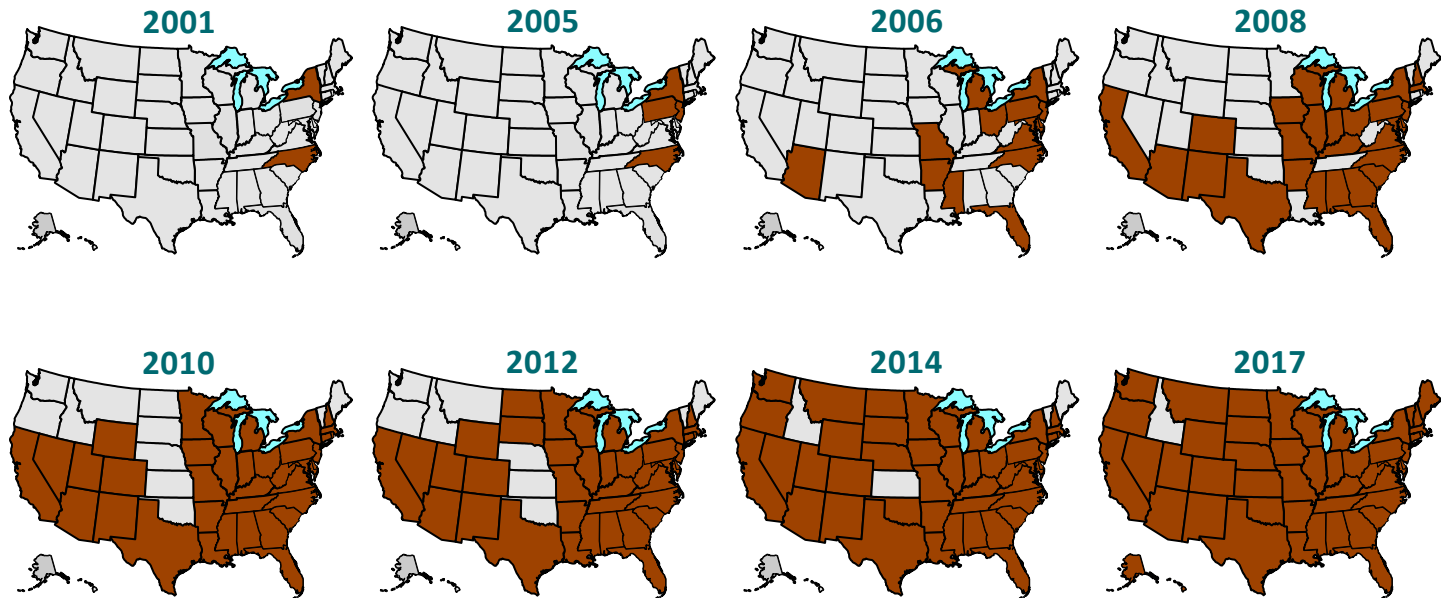


Think globally

Antibiotic Resistance: Containment Strategy

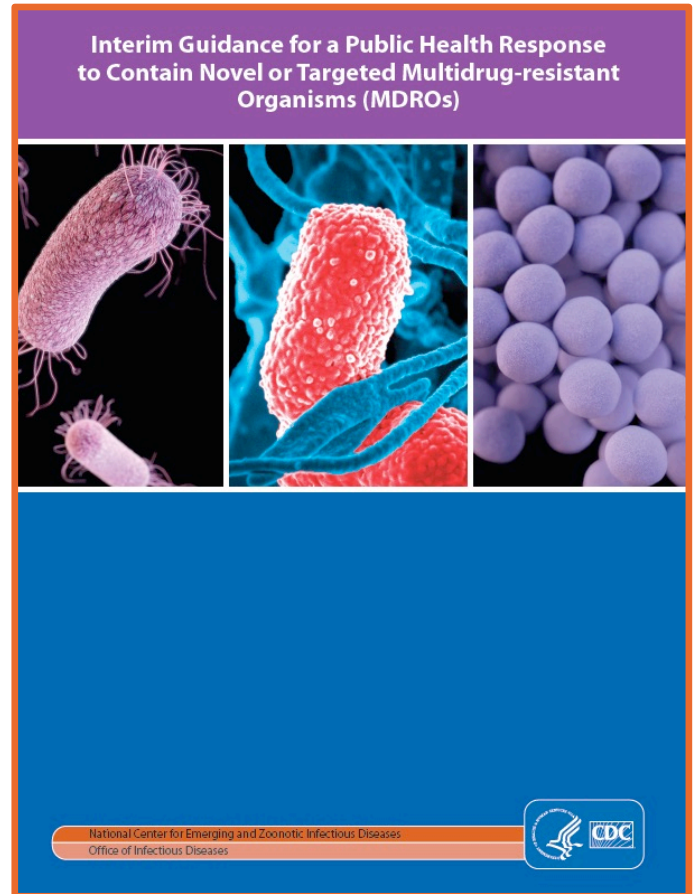
- Systematic approach to slow spread of novel or rare multidrug-resistant organisms or mechanisms through aggressive response to ≥ 1 case of targeted organisms
 - Carbapenemase-producing organisms, *mcr-1*
 - Pan-resistant organisms
 - *Candida auris*
- Emphasis on settings that historically are linked to amplification
 - Long term care facilities (e.g., skilled nursing)
 - Long term acute care facilities and high acuity skilled nursing (e.g., vSNF)

First type of CRE found in the US spread from 2 states in 2001 to 49 states, DC, and PR in 16 years



Containment Approach

- Main components
 - Detection
 - Infection control assessments
 - Colonization screenings
- Response tiers based on pathogen/resistance mechanism
- HAI/AR programs trained in containment approach through hands-on activities at Grantees Meeting and CSTE workshop
- Guidance document available on CDC website

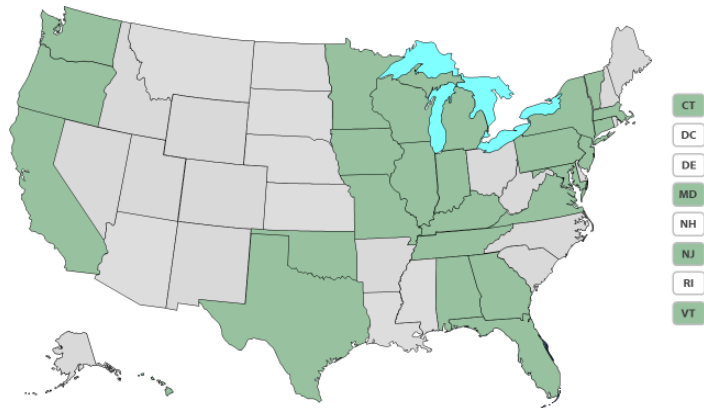


What are we doing for CRE, CR-*Pseudomonas aeruginosa*?

- Since January 1, 2017, **1532** CRE and **472** CRPA submitted to Antimicrobial Resistance Laboratory Network
 - **498 (25%)** carbapenemase-producers identified
 - **~15%** of carbapenemases are non-KPC (e.g., NDM, VIM, IMP, OXA-48)
- CDC consulted on **40** investigations of carbapenemase-producing organisms across **21** states
- **456** healthcare contacts screened
 - **62** asymptomatically-colonized individuals

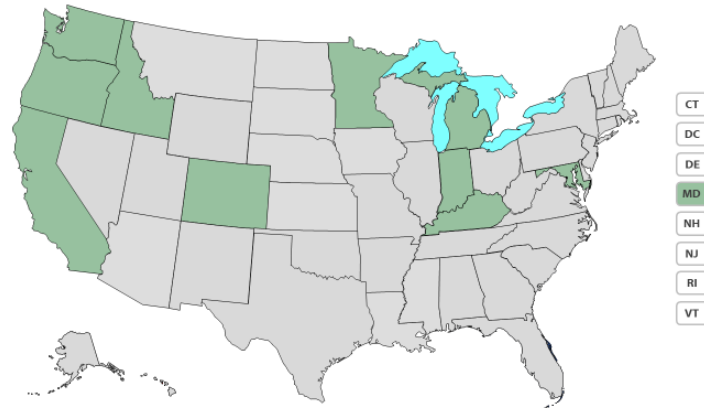
*CRE: Carbapenem-resistant Enterobacteriaceae; CRPA: Carbapenem-resistant *Pseudomonas aeruginosa*

OXA-48-Type-producing CRE cases in the U.S. as of July 2017



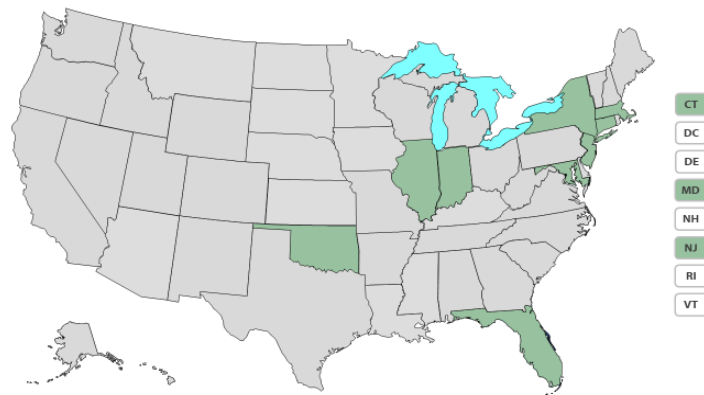
OXA-48 enzyme, 100 cases in 26 states

VIM-producing CRE cases in the U.S. as of July 2017



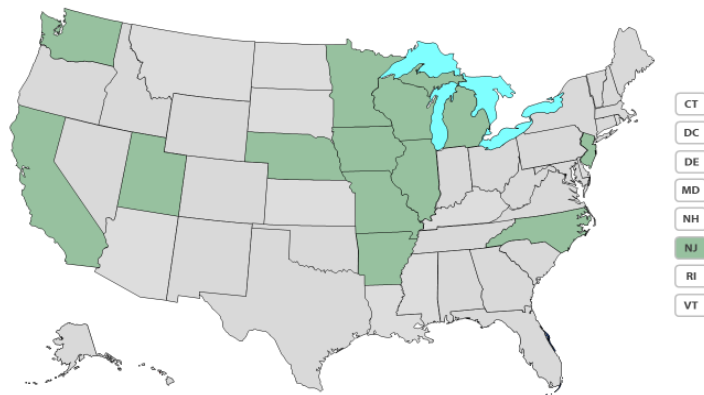
VIM-producing CRE, 27 cases in 10 states

Candida auris cases in the U.S. as of July 2017



Candida auris, 99 cases in 9 states

IMP-producing CRE cases in the U.S. as of July 2017

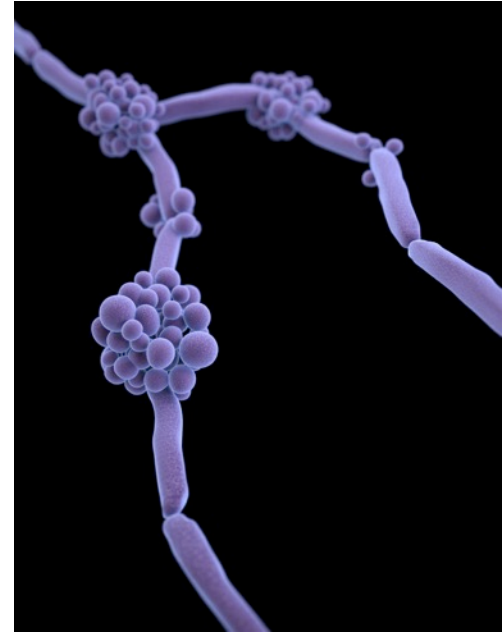


IMP-producing CRE, 30 cases in 13 states

***C. auris* INFECTIONS AROUND THE WORLD**

Proof that the old way of doing business to combat resistant threats will not be enough

- Unknown why unrelated *C. auris* strains have recently emerged in different countries
 - Causing invasive HAIs with high mortality
 - Some strains have elevated MICs to the three major antifungal classes, severely limiting treatment options
 - Specialized identification methods required – traditional biochemical methods could misidentify
- May not represent new organism so much as one that has either adapted to long-standing clinical practices, or emerged through changes in clinical practice



Water, Environment, and Devices.....

What are we learning?

New modes of transmission and reservoirs

- Duodenoscopes
 - NDM cluster identified issues with reprocessing duodenoscopes
 - New recommendations from CDC and FDA to improve safety
- Sink drains and hoppers
 - KPC-CRE outbreak and VIM-CRE outbreak
 - Lab work ongoing to describe extent of spread and to evaluate ways to prevent (e.g., lids on hoppers)

Duodenoscopes

- Used for diagnostic and the therapeutic interventions involving pancreas/ biliary tree
- About 600,000 procedures a year

Tip, Elevator
Mechanism



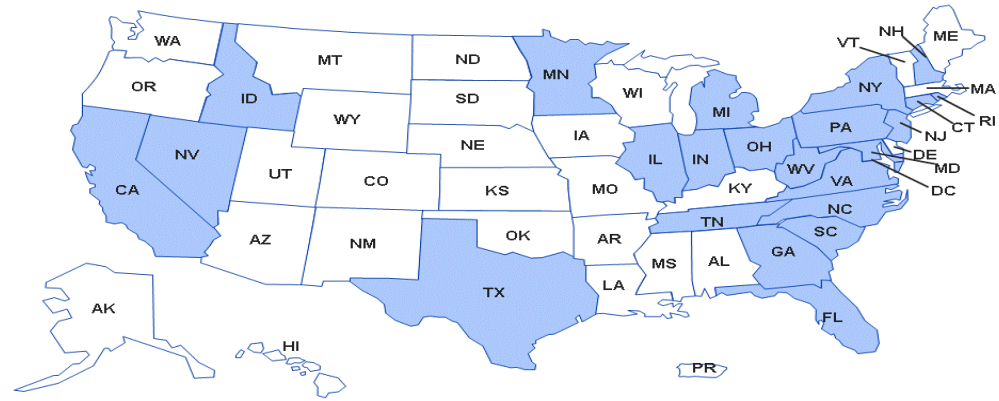
Elevator Mechanism

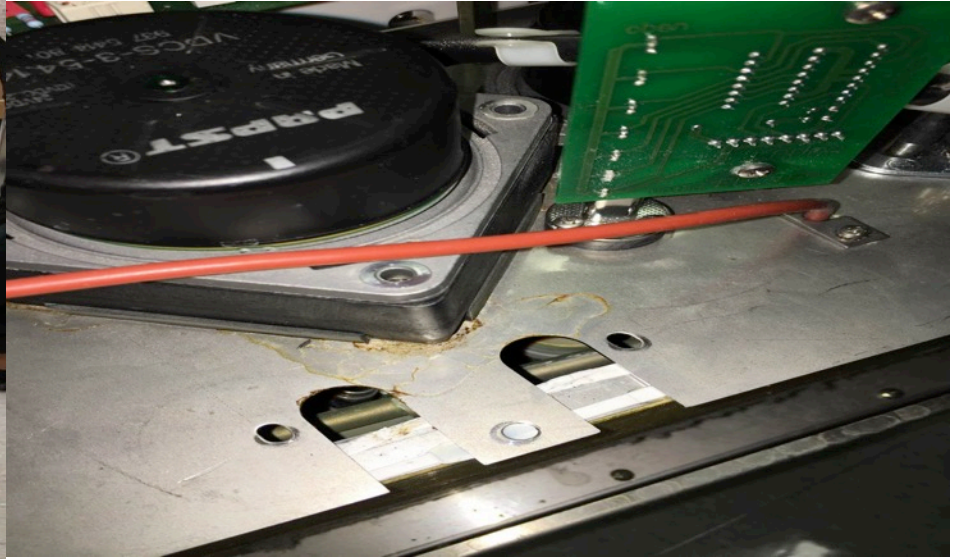


Method developed and implemented by CDC laboratory

Methylprednisolone Acetate (MPA) from NECC

- ❑ Three lots associated with infections (all preservative-free)
- ❑ Implicated lots distributed to 75 facilities in 23 states
- ❑ ~ 14,000 patients exposed
- ❑ 257 cases of infection (3 joints)
- ❑ 20 Deaths





Surgical site infections caused by NTM
After open heart surgeries
Due to Heater-cooler machines

Attaining perfect care:

- ❑ Optimally staffed, highly trained, competency-certified care delivery... plus:

- ❑ Improved hospital design

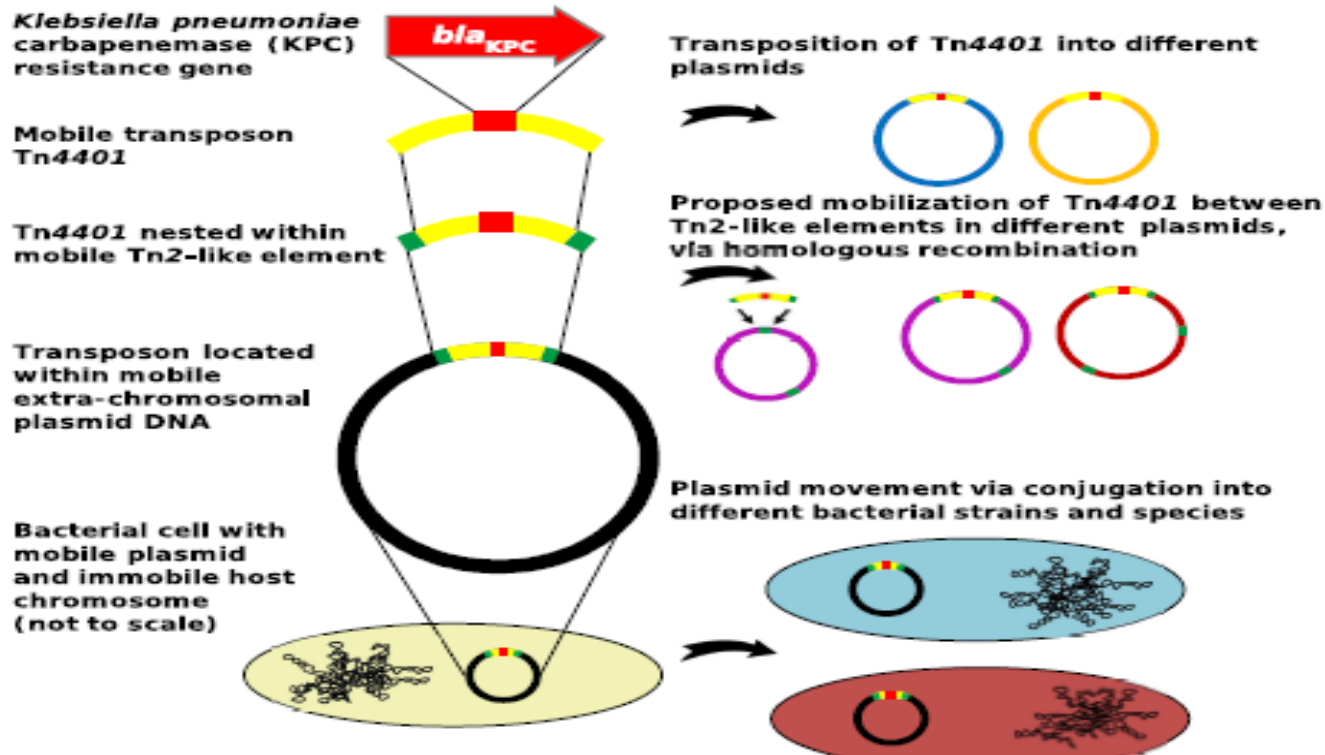
- ❑ Environmental interventions

- ❑ Innovations in materials and design

Precision Public Health

- ❑ Understanding patient factors (beyond traditional risk factors)
- ❑ Understanding bacterial genetics

Thinking Beyond The Resistant Bacteria Themselves: Plasmid and Gene Transfer



Sheppard AE et al. Nested Russian doll-like genetic mobility drives rapid dissemination of the carbapenem resistance gene *bla_{KPC}*. *Antimicrob Agents Chemother* 60:3767–3778.

Microbiome and Combating Antibiotic Resistance

- Research on the microbiome is a central component to drive innovations that will protect patients.
 - How antibiotics disrupt a healthy microbiome
 - How a disrupted microbiome puts people at risk
 - As well as develop and test microbiome measurements that monitor a patient's risk for disruption, and assess enhanced infection control triggers.

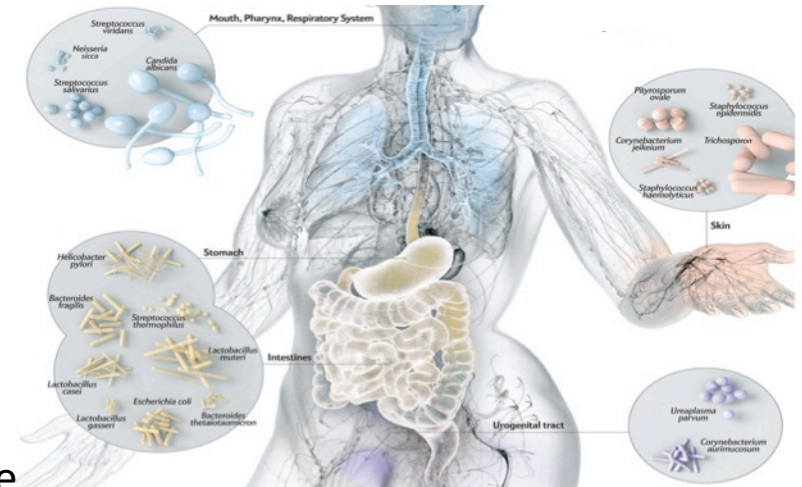
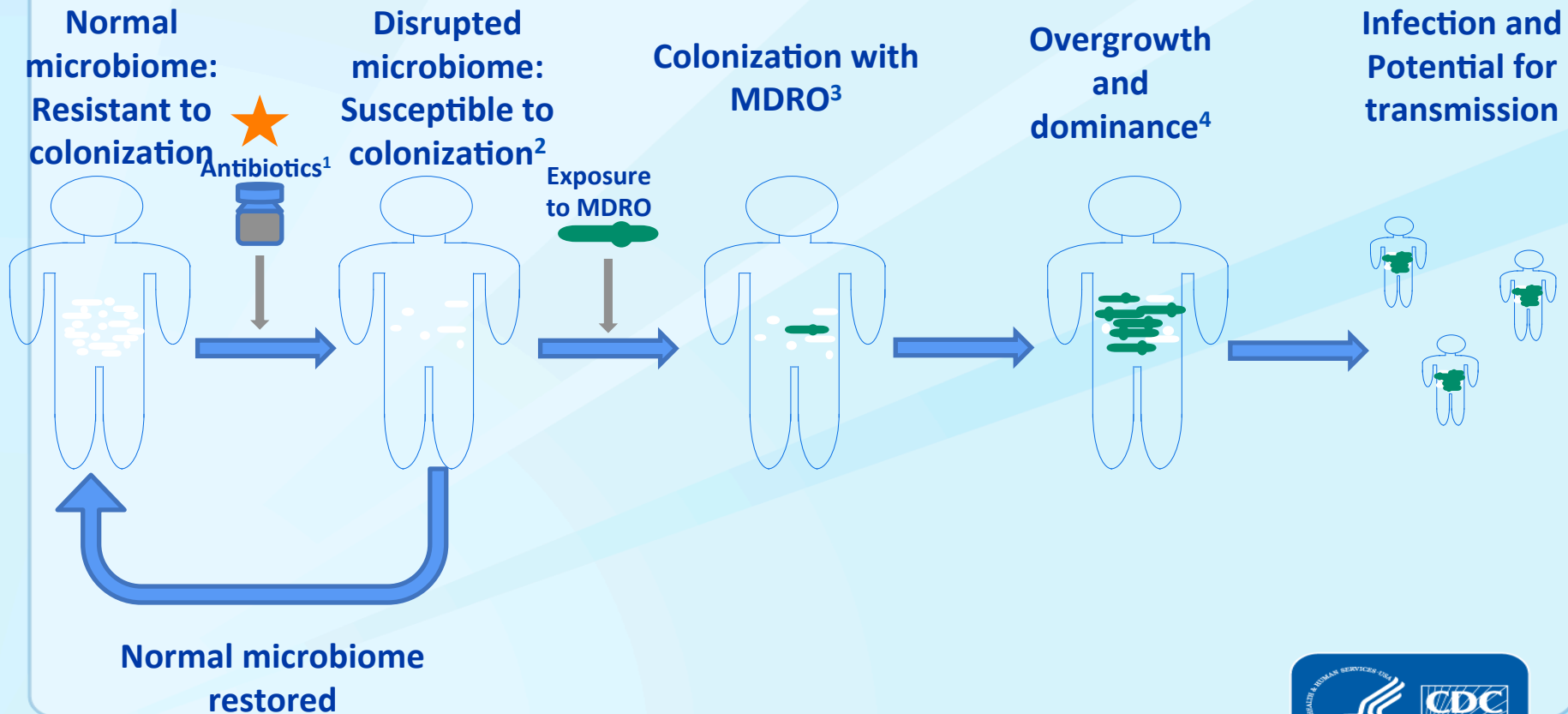


Image used with permission from www.BryanChristieDesign.com

Causal Pathway from Health to Disease

Microbiome Disruption Indices



Precision Public Health

- ❑ Understanding patient factors (beyond traditional risk factors)
- ❑ Understanding bacterial genetics
- Better assessment of transmission dynamics and potential prevention strategies
- Complements knowledge from traditional and innovative epidemiology

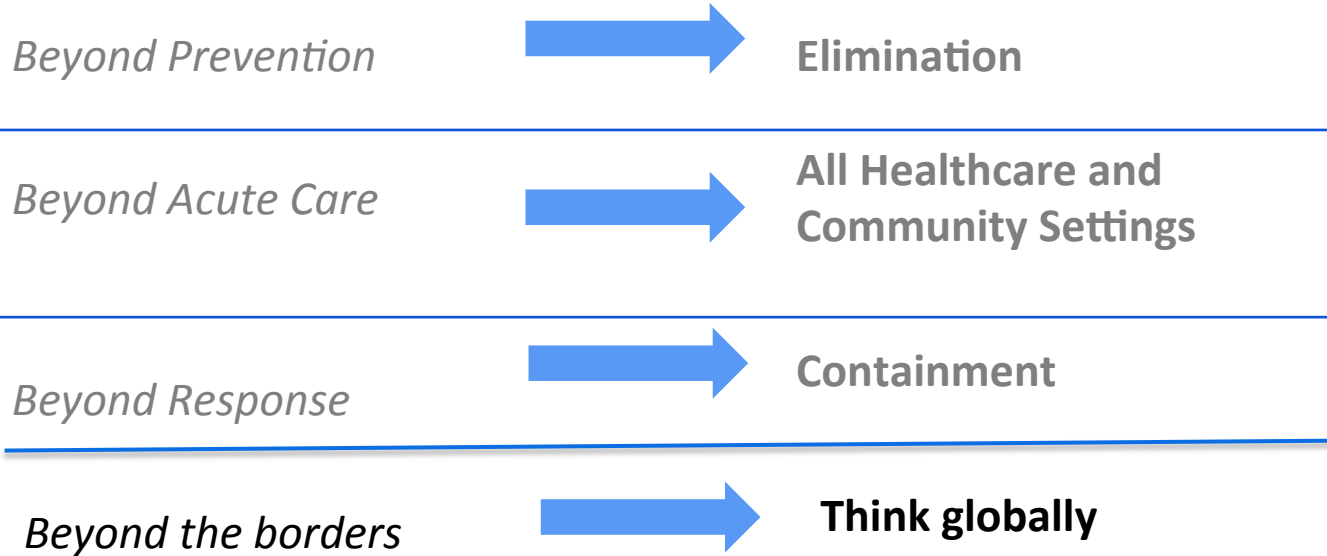
One size fits all



Tailored and
focused
approach

Similar expectations and rationale

Cultural Change in Expectations

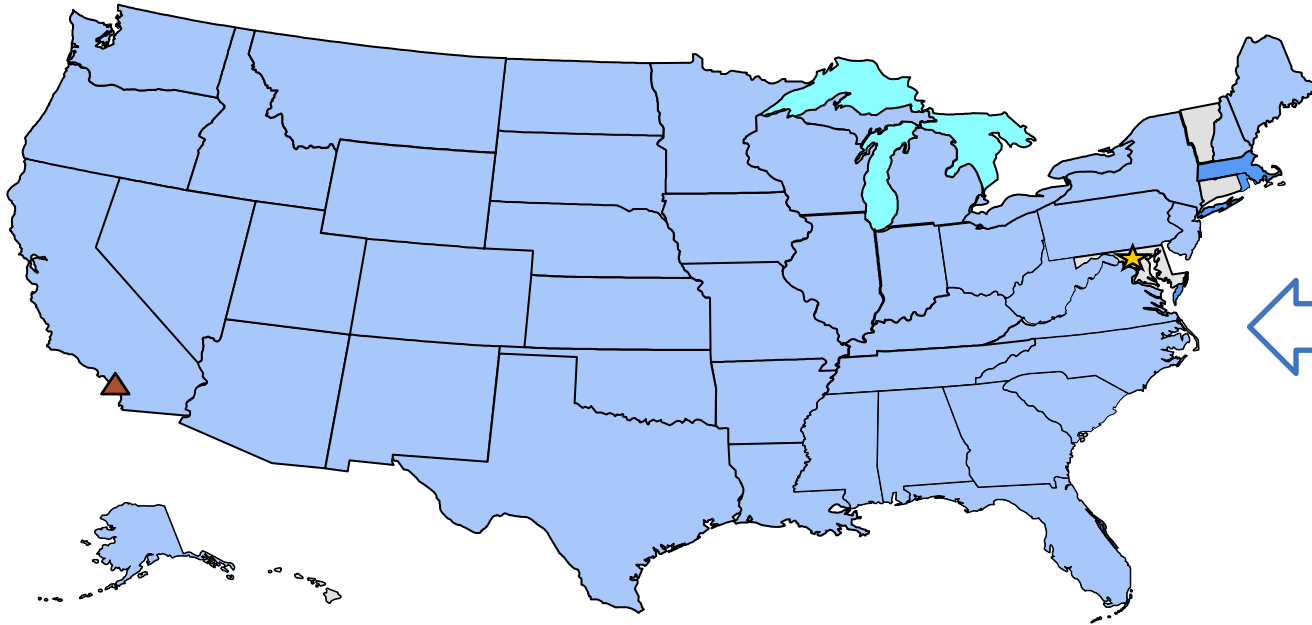


What are we learning?

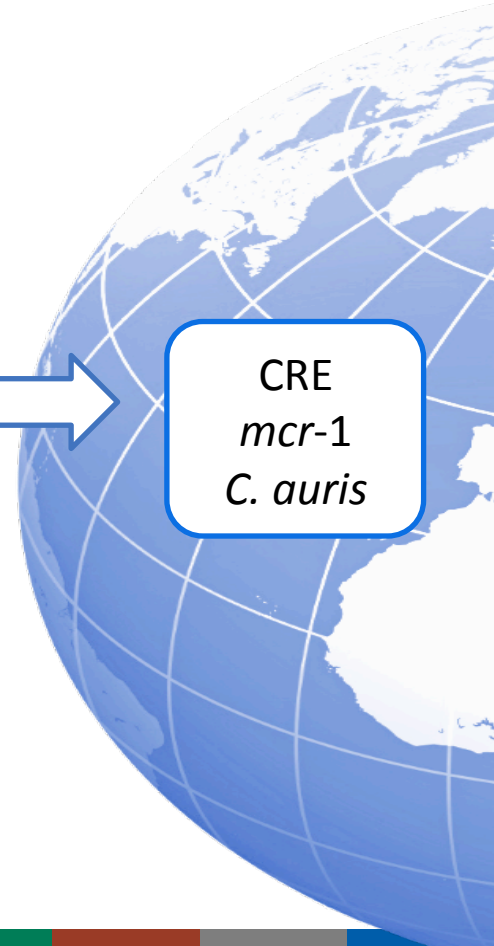
Resistant microorganisms do not respect borders

- Emerging resistant infection identified outside of large metropolitan areas
 - Imported from healthcare facilities in higher prevalence areas/
 - Environmental factor?
- Some patients with new resistant infection mechanism had international travel in year prior

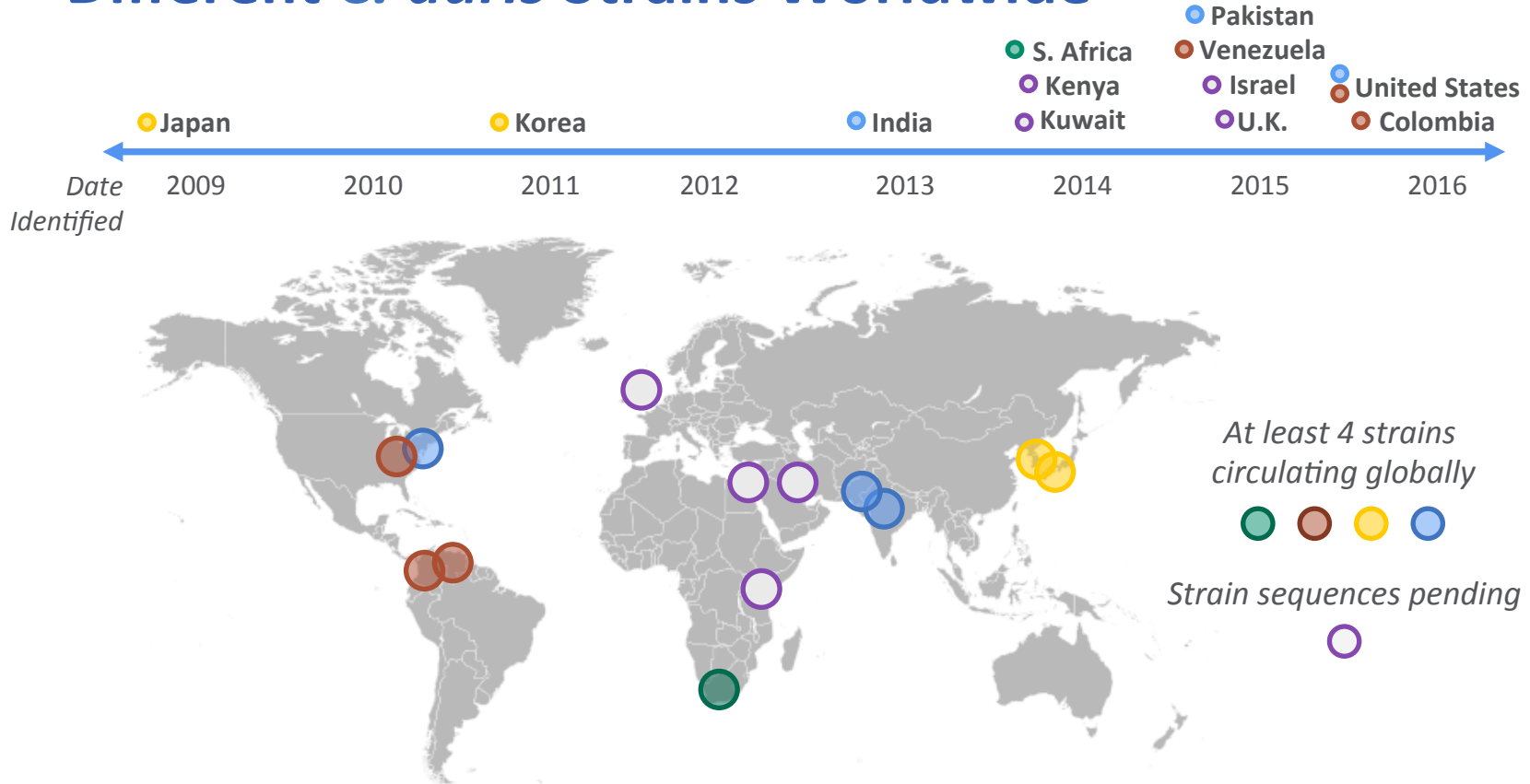
Antibiotic Resistance: Acting to Combat a Global Issue



CRE
mcr-1
C. auris



Retrospective Analyses Show Rapid Emergence of Different *C. auris* Strains Worldwide



CDC International Infection Control Program (IICP)

What We Do



Improve Infection Prevention and Control Capacity

IICP facilitates and strengthens capacity for implementation and evaluation of infection control programs and surveillance systems for healthcare-associated infections (HAI)



Reduce the Global Burden of Drug Resistance

IICP assists countries in developing national antimicrobial resistance action plans and prevention programs as well as establishing laboratory-based surveillance systems



Rapidly Respond to Outbreaks

IICP rapidly deploys scientists around the globe to investigate and control healthcare-related outbreaks

Prevent Infections: Where Do We Want To Be

- Every patient gets optimal care
- All healthcare providers are expected to practice infection control and use antibiotics correctly as part as 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 as part of their priorities



National and Global Momentum on HAI-AR:

National Plan to Prevent HAIs

CDC's Antimicrobial Resistant Threat Report (2013)

WHO Global Plan on Antimicrobial Resistance

National Action Plan on CARB (2015)

UNGA High-Level Meeting on AMR (2016)

G20 resolution (2017)



Expanded and Sustainable Partnerships

- Professional organizations beyond HAI
- Hospital associations, Nursing home association etc
- Healthcare systems
- Clinicians
- Industry
- Purchasers and payers
- Consumers

- Learning from each other
- Learning from other fields
- Global partners

Prevention is our Goal and Responsibility

Think holistically
Act locally to protect patients

Momentum is NOW
and always....

