The Current and Future State of Infection Prevention & Control

What's New in Medicine, September 2019

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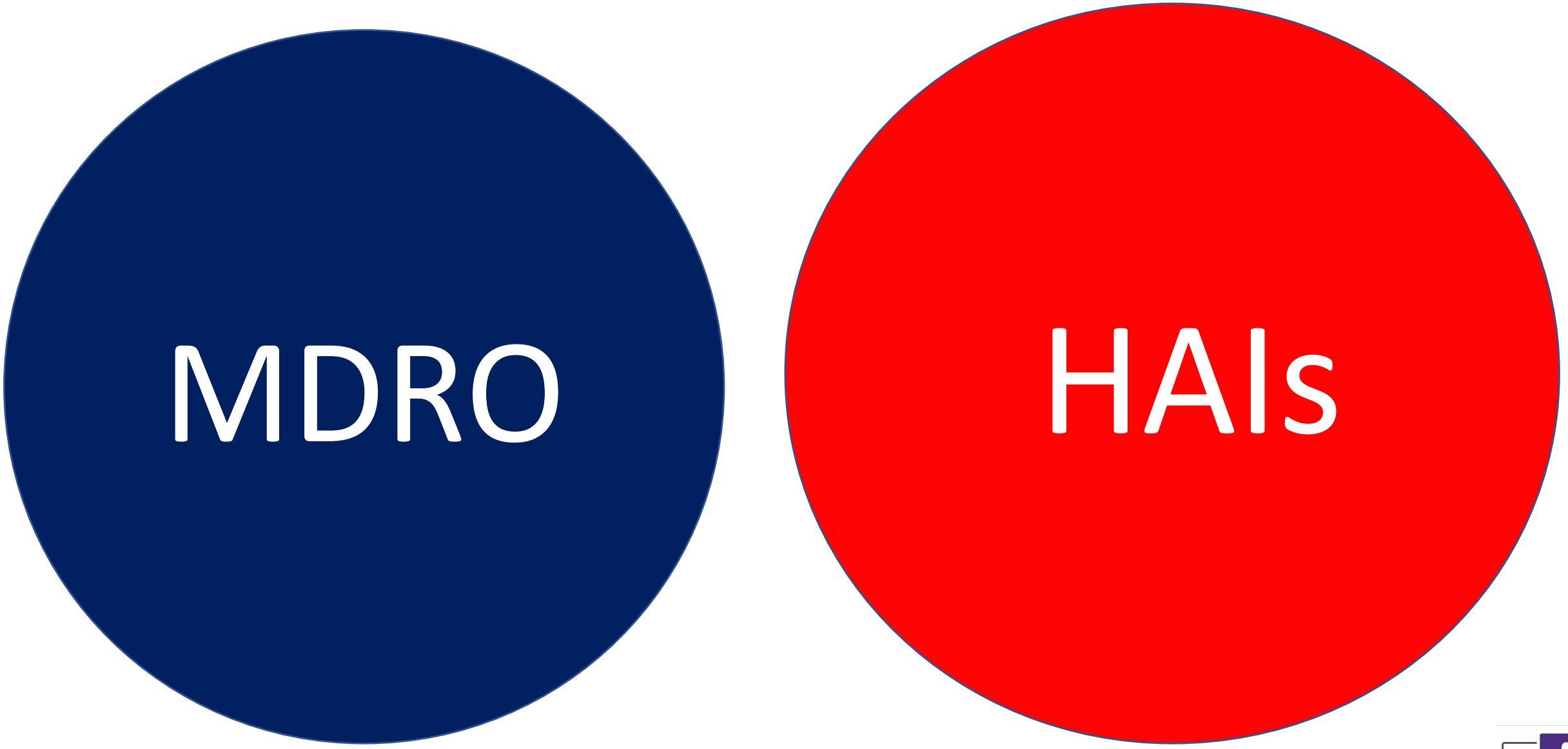
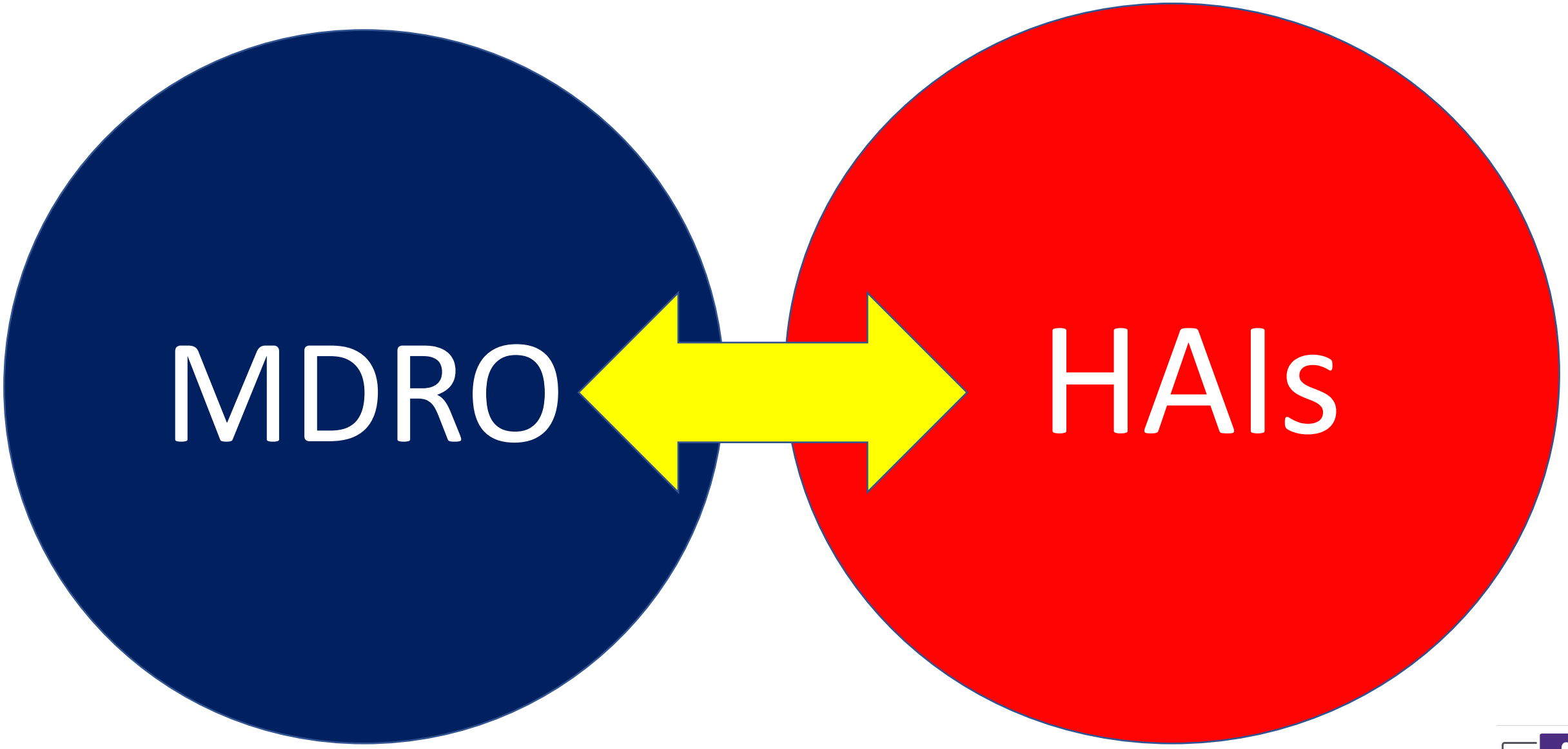
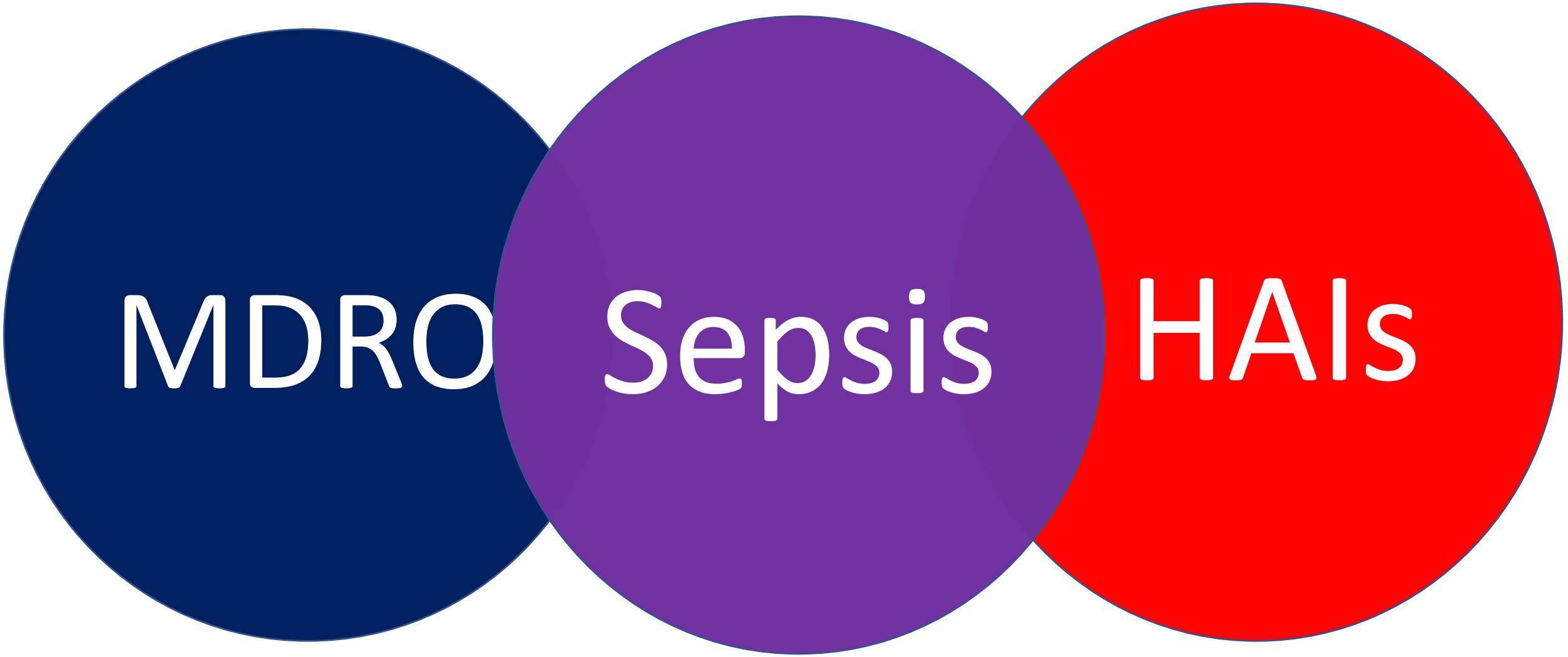
No relevant financial relationships with commercial interests to disclose.


MDRO
HAIs


MDRO
HAIs


MDRO
Sepsis
HAIs

THE LANCET
Global Health

Global infection prevention and control priorities 2018–22: a call for action

THE
Globa

Global i

a call fo

8–22:

Panel: Call for action

Priorities for IPC at country level

Countries where IPC has just started

- Decisive and visible political commitment, including IPC policy development and enforcement
- Availability of resources (both human and infrastructure)
- Establishment and execution of IPC programmes at the national and acute health facility levels to ensure advocacy, training and data for future improvement and sustainability
- Action to increase availability of in-country IPC knowledge and expertise

Countries with advanced IPC programmes

- Increased accountability with IPC as a quality indicator
- Development of advanced information technology tools to support IPC monitoring and implementation
- Translation of information through enhanced communications to sustain awareness and engagement
- Credible incentives considering the local context to increase compliance rates
- Enhanced education and training to embed IPC knowledge across all disciplines

TH
Glo

Glob **8–22:**
a call

Priorities for IPC at the global level

Strengthen IPC in the health system perspective

- Strengthen IPC visibility and advocacy: convince decision-makers and stakeholders
- Lead on IPC knowledge development: create standardised curricula templates that can be adapted locally ("adapt to adopt") and stimulate further research on priority areas
- Foster and promote IPC as a marker of quality: establish international IPC minimum standards
- Build active networks and stronger communications:- ensure that patient safety and quality improvement leaders, as well as other health workers across all disciplines, are engaged to advocate for IPC

Elevate the role of IPC specifically to better combat AMR

- Strengthen the power to act: secure support for a "top-down" chief executive approach, empower IPC leads
- Improve evidence presentation to leaders: effectively outline available data and other information on the impact of IPC solutions on AMR
- Expand the narrative: help people visualise how IPC programmes can lead to AMR risk reduction

HAIs in the United States

Table 4. Estimated Numbers of Major Types of Health Care–Associated Infection in the United States in 2011.

Type of Infection	Infections Identified in Survey	Surveyed Patients with Type of Infection	Estimated Infections in the United States*
	no.	*% (95% CI)*	*no. (95% CI)*
All health care–associated infections			
Pneumonia	110	24.3 (20.6–28.5)	157,500 (50,800–281,400)
Surgical-site infection	110†	24.3 (20.6–28.5)	157,500 (50,800–281,400)
Gastrointestinal infection	86	19.0 (15.6–22.8)	123,100 (38,400–225,100)
Urinary tract infection	65	14.4 (11.4–17.9)	93,300 (28,100–176,700)
Primary bloodstream infection	50	11.1 (8.4–14.2)	71,900 (20,700–140,200)
Eye, ear, nose, throat, or mouth infection	28‡	6.2 (4.2–8.7)	40,200 (10,400–85,900)
Lower respiratory tract infection	20	4.4 (2.8–6.6)	28,500 (6900–65,200)
Skin and soft-tissue infection	16	3.5 (2.1–5.6)	22,700 (5200–55,300)
Cardiovascular system infection	6	1.3 (0.5–2.7)	8,400 (1200–26,700)
Bone and joint infection	5	1.1 (0.4–2.4)	7,100 (1000–23,700)
Central nervous system infection	4	0.9 (0.3–2.1)	5,800 (700–20,700)
Reproductive tract infection	3	0.7 (0.2–1.8)	4,500 (500–17,800)
Systemic infection	1	0.2 (0.01–1.1)	1,300 (0–10,900)
Total			721,800 (214,700–1,411,000)
Infections in non-neonatal intensive care units			
Catheter-associated urinary tract infection	25	5.5 (3.7–7.9)	35,600 (9100–78,000)
Central-catheter–associated primary bloodstream infection	11	2.4 (1.3–4.2)	15,600 (3200–41,500)
Ventilator-associated pneumonia	35	7.7 (5.5–10.5)	49,900 (13,600–103,700)
Surgical-site infections attributed to Surgical Care Improvement Project procedures§	46	10.2 (7.6–13.2)	66,100 (18,700–130,300)
Hospital-onset infections caused by specific pathogens			
Clostridium difficile infection¶	56	12.4 (9.6–15.7)	80,400 (23,700–155,000)
MRSA bacteremia‖	7	1.5 (0.7–3.0)	9,700 (1700–29,600)

721,800

N Engl J Med 2014;370:1198-1208

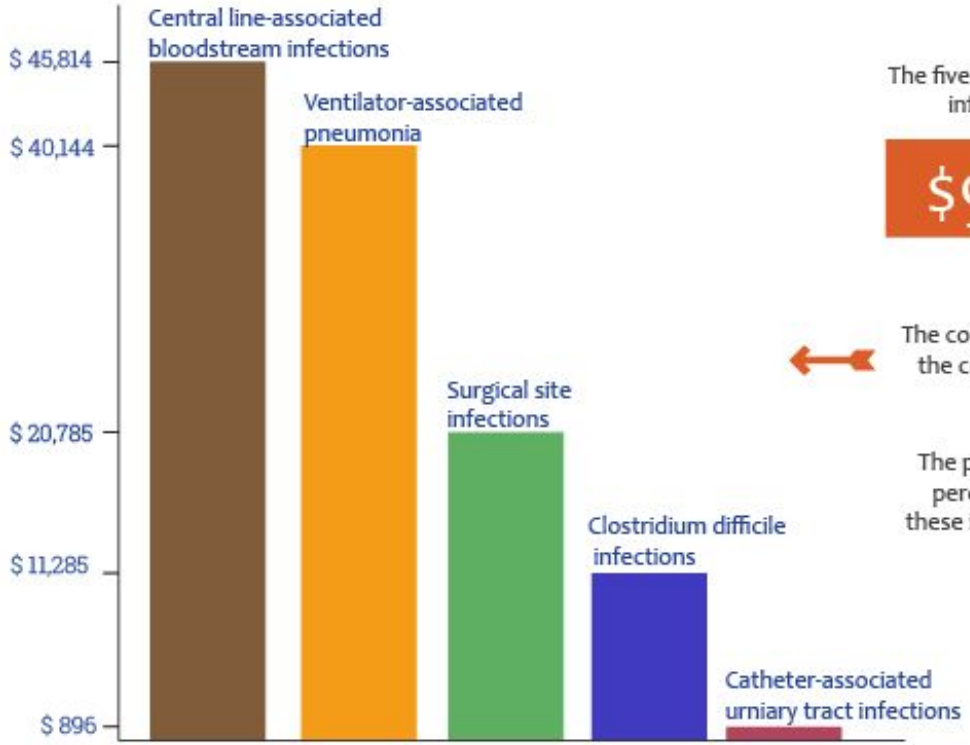
WA State Acute Care Hospitals

Washington Data by HAI Type

HAI Type	# OF FACILITIES THAT REPORTED DATA TO CDC'S NHSN, 2017+	2017 STATE SIR VS. 2016 STATE SIR	2017 STATE SIR VS. 2017 NATIONAL SIR	2017 STATE SIR VS. NATIONAL BASELINE*	2017 STATE SIR	2017 NATIONAL SIR
CLABSI	58	14%	-25%	-39%	0.61	0.81
CAUTI	60	3%	14%	0%	1.00	0.88
VAE	28	11%	-25%	-28%	0.72	0.95
SSI: Abdominal Hysterectomy	49	3%	27%	-35%	0.65	0.89
SSI: Colon Surgery	51	2%	5%	14%	0.86	0.91
MRSA Bacteremia	57	20%	-36%	-45%	0.55	0.86
C. *difficile* Events	57	-11%	18%	-6%	0.94	0.80

Costs of the five most common hospital-acquired infections (HAIs) in the US

Costs per case



The five most common hospital-acquired infections (HAIs) cost the US

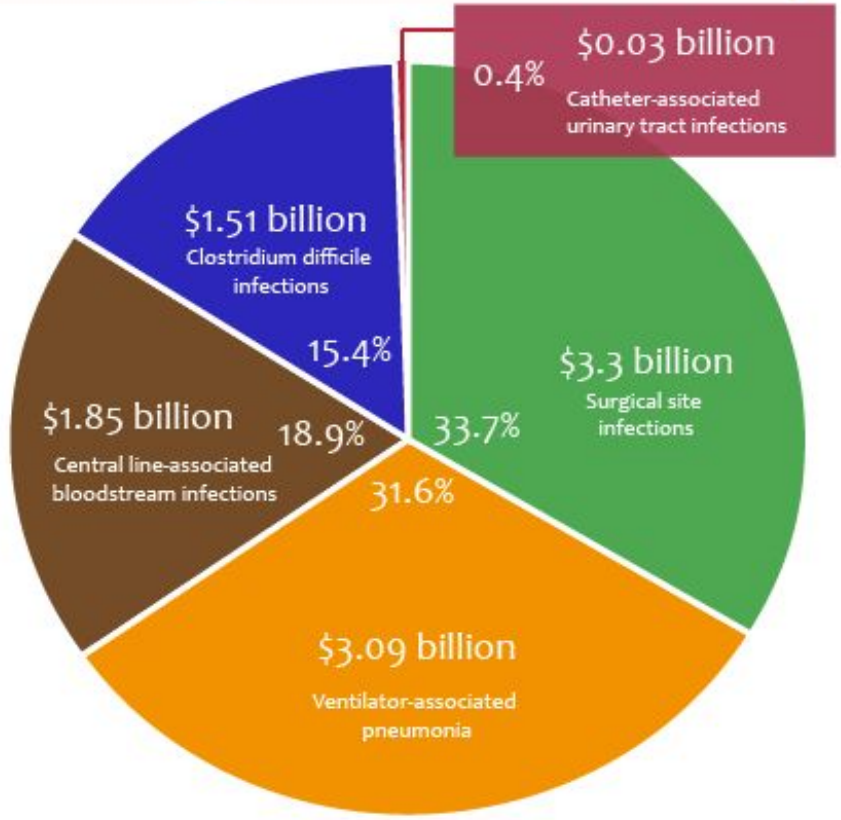
$9.8 billion

annually.

The column graph on the left shows the cost per infection for each of these infections.

The pie-chart on the right displays the percentage contribution of each of these infections to this total annual cost.

Percentage share of total annual costs



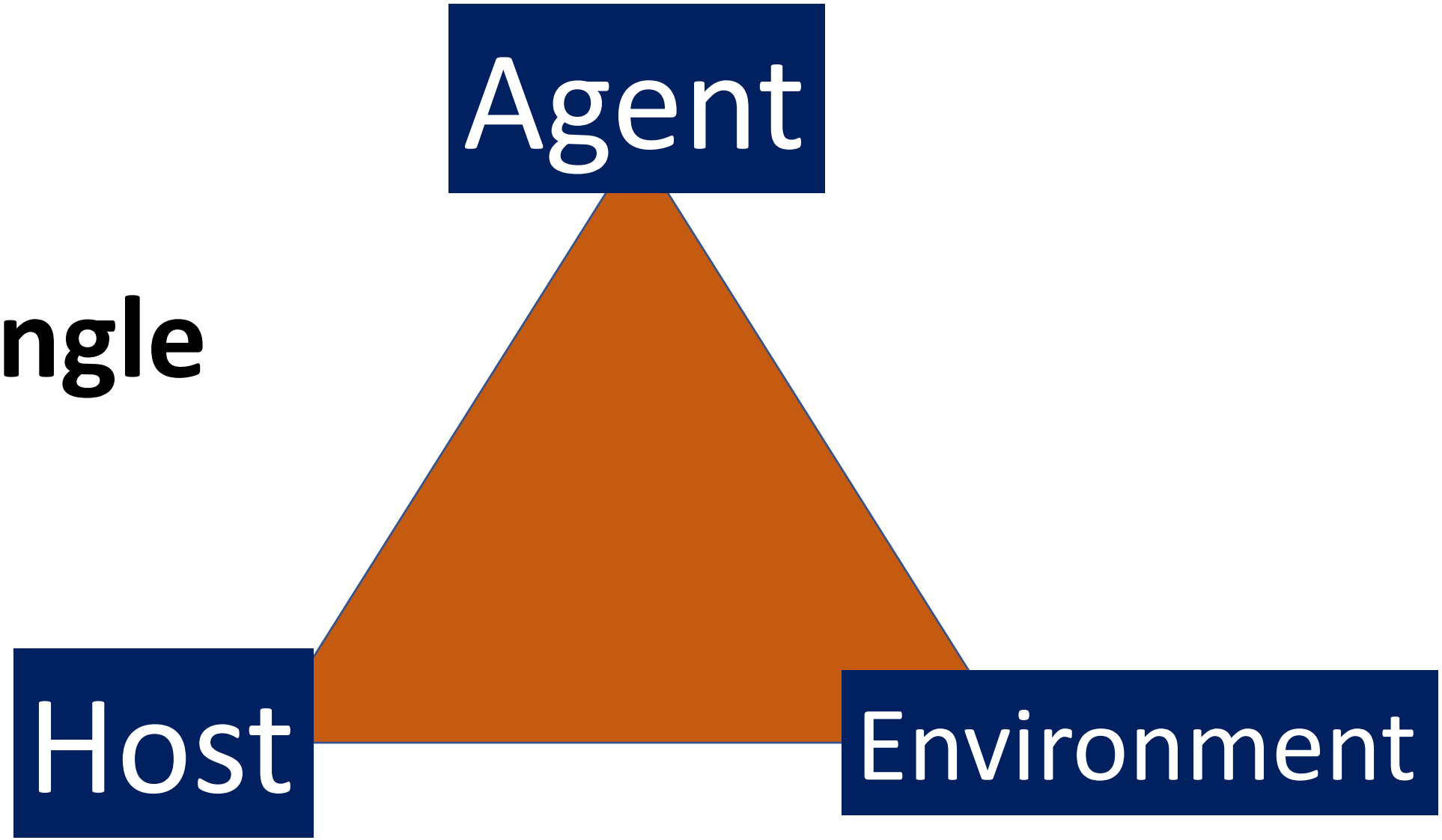
Data source: Eyal Zimlichman, Daniel Henderson, Orly Tamir, Calvin Franz, Peter Song, Cyrus K. Yamin, Carol Keohane, Charles R. Denham, & David W. Bates. Health Care–Associated Infections: A Meta-analysis of Costs and Financial Impact on the US Health Care System. *JAMA Internal Medicine*.

CDDEP THE CENTER FOR Disease Dynamics, Economics & Policy
WASHINGTON DC • NEW DELHI

CC BY NC SA

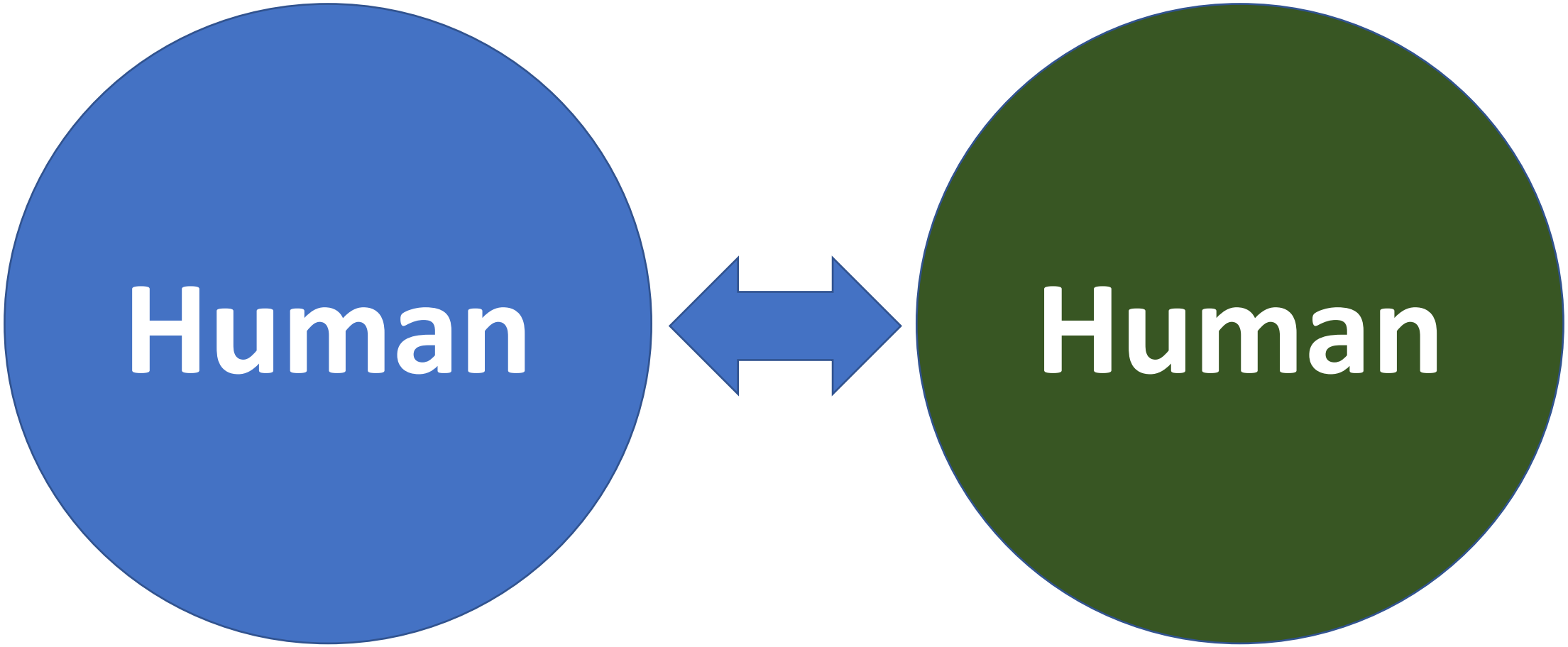
What works to prevent HAIs…

The Epi Triangle

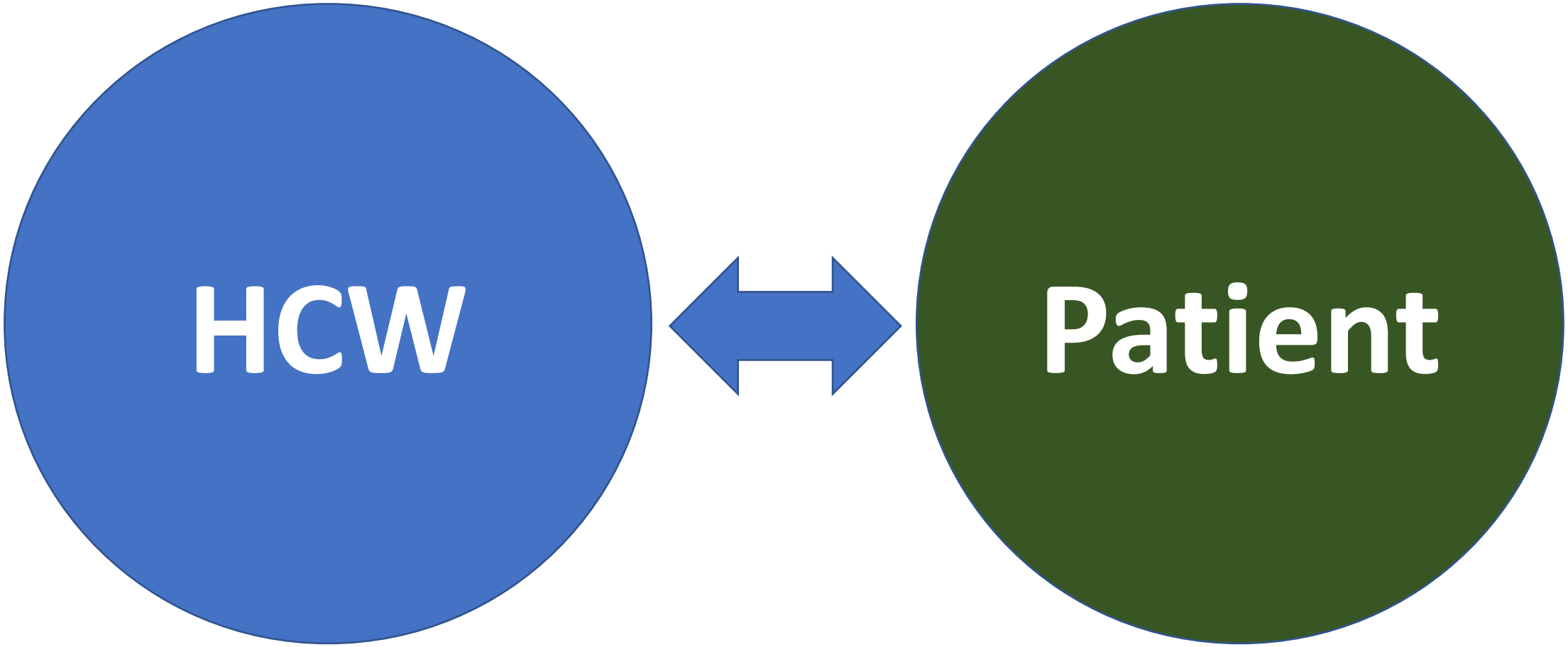


CDC.gov

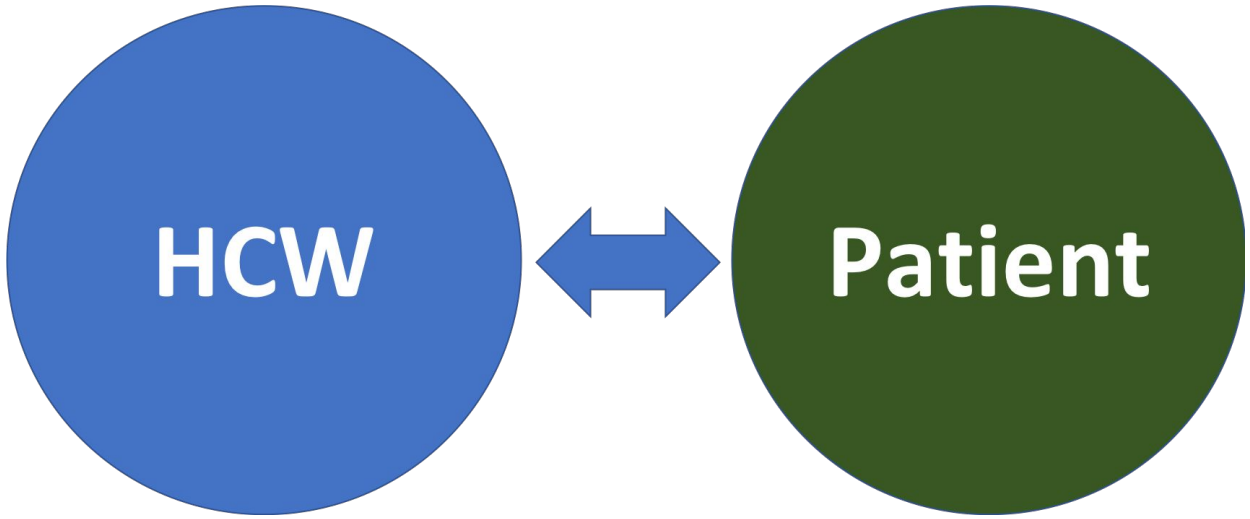
Direct Human Transmission



Direct Human Transmission

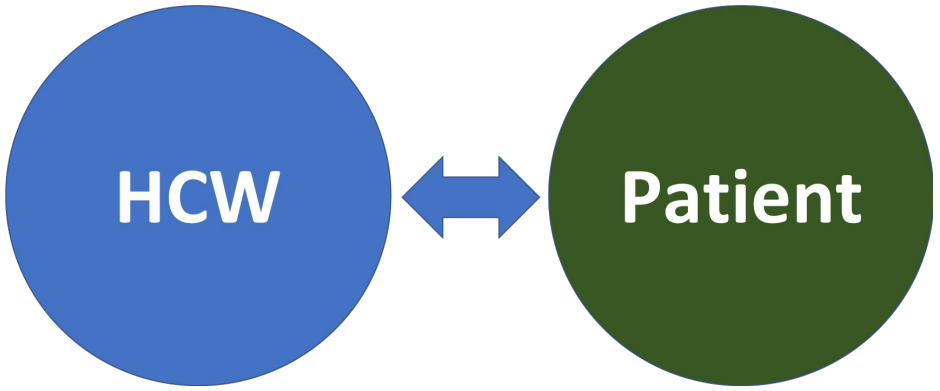


Direct Human Transmission



MRSA
Influenza
Norovirus
Scabies
hepatitis B

Direct Human Transmission

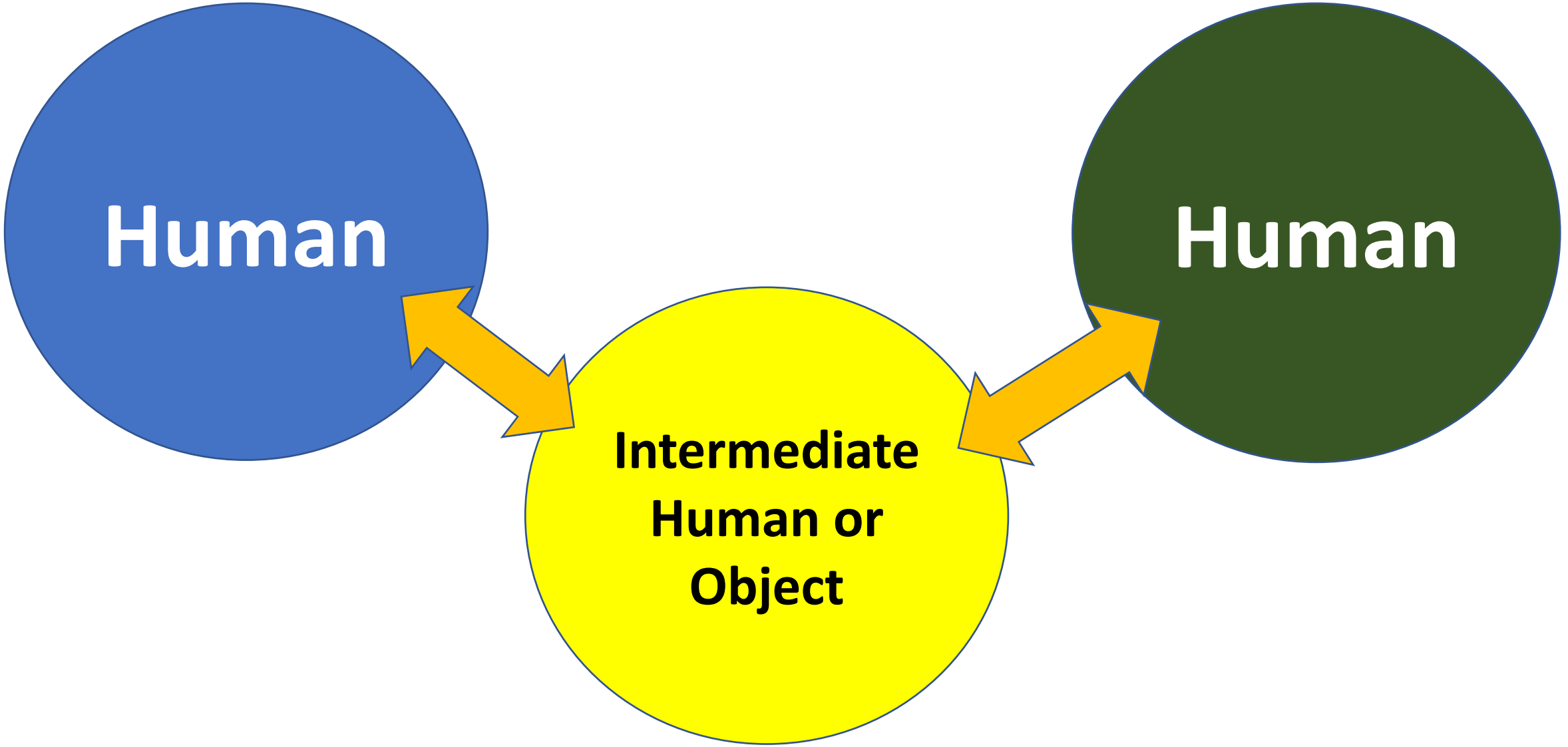


Eastside | Health | Local News | Northwest | Puget Sound

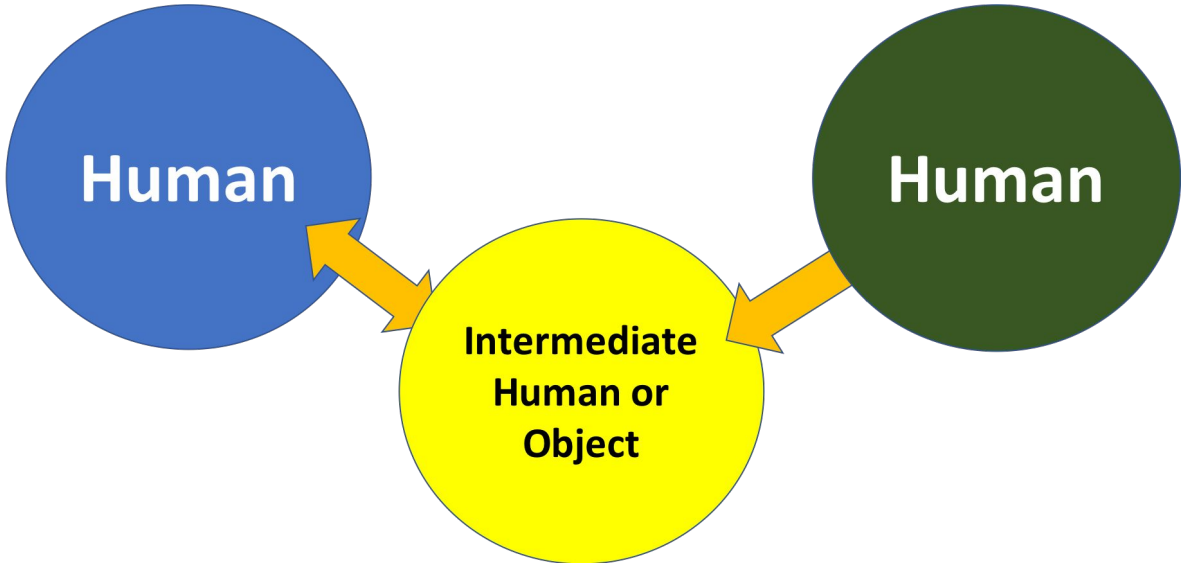
Seattle Children's hospital nurse diagnosed with measles

July 15, 2019 at 5:44 pm

Indirect Transmission

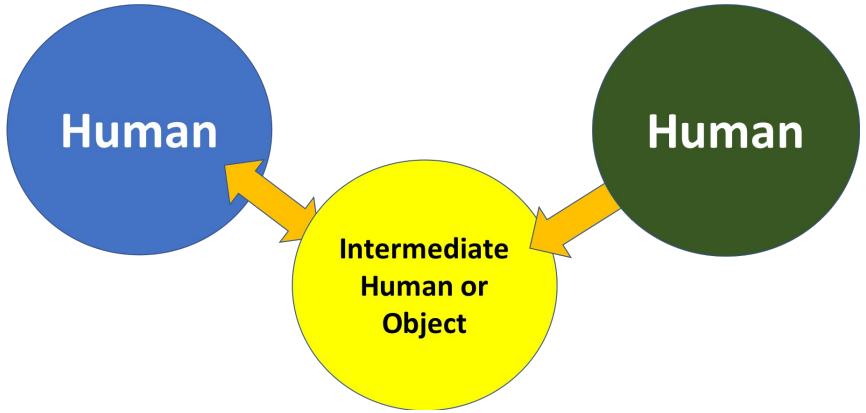


Indirect Transmission



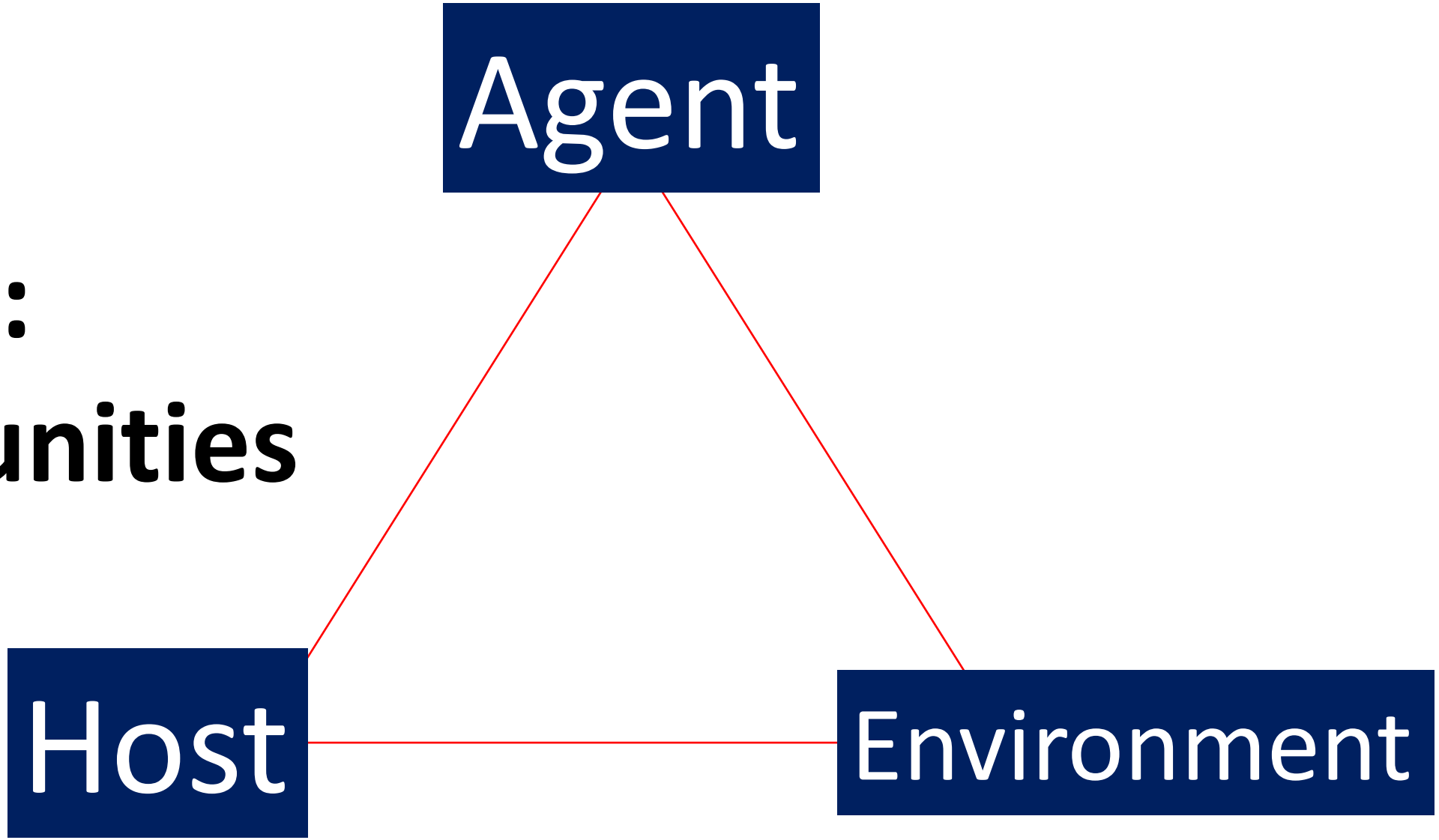
HCW hands
Surfaces, water, air
Catheters, devices
Instruments
Toys
Clothing

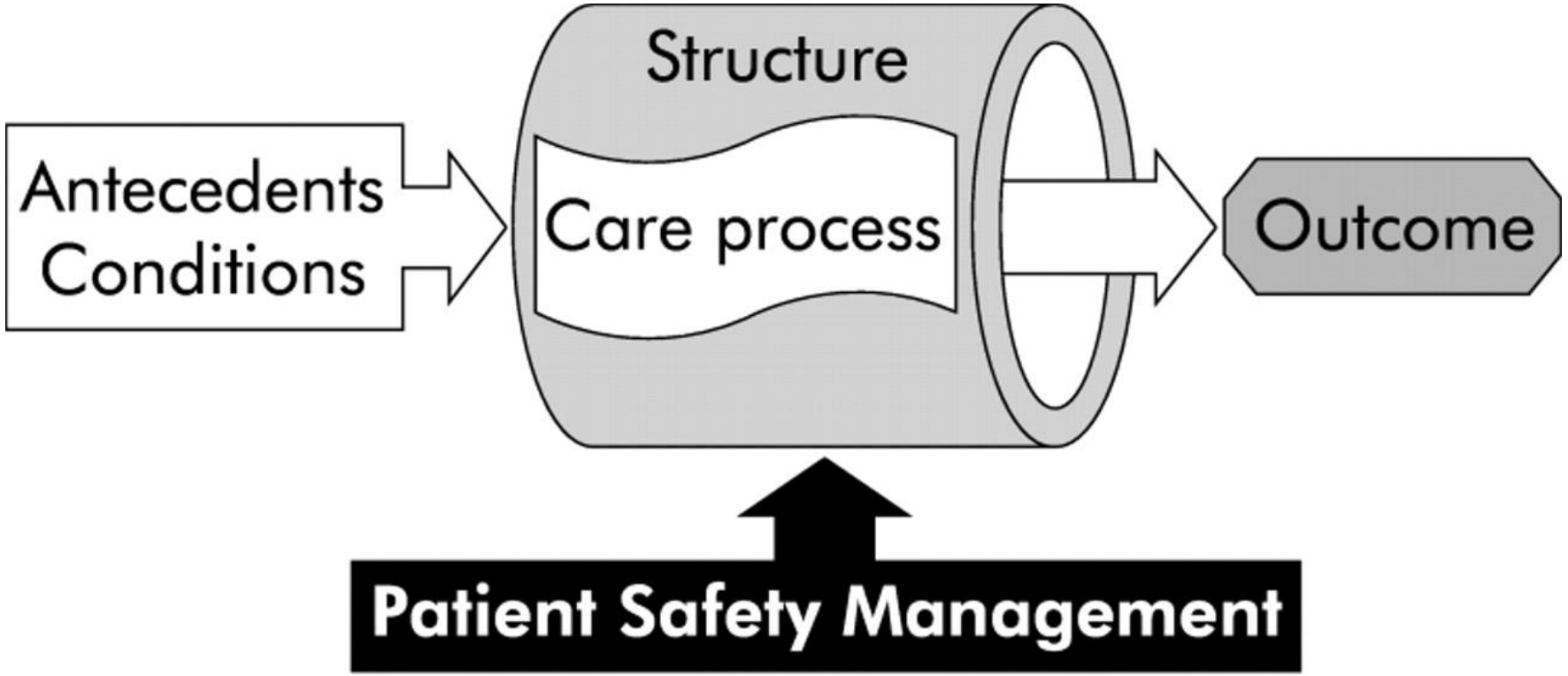
Indirect Transmission



1 dead, 5 infected by mold that halted Seattle Children's Hospital surgeries

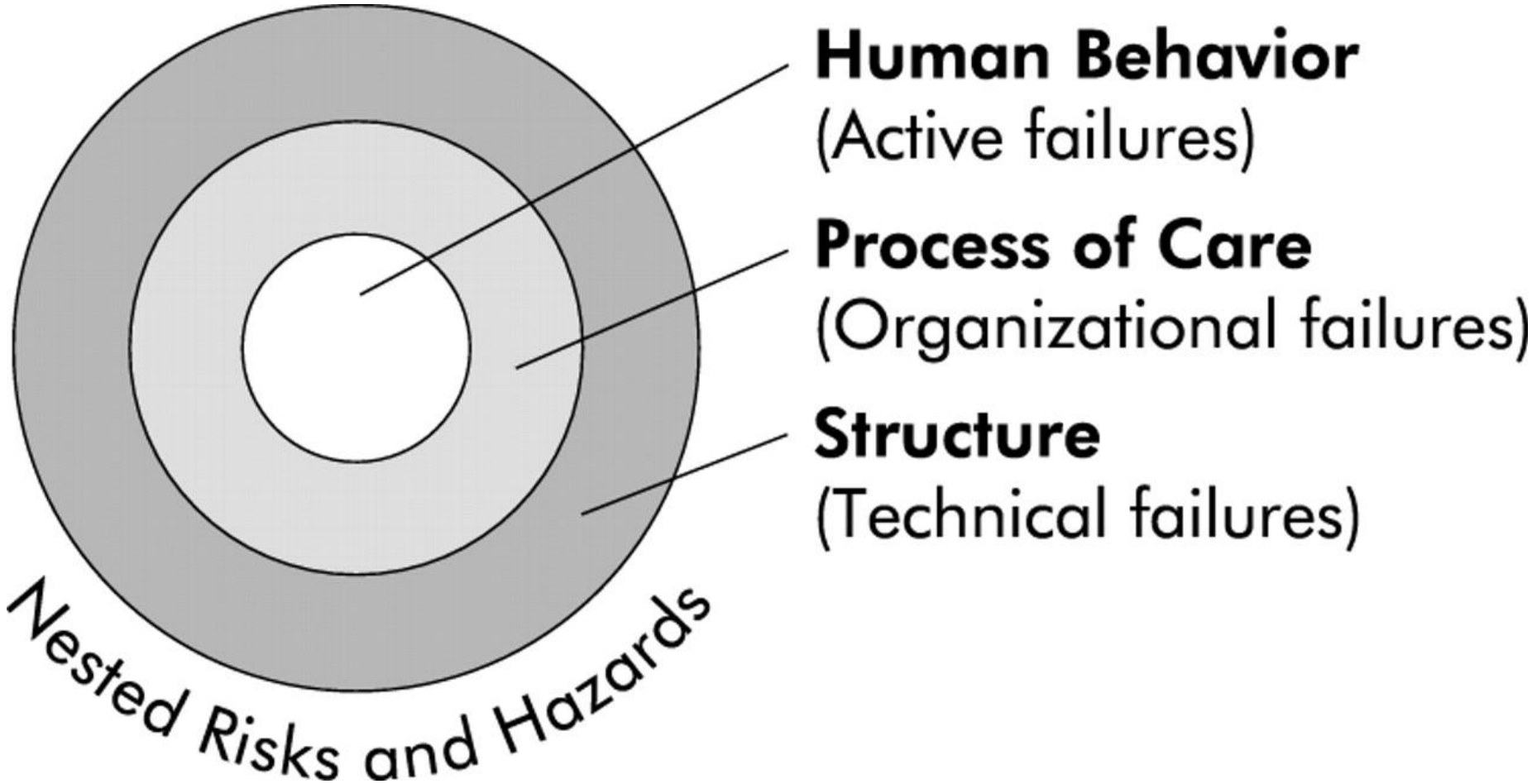
The Epi Triangle: Opportunities





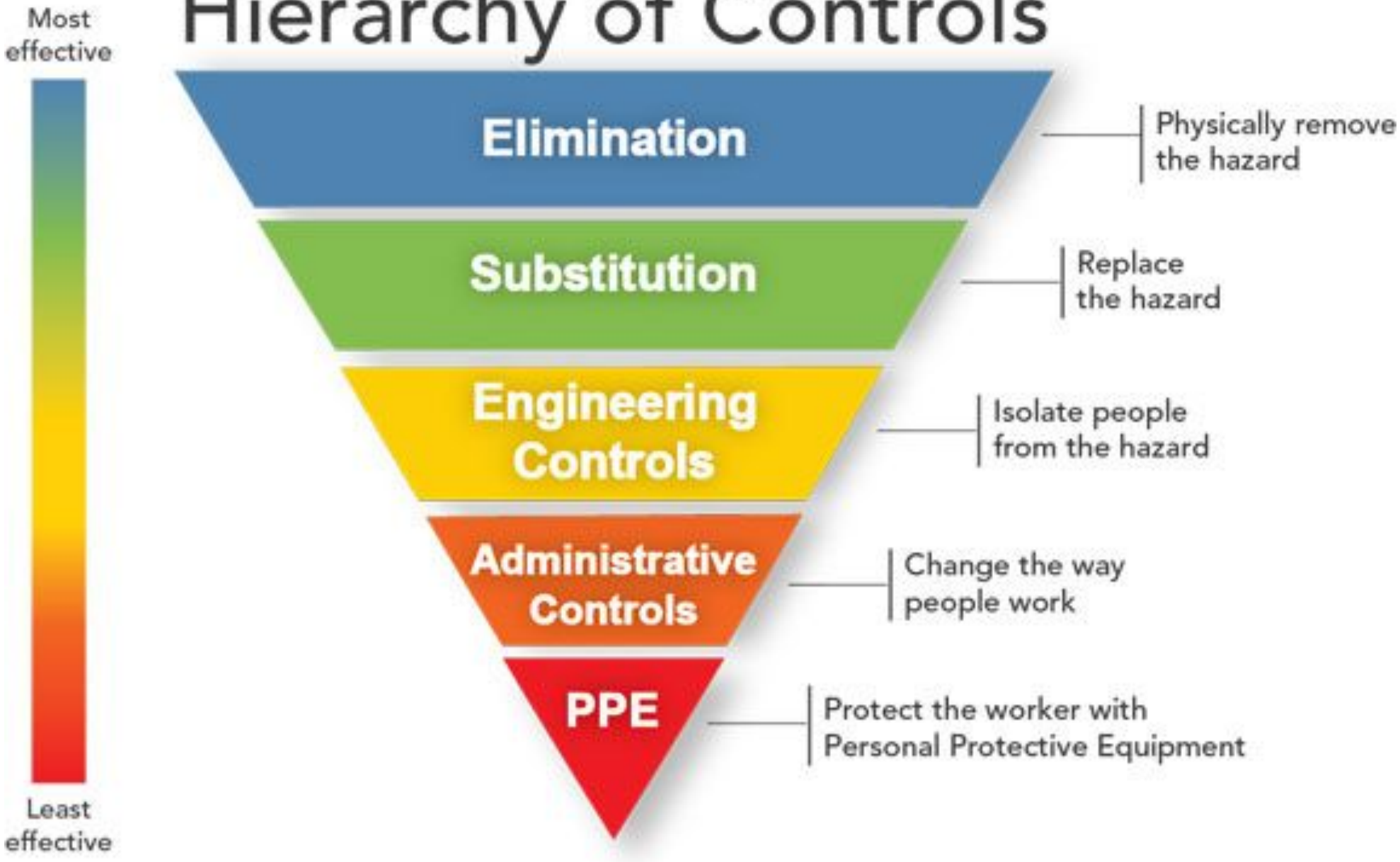
Adjust structure and process to eliminate or minimize risks of health care associated injury before they have an adverse event that impacts on the outcomes of care

J B Battles, and R J Lilford Qual Saf Health Care 2003;12:ii2-ii7



J B Battles, and R J Lilford Qual Saf Health Care 2003;12:ii2-ii7

Hierarchy of Controls



Surfaces

High Touch
Railings
Pumps
Door handles
Supply carts

Low Touch
Toilets
Sinks
Monitors
Mobile work stations

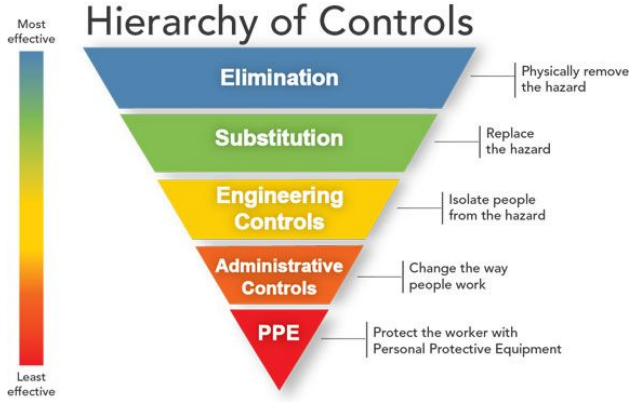
Microbial Survival

Survival of Select Pathogens on Environmental Surfaces

Pathogen	Survival Time
Bacteria	
C. difficile	≥1 year
MRSA	7 days–7 months
VRE	5 days–4 months
Viruses	
Hepatitis B	≥1 month
Norovirus	8 hours–7 days

Kramer, BMC ID, 2016

Surfaces: Actions



- Minimize surfaces
- Make them easy to clean
- Schedule and train to clean all surfaces/objects regularly
- Challenges:
  - Who is responsible?
  - Is it getting done?
  - How to monitor?

Surfaces

Logical Pattern of Cleaning, From Cleanest to Dirtiest

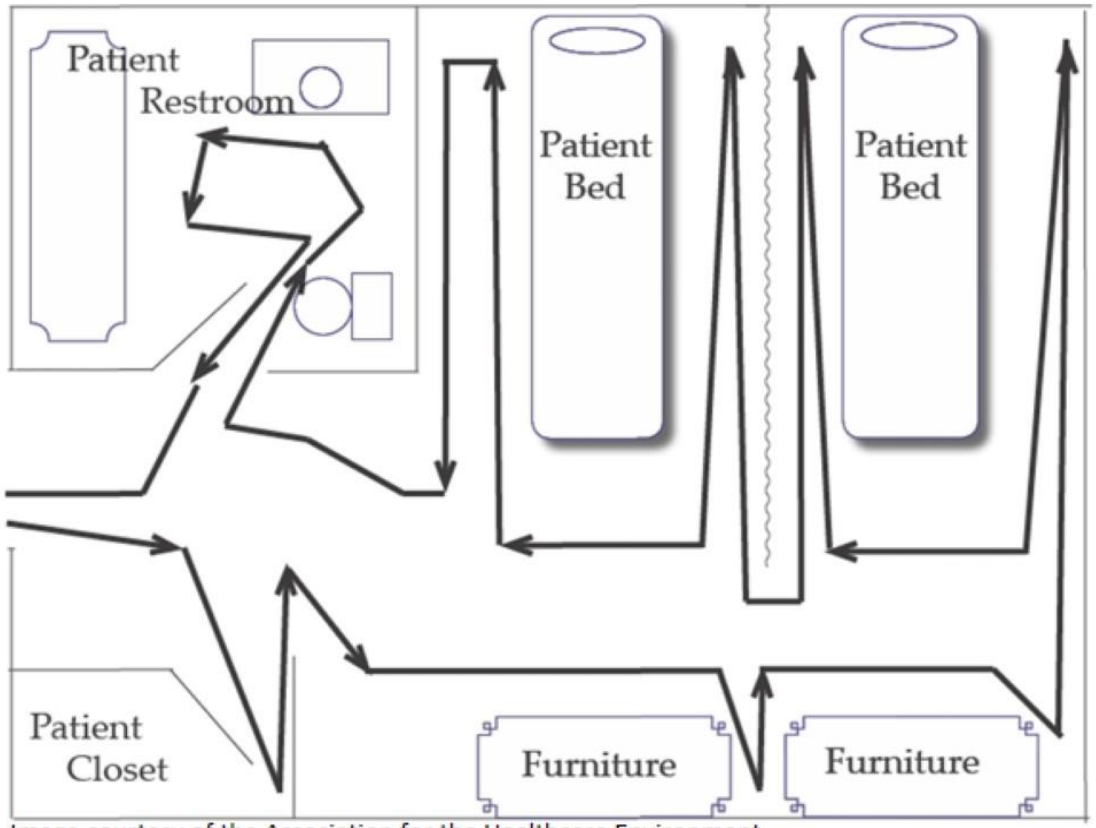
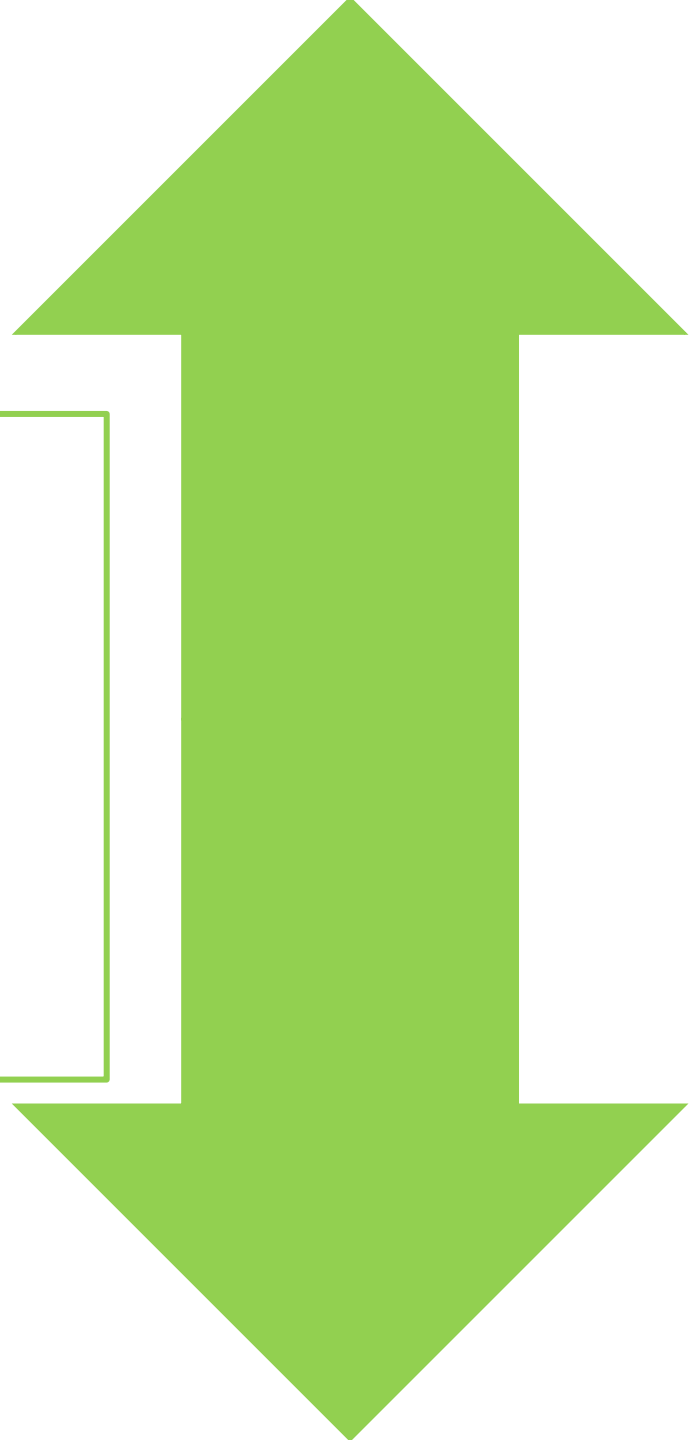


Image courtesy of the Association for the Healthcare Environment

Pattern is specific to private or semi-private rooms, but approach can be applied to any setting

CDC.gov

Vertical interventions:
MRSA, VRE, ESBL, CDI, TB – Isolation and Precautions



VA MRSA Initiative

- Decreased transmission
- Reduced HAIs
  - MRSA VAP
  - MRSA CLA-BSI
  - *C. difficile* in non-ICU
  - VRE in ICU and non-ICU

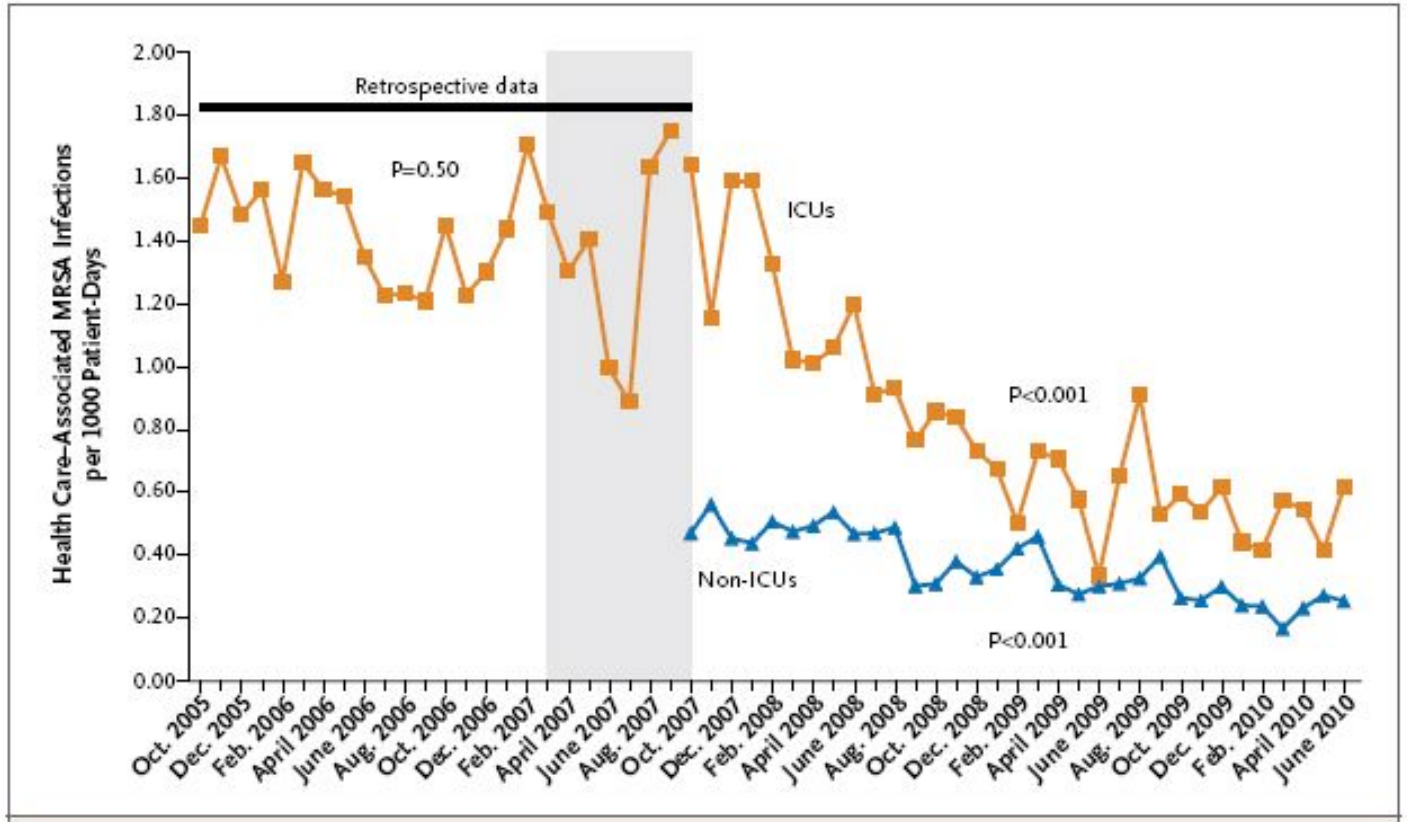


Figure 3. Nationwide Rates of Health Care–Associated Infections with Methicillin-Resistant *Staphylococcus aureus* (MRSA) in Veterans Affairs (VA) Facilities.

Between October 2007, when the MRSA bundle was fully implemented, and the end of June 2010, the rates of health care–associated MRSA infections declined by 62% in intensive care units (ICUs) and by 45% in non-ICUs. There was no significant change in the rates of health care–associated MRSA infections in the ICUs for the 2-year period (October 2005 through September 2007) before full implementation of the MRSA bundle; data for that 2-year period were not available for non-ICUs. The shaded area represents the transition period when the VA MRSA Prevention Initiative was being introduced. The analysis of trends was performed with the use of Poisson regression.

N Engl J Med 2011;364:1419-30

Horizontal interventions:

HH, SSI bundles, CL bundles

An Intervention to Decrease Catheter-Related Bloodstream Infections in the ICU

Peter Pronovost, M.D., Ph.D., Dale Needham, M.D., Ph.D., Sean Berenholtz, M.D., David Sinopoli, M.P.H., M.B.A., Haitao Chu, M.D., Ph.D., Sara Cosgrove, M.D., Bryan Sexton, Ph.D., Robert Hyzy, M.D., Robert Welsh, M.D., Gary Roth, M.D., Joseph Bander, M.D., John Kepros, M.D., et al.

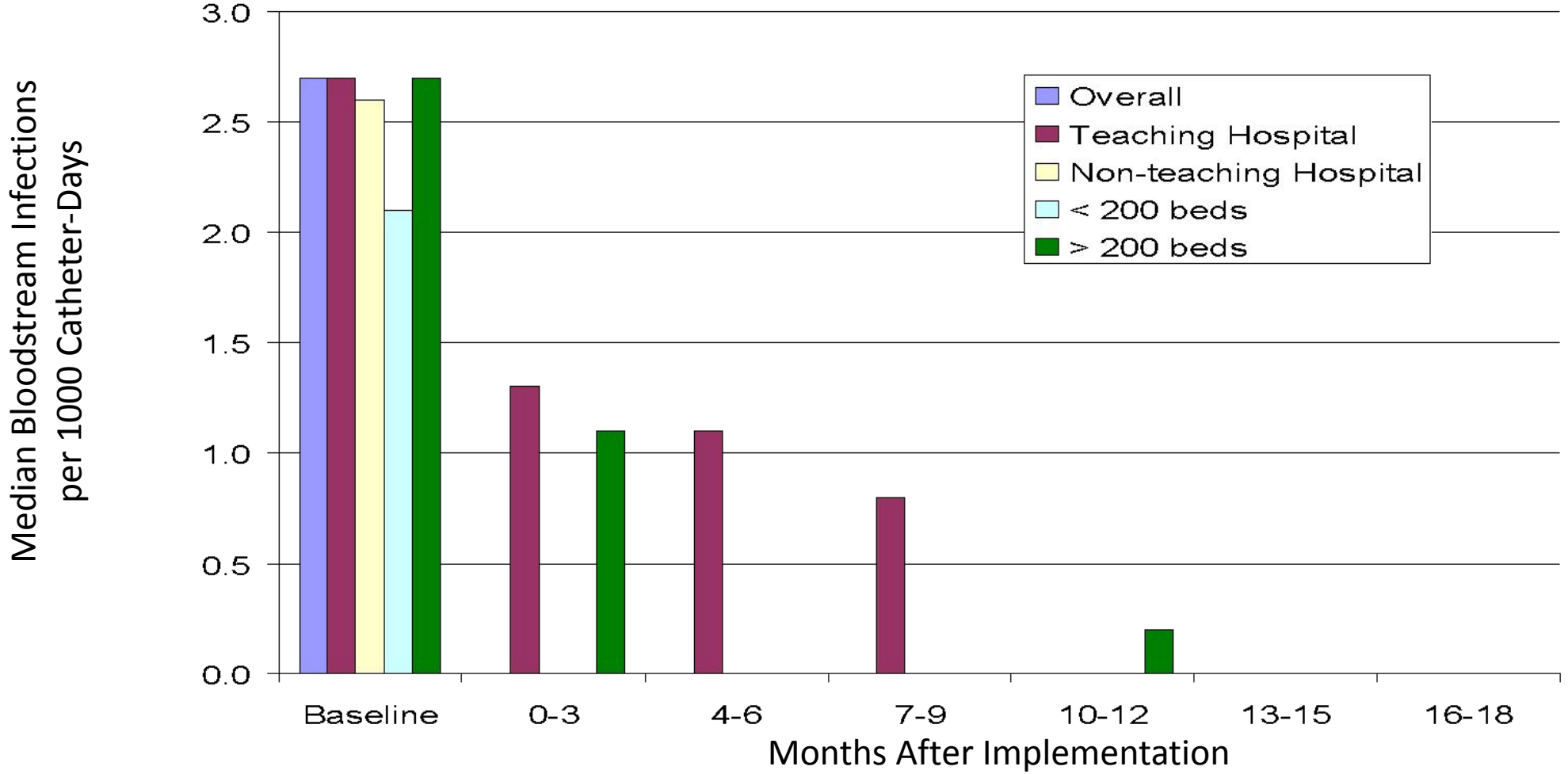
Table 3. Rates of Catheter-Related Bloodstream Infection from Baseline (before Implementation of the Study Intervention) to 18 Months of Follow-up.*

Study Period	No. of ICUs	No. of Bloodstream Infections per 1000 Catheter-Days				
		Overall	Teaching Hospital	Nonteaching Hospital	<200 Beds	≥200 Beds
		median (interquartile range)				
Baseline	55	2.7 (0.6–4.8)	2.7 (1.3–4.7)	2.6 (0–4.9)	2.1 (0–3.0)	2.7 (1.3–4.8)
During implementation	96	1.6 (0–4.4)†	1.7 (0–4.5)	0 (0–3.5)	0 (0–5.8)	1.7 (0–4.3)†
After implementation						
0–3 mo	96	0 (0–3.0)‡	1.3 (0–3.1)†	0 (0–1.6)†	0 (0–2.7)	1.1 (0–3.1)‡
4–6 mo	96	0 (0–2.7)‡	1.1 (0–3.6)†	0 (0–0)‡	0 (0–0)†	0 (0–3.2)‡
7–9 mo	95	0 (0–2.1)‡	0.8 (0–2.4)‡	0 (0–0)‡	0 (0–0)†	0 (0–2.2)‡
10–12 mo	90	0 (0–1.9)‡	0 (0–2.3)‡	0 (0–1.5)‡	0 (0–0)†	0.2 (0–2.3)‡
13–15 mo	85	0 (0–1.6)‡	0 (0–2.2)‡	0 (0–0)‡	0 (0–0)†	0 (0–2.0)‡
16–18 mo	70	0 (0–2.4)‡	0 (0–2.7)‡	0 (0–1.2)†	0 (0–0)†	0 (0–2.6)‡

* Because the ICUs implemented the study intervention at different times, the total number of ICUs contributing data for each period varies. Of the 103 participating ICUs, 48 did not contribute baseline data. P values were calculated by the two-sample Wilcoxon rank-sum test.
† P≤0.05 for the comparison with the baseline (preimplementation) period.
‡ P≤0.002 for the comparison with the baseline (preimplementation) period.

- Hand hygiene
- Full barrier precautions
- Chlorhexidine skin prep
- Avoid femoral vein
- Remove unnecessary catheters

Bundle in Action: Keystone Project



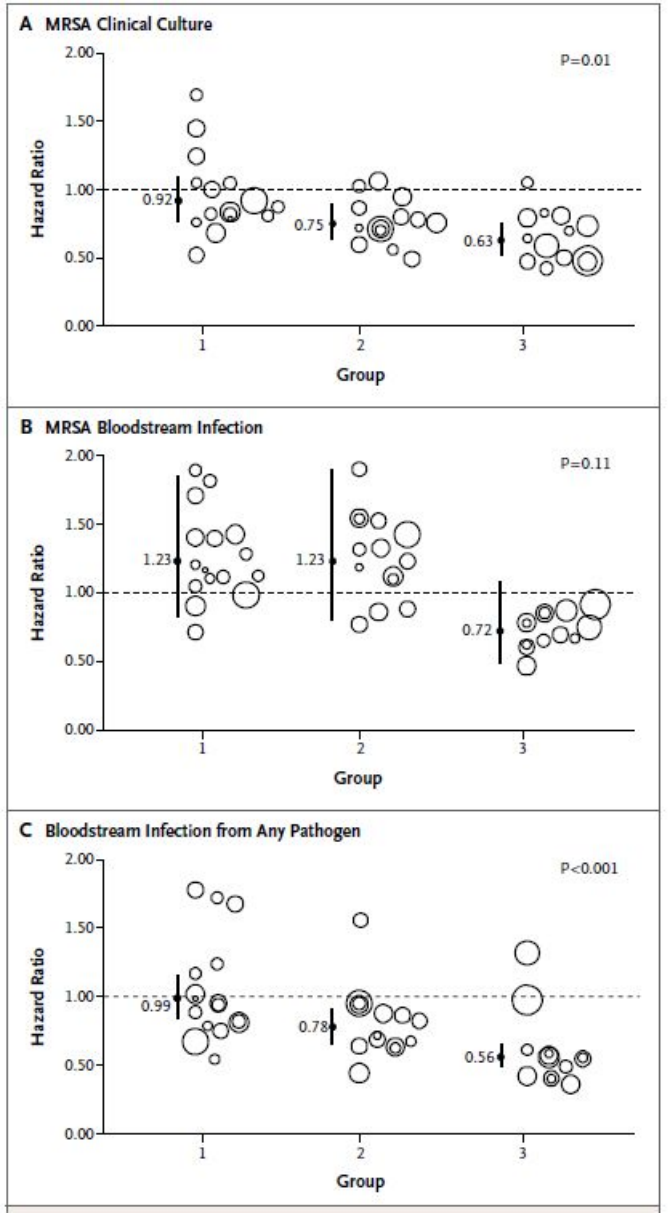
Reduction in mean rate from 7.7 to 1.4 per 1000 catheter-days

N Engl J Med 2006;355:2725-32

Targeted vs Universal Decolonization to Prevent ICU Infection

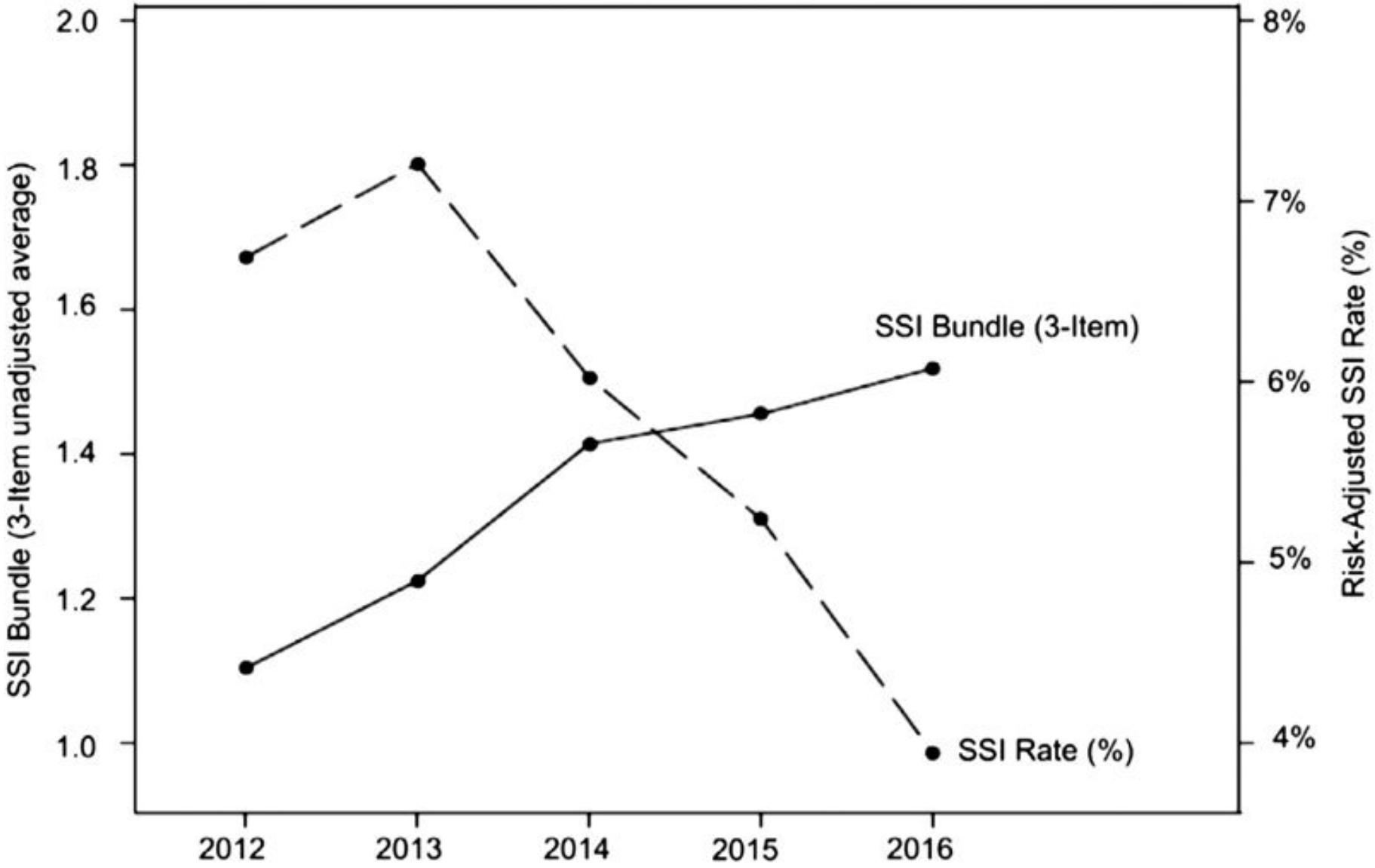
43 Hospitals Randomized:

- Group 1: Nasal surveillance cultures and contact precautions
- Group 2: Similar to group 1 plus 5 day decolonization with mupirocin and CHG baths for those with MRSA
- Group 3: No screening, contact precautions used, all patients received 5 day colonization with mupirocin and CHG baths



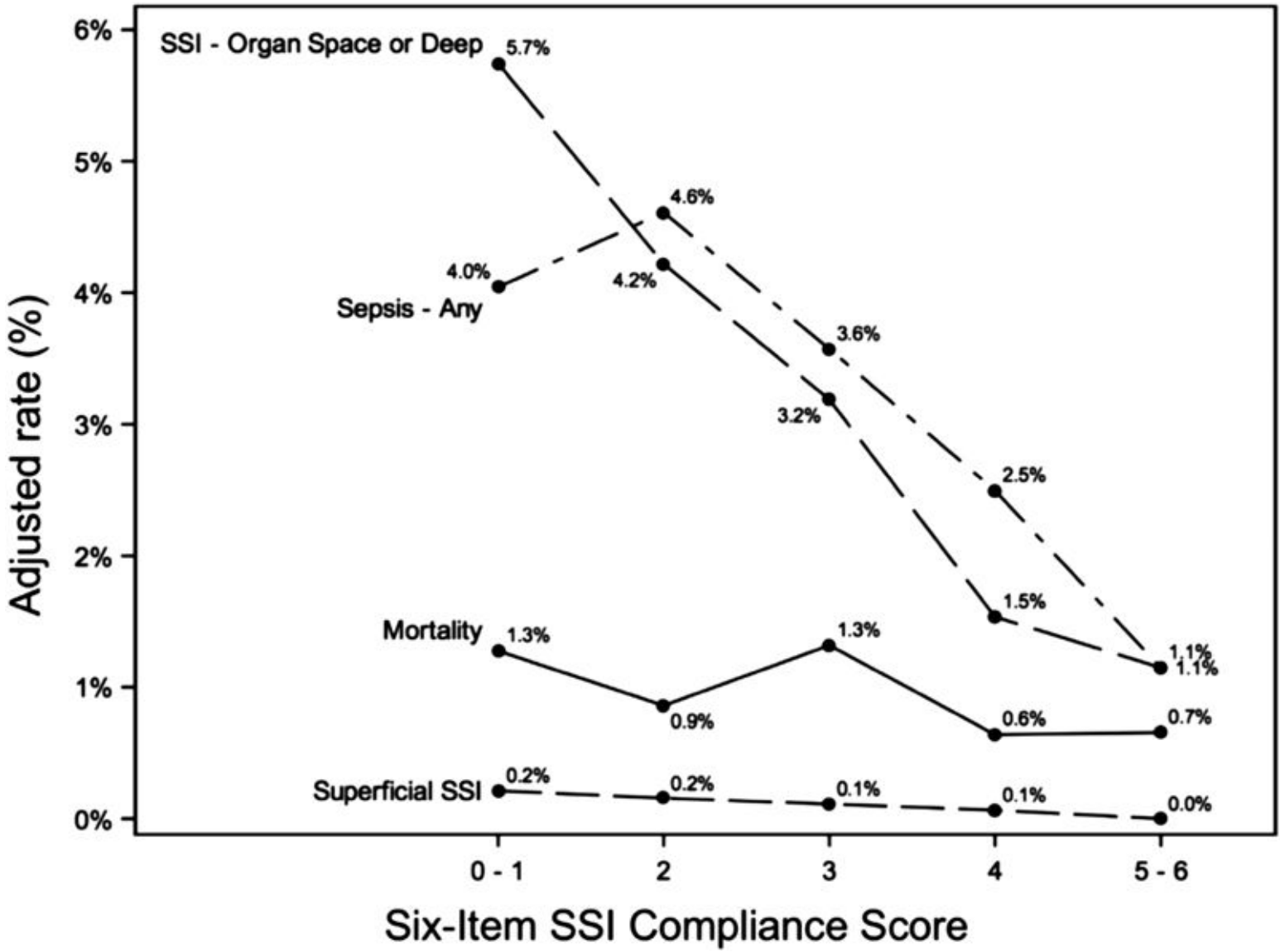
Huang, NEJM, 2017

Colorectal SSI Prevention Bundles



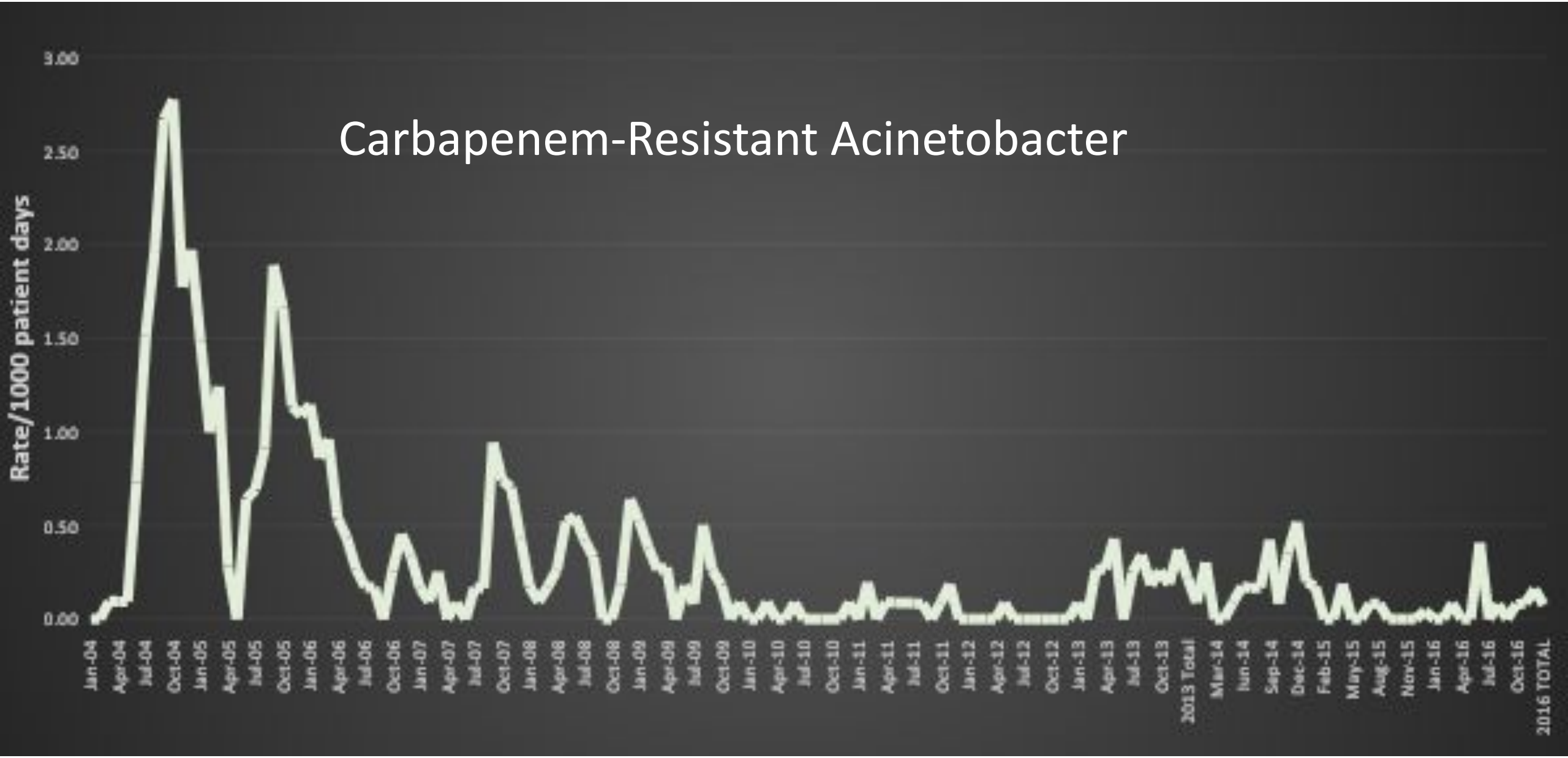
Vu, J Am Coll Surg, 2017

Colorectal SSI Prevention Bundles

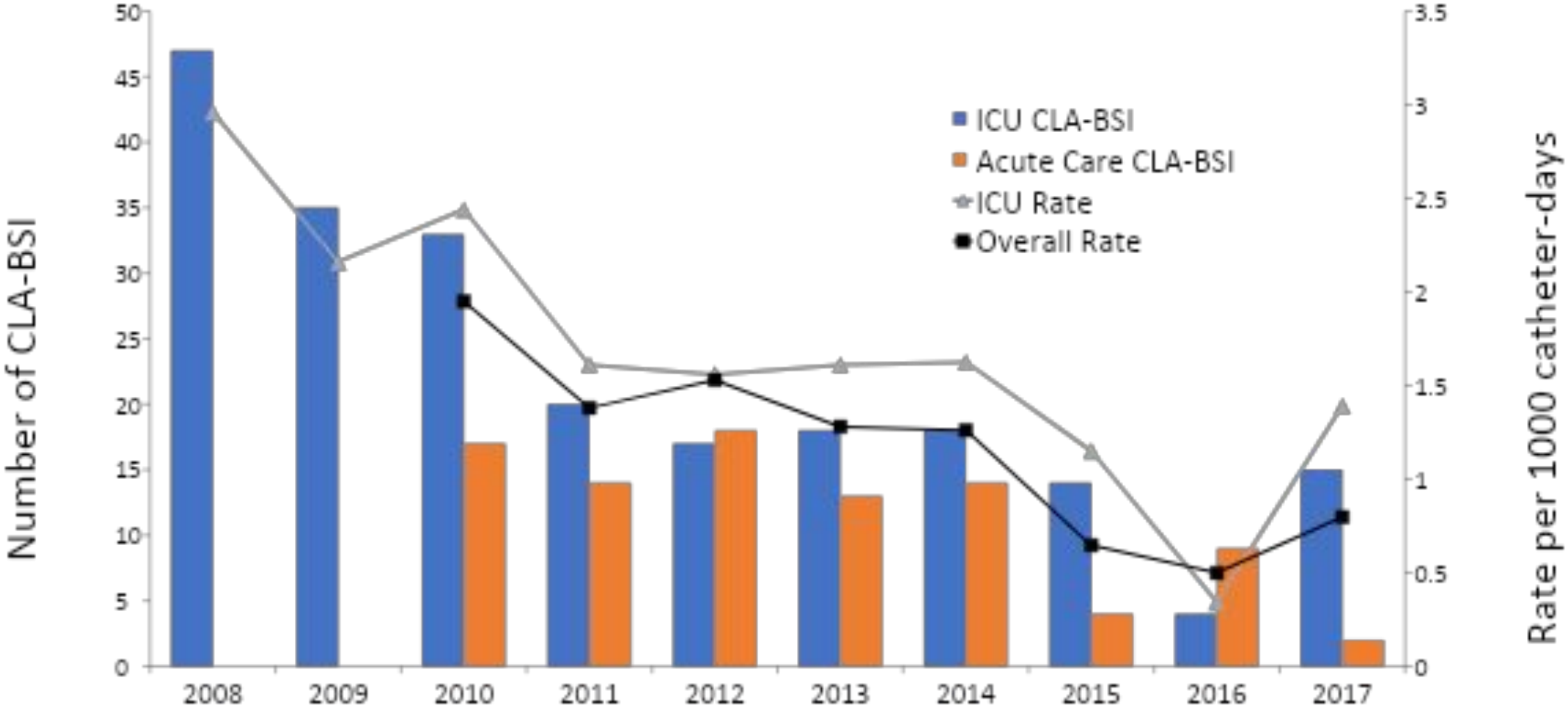


Vu, J Am Coll Surg, 2017

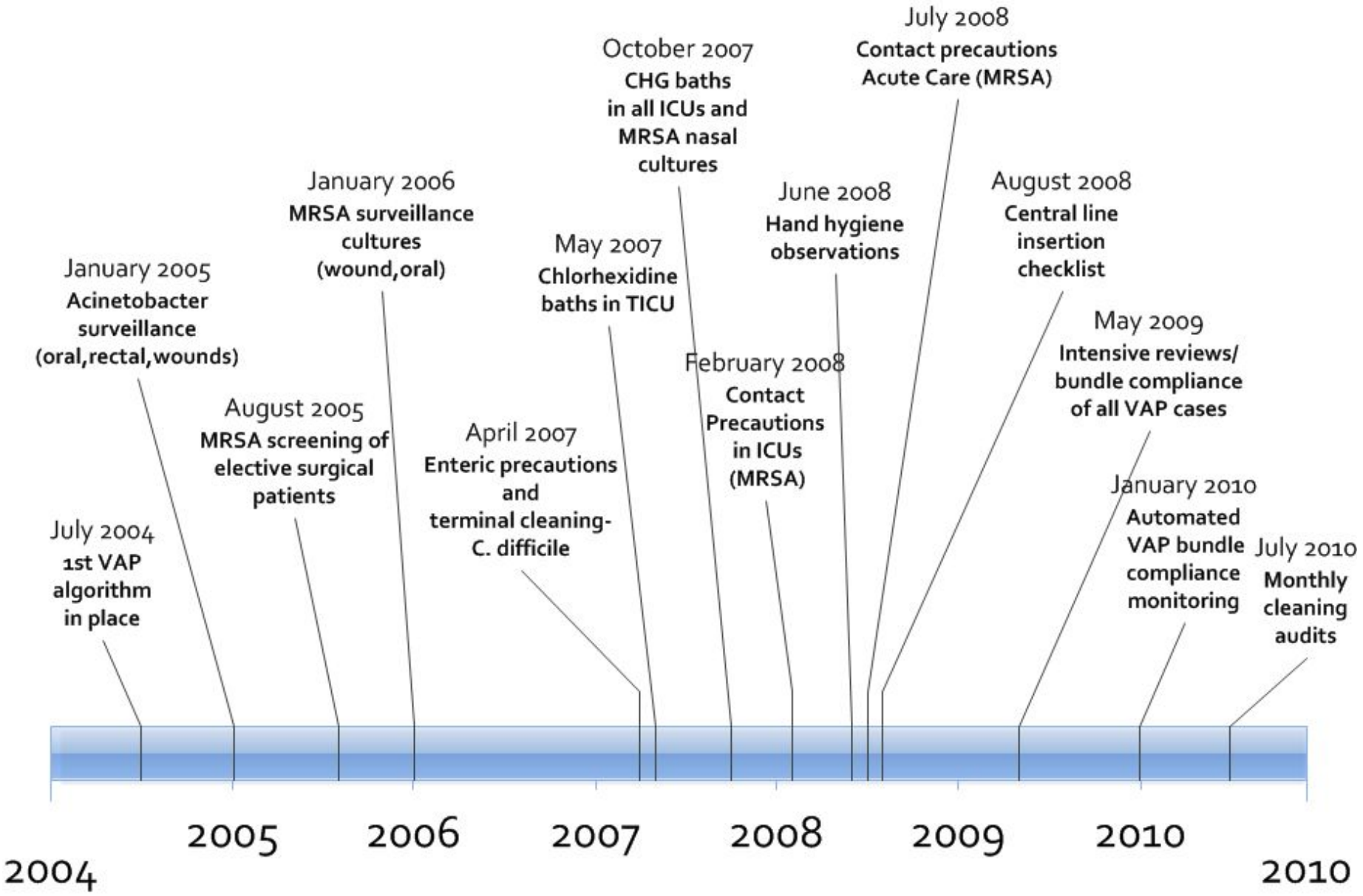
Carbapenem-Resistant Acinetobacter



HMC CLA-BSI 2008-2017



VAP Prevention 2003-2010



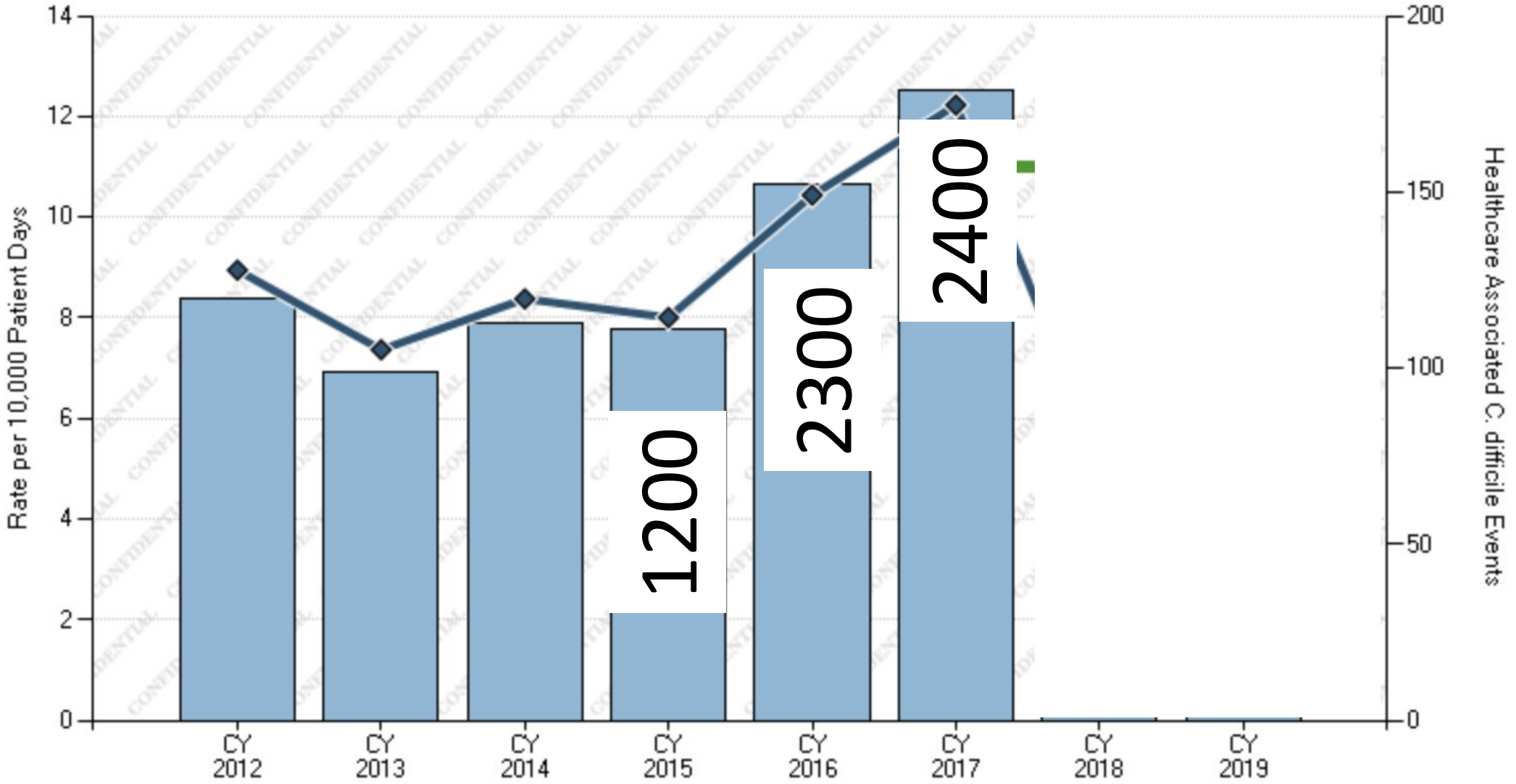
VAP Pathogens 2003

Microorganism	Early Onset (N=30)	Late Onset (N=138)
MSSA	8 (27%)	21 (15%)
Haemophilus	8 (27%)	20 (14%)
Strep pneumoniae	6 (20%)	1 (0.7%)
Alpha heme strep	5 (17%)	20 (14%)
MRSA	3 (10%)	32 (23%)
Acinetobacter	3 (10%)	44 (32%)
Enterobacter	2 (7%)	4 (3%)
Pseudomonas	0 (0%)	13 (9%)

Late VAP- Yes Change!

Pathogens	July 03 – June 04 (N=138)	July 08 – June 09 (N=114)	July 09 – June 10 (N=83)
Acinetobacter	44 (32%)	**4 (4%) ↓**	**4 (5%) ↓**
MRSA	32 (23%)	**8 (7%) ↓**	**2 (2%) ↓**
MSSA	21 (15%)	**30 (26%) ↑**	**23 (28%) ↑**
Haemophilus	20 (14%)	24 (21%)	13 (16%)
Pseudomonas	13 (9%)	**14 (12%) ↑**	**15 (18%) ↑**
Enterobacter	4 (3%)	12 (11%)	4 (5%)
Klebsiella spp.	7 (5%)	7 (6%)	5 (6%)
Serratia spp.	5 (3%)	7 (6%)	1 (1%)
E. coli	6 (4%)	6 (5%)	1 (1%)

C. difficile

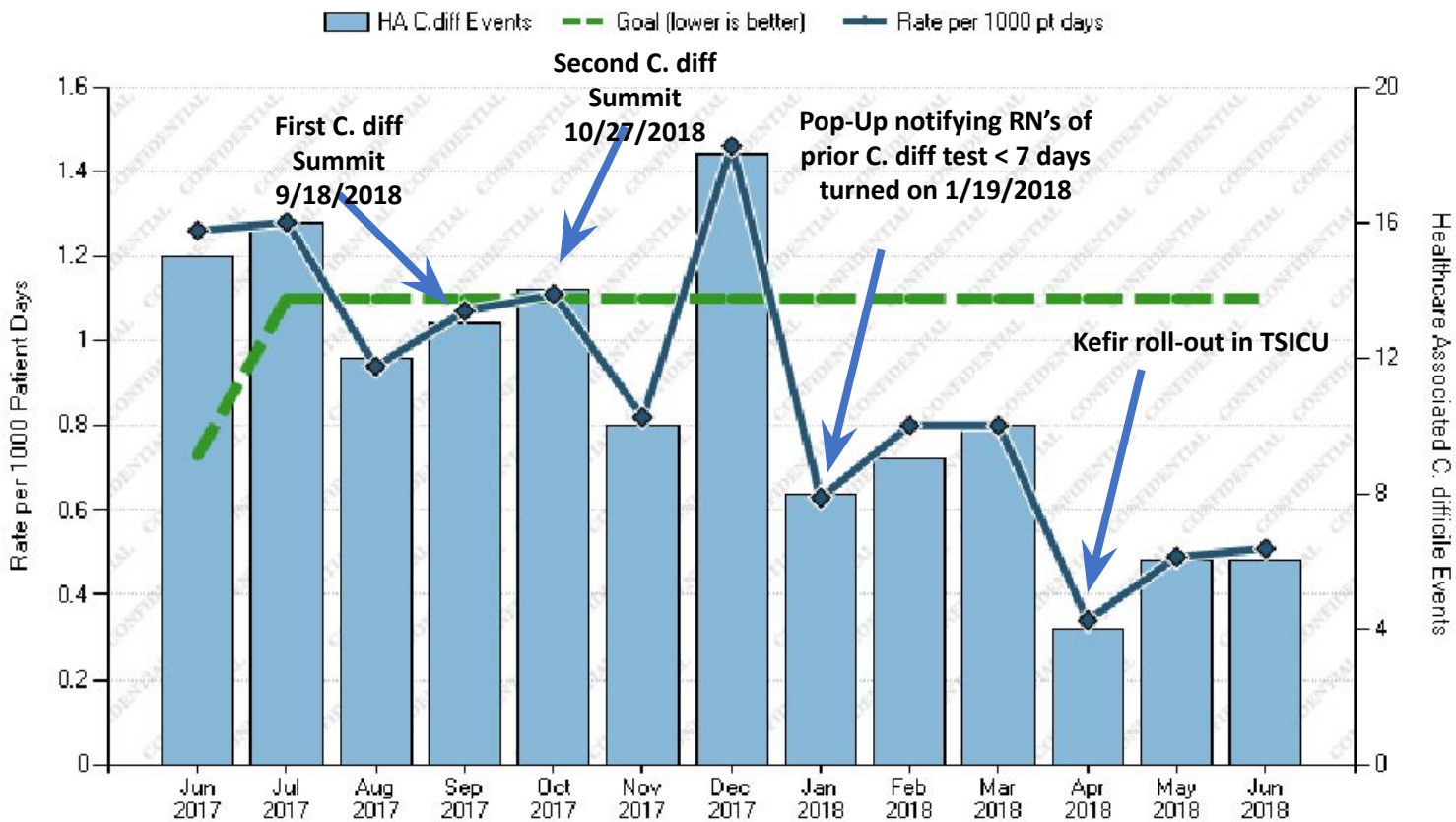

Rate per 10,000 Patient Days
Healthcare Associated C. difficile Events
0
2
4
6
8
10
12
14
0
50
100
150
200
1200
2300
2400
CY 2012
CY 2013
CY 2014
CY 2015
CY 2016
CY 2017
CY 2018
CY 2019

HMC Healthcare Associated C. difficile (C.diff) (per 1000 pt days)

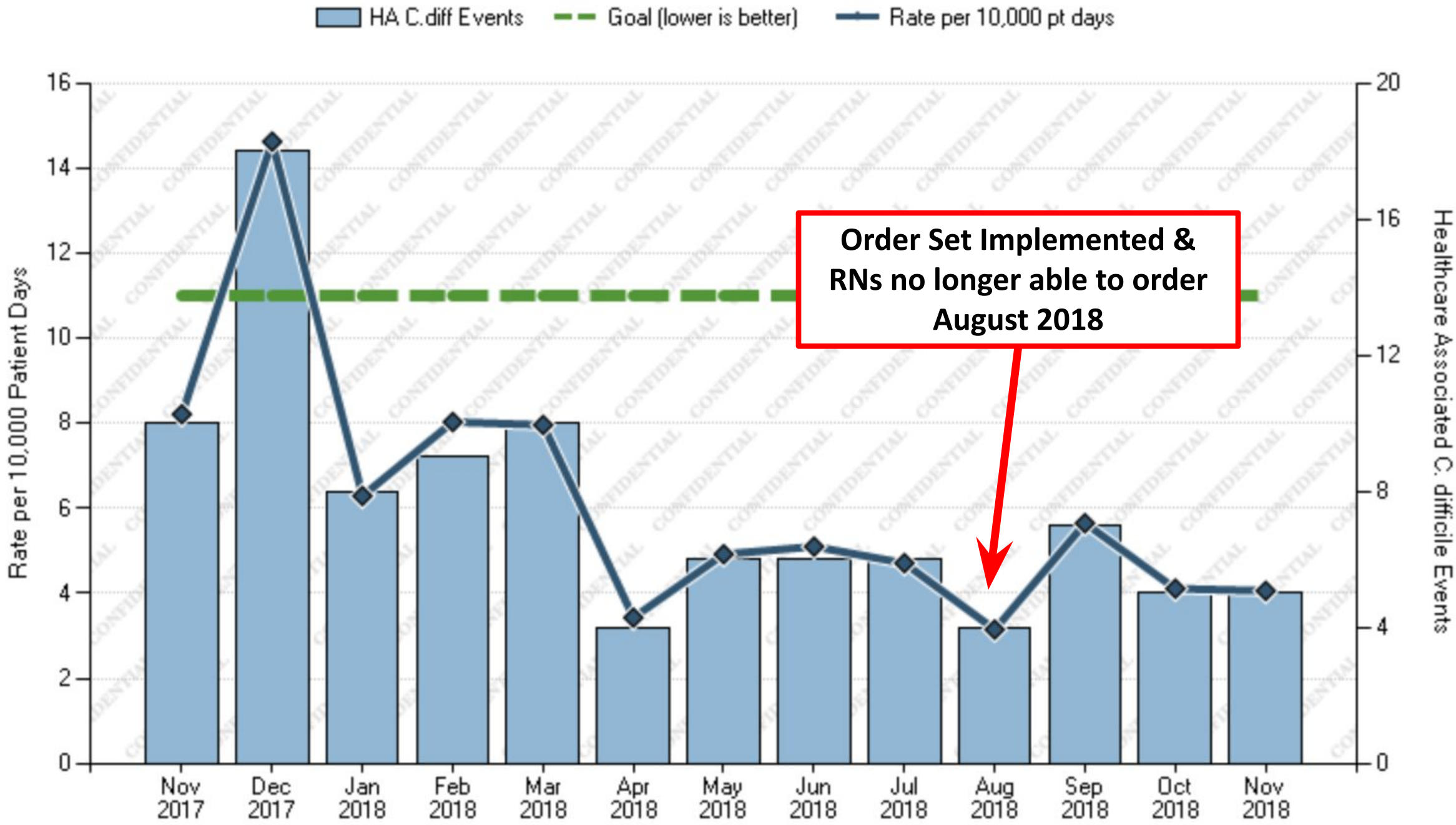
[CdiffB] - Monthly

Confidential Quality Data RCW 70.41.200, 4.24.250, 43.70.510, and 70.168.090

Clostridium difficile Infection is commonly referred to as C. difficile or C.diff.



	Jun 2017	Jul 2017	Aug 2017	Sep 2017	Oct 2017	Nov 2017	Dec 2017	Jan 2018	Feb 2018	Mar 2018	Apr 2018	May 2018	Jun 2018
Goal (lower is better)	0.73	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10
Rate per 1000 pt days	1.26	1.28	0.94	1.07	1.11	0.82	1.46	0.63	0.80	0.80	0.34	0.49	0.51
HA C.diff Events	15	16	12	13	14	10	18	8	9	10	4	6	6
Patient Days	11858	12545	12736	12106	12584	12187	12309	12725	11212	12565	11651	12205	11771


HA C.diff Events
Goal (lower is better)
Rate per 10,000 pt days
Rate per 10,000 Patient Days
Healthcare Associated C. difficile Events
Order Set Implemented & RNs no longer able to order August 2018
0
2
4
6
8
10
12
14
16
20
Nov 2017
Dec 2017
Jan 2018
Feb 2018
Mar 2018
Apr 2018
May 2018
Jun 2018
Jul 2018
Aug 2018
Sep 2018
Oct 2018
Nov 2018

"Unbeatable" superbug fungus sickens hundreds across the U.S., CDC says

UPDATED ON: APRIL 8, 2019 / 7:57 PM / CBS NEWS

Candida auris: A drug-resistant yeast that spreads in healthcare facilities

A CDC message to infection preventionists

Candida auris

-Discovered in 2009
-Simultaneous emergence in 4 different areas of the globe, with 4 different clades
-Challenge for many labs to identify
-Multi-drug resistant
-Hardy and sticks to environment

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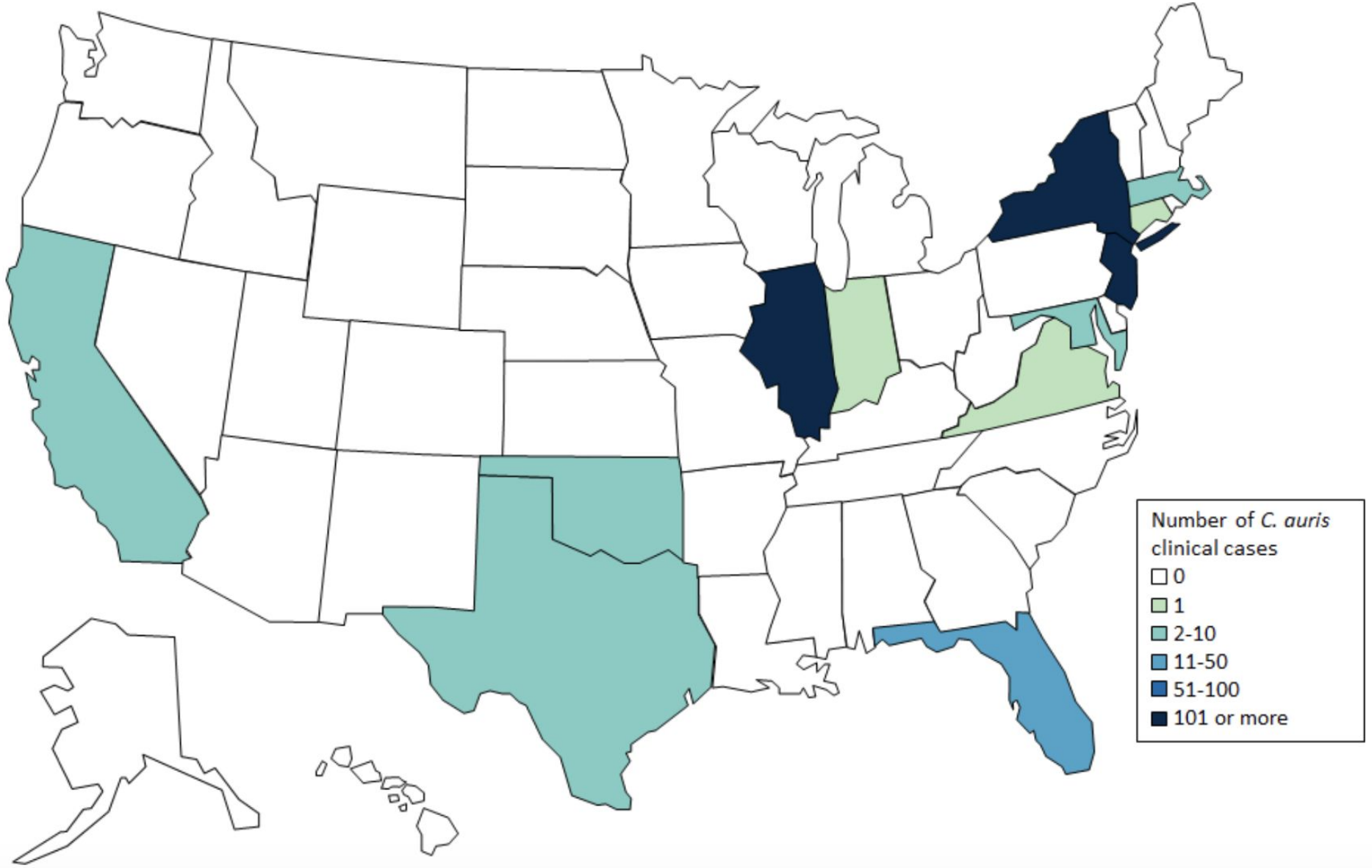
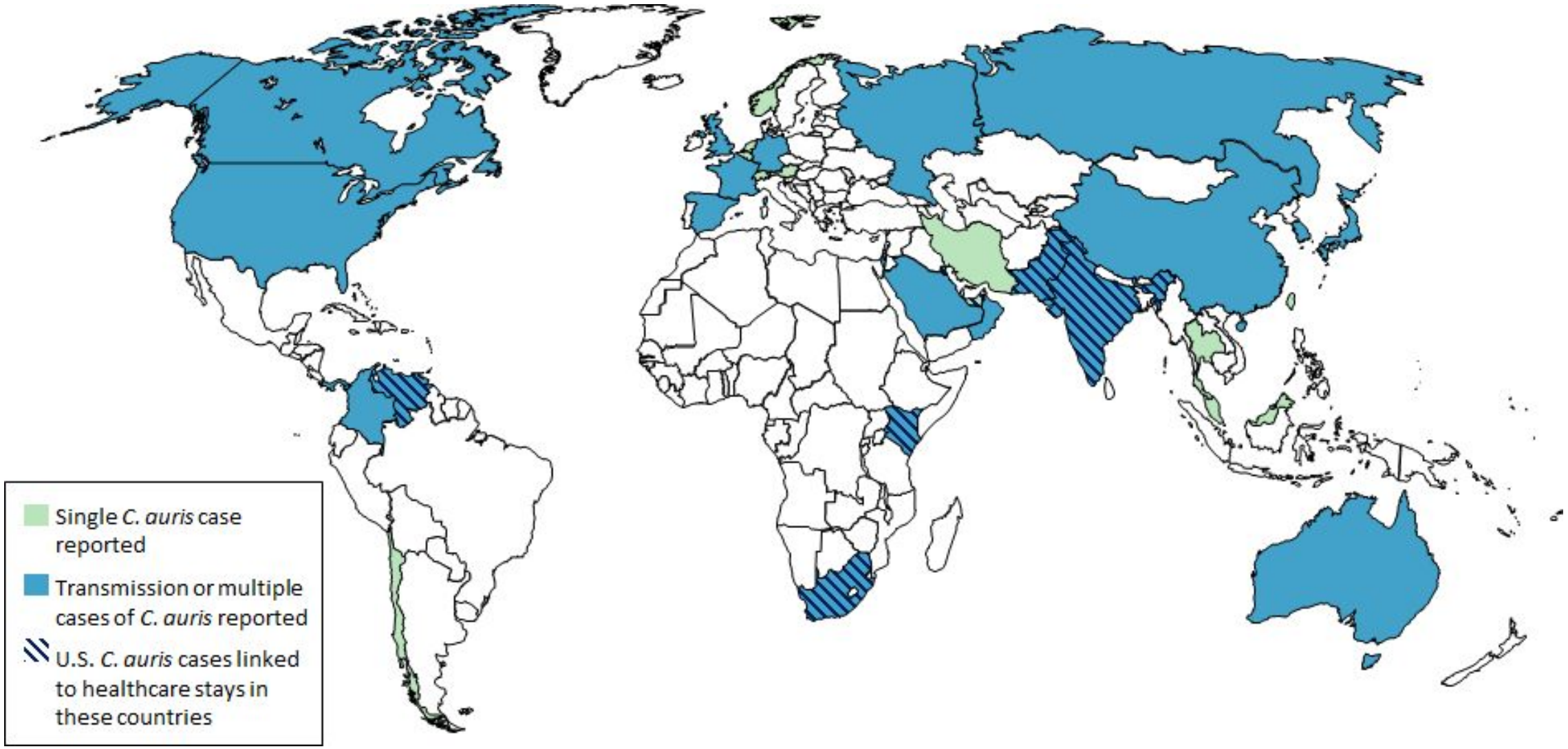
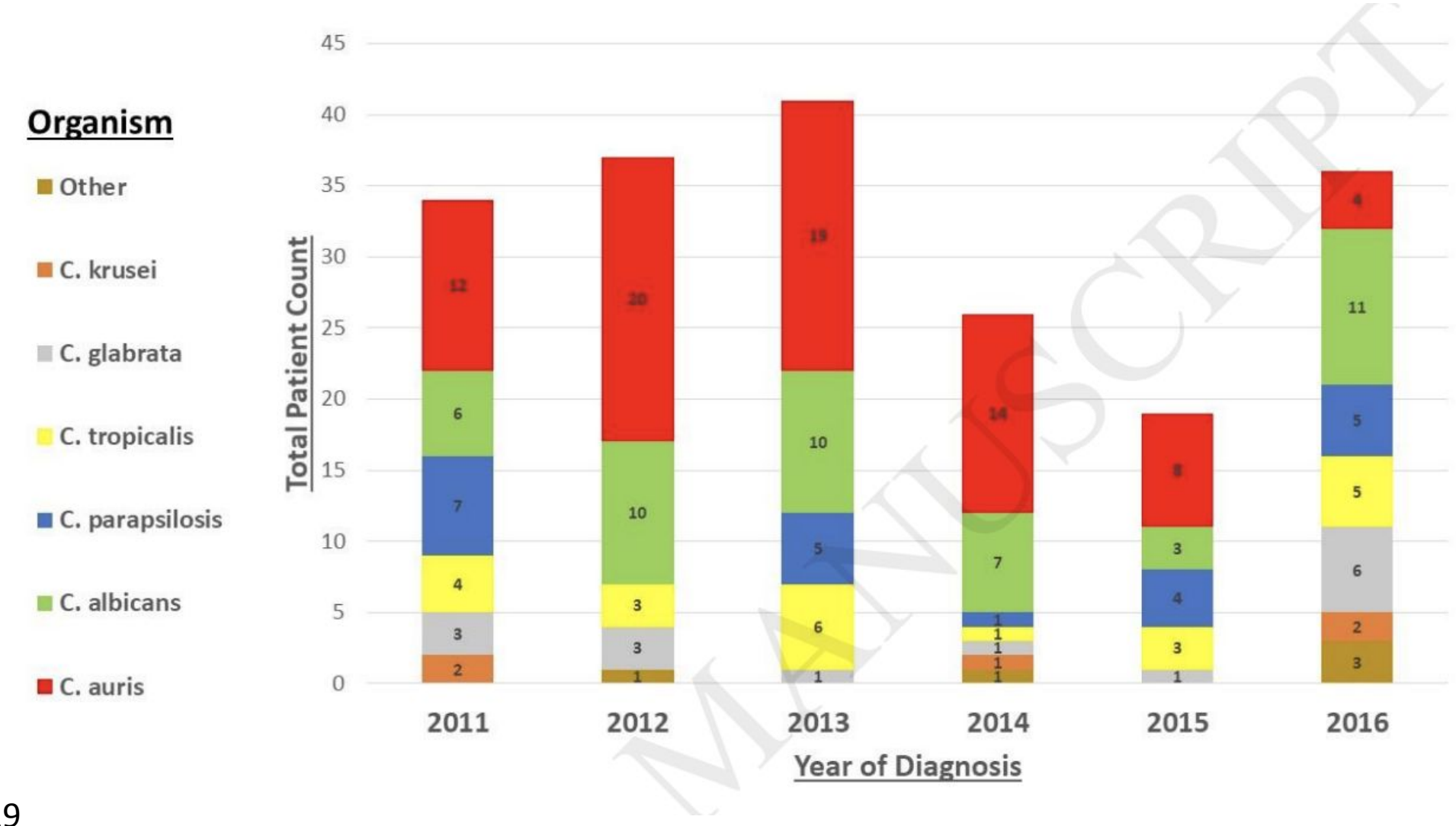
U.S. Map: Clinical cases of *Candida auris* reported by U.S. states, as of May 31, 2019



Candida auris



Candida auris



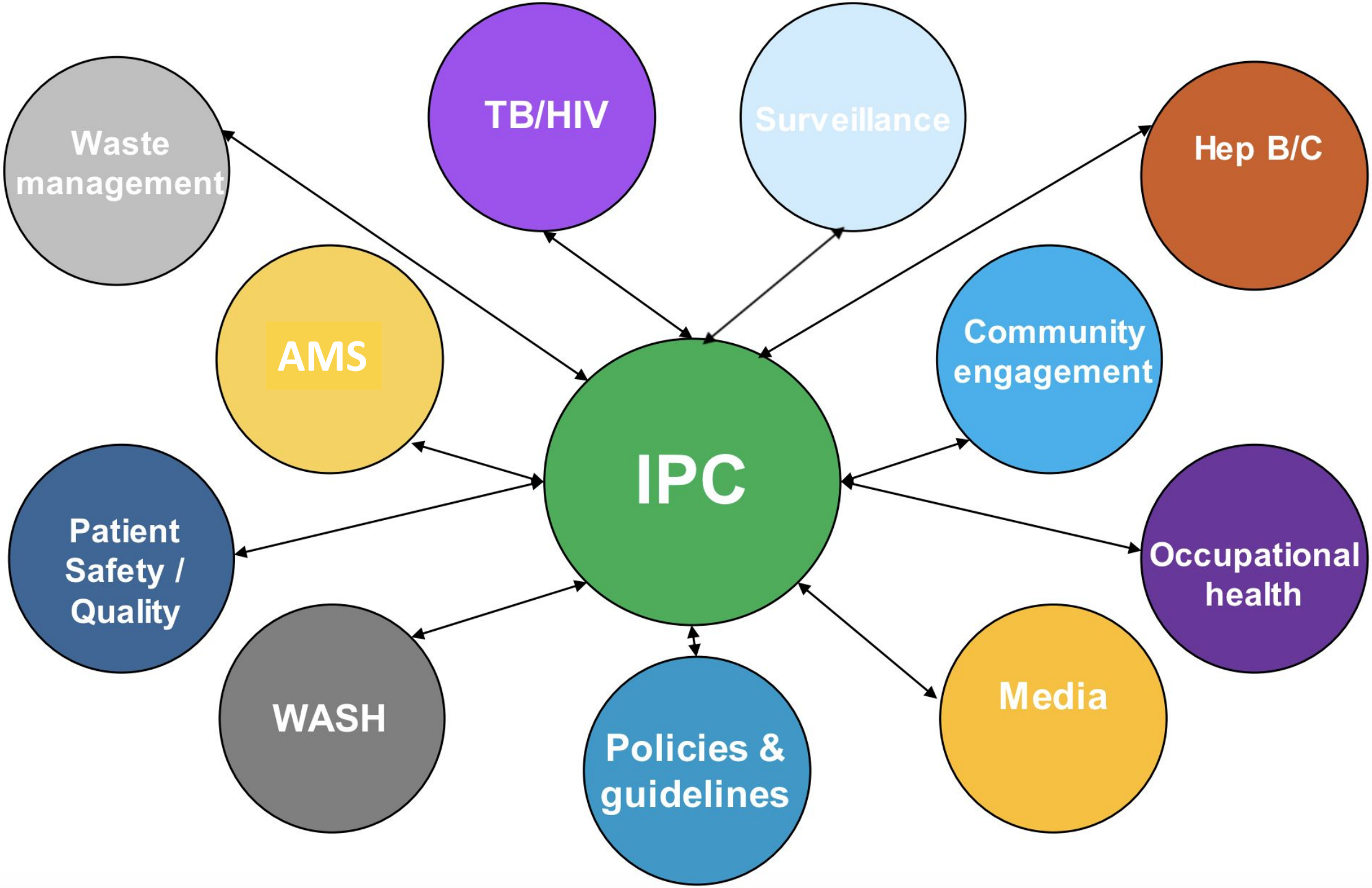
Adam, IJID, 2019

Escherichia coli– 2016

Drug	% Susceptible
Ampicillin	17%
Amox-Clavunate	65%
Amikacin	**99%**
Aztreonam	70%
Ciprofloxacin	60%
Cefotaxime	66%
Cefuroxime	61%
Gentamicin	80%
Meropenem	**99%**
TMP/SMX	24%

Klebsiella pneumoniae – 2016

Drug	% Susceptible
Ampicillin	0%
Amox-Clavunate	49%
Amikacin	**92%**
Aztreonam	44%
Ciprofloxacin	57%
Cefotaxime	43%
Cefuroxime	36%
Gentamicin	64%
Meropenem	**84%**
TMP/SMX	47%

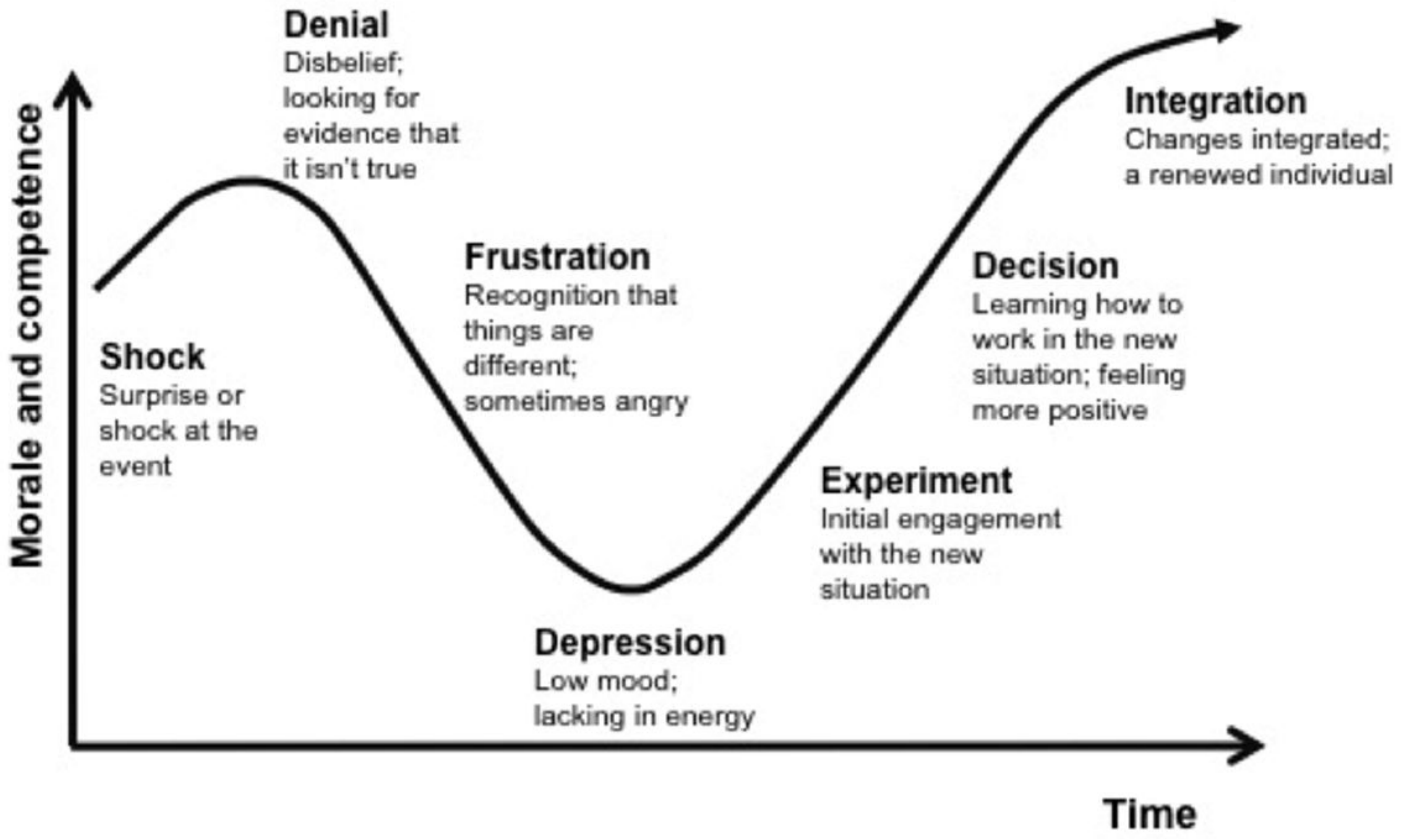

Waste management
TB/HIV
Surveillance
Hep B/C
AMS
Community engagement
IPC
Patient Safety / Quality
Occupational health
WASH
Policies & guidelines
Media

HIERACHY OF HEALTH AND SAFETY CONTROLS

- Training and admin controls
- Engineering controls
- Work practice controls
- Personal protective equipment

The Key to the Future of IPC

The Kübler-Ross change curve



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- Transmission-based precautions: http://www.wsha.org/wp-content/uploads/Standardization_Appendix_A.pdf
- PPE: https://www.cdc.gov/hai/prevent/ppe.html
- CDC CME on IPC: https://www.cdc.gov/infectioncontrol/training/cme-info.html