

Understanding multidrug-resistance: Focus on Carbapenems

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Division of Healthcare Quality Promotion

GA CRE Collaborative

Learning Session 1

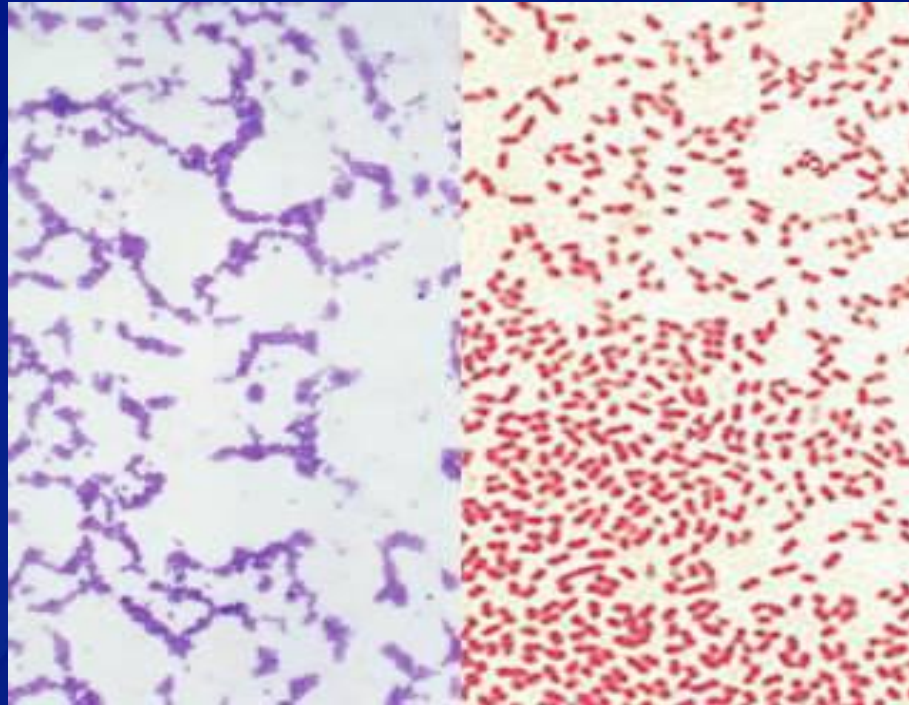
March 20, 2014

Presentation Objectives

- ❑ Brief overview on microbiology and antibiotics
- ❑ Describe antibiotic resistant organisms with a focus on carbapenem-resistance
- ❑ Discuss how/why resistant organisms spread in healthcare settings
- ❑ Identify the core prevention strategies for reducing the emergence and transmission of resistance

Basics on bacteria

Gram Stain
Positive
(purple)



Gram Stain
Negative
(pink/red)

- ❑ Bacteria have different characteristics that allow us to identify them in the lab
 - ❑ Shape, size, gram stain, growth patterns, etc.
- ❑ We often use these characteristics to develop antibiotics

Common bacteria in healthcare

Gram positive

- ❑ Many are cocci, “round bacteria”
 - ❑ Examples are *Streptococci*, *Staphylococci*, *Enterococci*
- ❑ *Clostridium difficile* (C. diff) is an anaerobic, Gram positive rod



Gram negative

- ❑ Most are bacilli, “rod-shaped bacteria”
 - ❑ Examples are: *E. coli*, *Klebsiella*, *Enterobacter*, *Proteus*, *Pseudomonas*, *Acinetobacter*



Important gram-negative bacteria for this project



	<i>Genus</i>	Common species	Common culture sites
<i>Enterobacteriaceae</i>	<i>Escherichia sp.</i>	<i>E. coli</i>	Urine
	<i>Klebsiella spp.</i>	<i>K. pneumoniae</i> and <i>K. oxytoca</i>	Urine, resp.
	<i>Enterobacter spp.</i>	<i>E. cloacae</i> and <i>E. aerogenes</i>	Urine
Not <i>Enterobacteriaceae</i>	<i>Pseudomonas sp.</i>	<i>Pseudomonas aeruginosa</i>	Urine, resp., wound
	<i>Acintobacter sp.</i>	<i>A. baumannii</i>	Urine, resp.

Antibiotics 101

- ❑ Antibiotics are drugs that treat and kill bacteria
- ❑ They are grouped into classes based on their structure and activity
 - Narrow-spectrum target a few specific bacteria
 - Broad-spectrum can kill a wide variety of bacteria
- ❑ Antibiotic resistance = when the bacteria are no longer fully killed by the antibiotic
 - Bacteria with resistance can cause patients to have more severe infections which are harder and more costly to treat
 - Infection prevention programs track certain “bug-drug” combinations for resistance

Antibiotics: Beta Lactam classes

Penicillin and extended spectrum agents

- ❑ Examples: Penicillin, amoxicillin, ampicillin, methicillin
- ❑ Can be combined with a drug to help them overcome bacterial resistance
 - Amoxicillin + Clavulante = Augmentin;
 - Ampicillin + Sulbactam = Unasyn
 - Piperacillin + tazobactam = Zosyn

Cephalosporins

- ❑ More gram positive activity: Cephalexin, Cefazolin
- ❑ More gram negative activity: Ceftriaxone, Ceftazidime, Cefepime
- ❑ New broader spectrum, including MRSA: Ceftaroline

Antibiotics: Carbapenems

- ❑ Extremely broad-spectrum, among the most powerful antibiotics we currently have available
- ❑ Spectrum includes *Streptococci*, susceptible *Staphylococci*, *Enterobacteriaceae*, *Pseudomonas*, *Acinetobacter sp.*, and anaerobic bacteria

Drug	Route of Administration
Imipenem	IV
Meropenem	IV
Ertapenem	IM, IV
Doripenem	IV

Antibiotics : Gram positive agents

❑ Vancomycin

- Treats methicillin-resistant *Staphylococcus aureus* (MRSA)
- Oral form is NOT absorbed from gut; only used to treat *C difficile*
- IV form will get good systemic levels - used to treat all other infections

❑ Daptomycin

- Covers resistant gram-positive organisms: MRSA and Vancomycin-resistant *Enterococci* (VRE)
- Only available as IV formula

❑ Linezolid

- Covers MRSA and VRE
- Both oral and IV forms available and get good systemic levels

Antibiotics: Gram negative agents

Fluoroquinolones (oral and IV forms)

- ❑ Ciprofloxacin: Mostly gram negative activity
 - Commonly used for UTI treatment
- ❑ Levofloxacin/Moxifloxacin: Broader activity
 - Also used for treating UTIs and infections from gram-negative bacteria
 - Also covers *Streptococcus pneumoniae* and other respiratory bacteria

Aminoglycosides (only IV)

- ❑ Examples: Gentamicin, Tobramycin, Amikacin
- ❑ Excellent gram negative drugs – especially for urinary tract
- ❑ Limited use because of toxicity (kidney, hearing/balance)

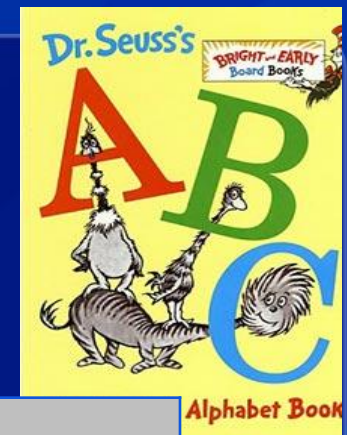
Antibiotics: Miscellaneous

- ❑ Trimethoprim/Sulfamethoxazole (Bactrim):
 - Mainly given in oral form – must watch renal function
 - Considered narrow spectrum, but has activity against both Gram negative and Gram positive bacteria
 - Commonly used to treat UTIs
 - Also used for MRSA skin infections
- ❑ Azithromycin:
 - Commonly given in oral dose pack called “Z-pack”
 - Considered narrow spectrum, used for respiratory/sinus infections
- ❑ Metronidazole (Flagyl) (oral and IV form)
 - A primary treatment for C. difficile infections
 - Oral form can cause nausea and stomach upset

Understanding multidrug-resistance

- ❑ Multidrug-resistant organisms (MDROs) are a group of bacteria with important resistance patterns
- ❑ Sometimes just one key drug will define a MDRO
 - ❑ Methicillin-resistance in *Staphylococcus aureus*
 - ❑ Vancomycin-resistance in *Enterococcus sp.*
- ❑ Gram-negative bacteria can develop resistance to multiple classes of antibiotics
 - ❑ Resistance elements travel together so one bacteria can become resistant to many classes: Beta-lactams, carbapenems, fluoroquinolones, aminoglycosides, etc.
 - ❑ Seen in *Enterobacteriaceae*, *Pseudomonas* and *Acinetobacter*

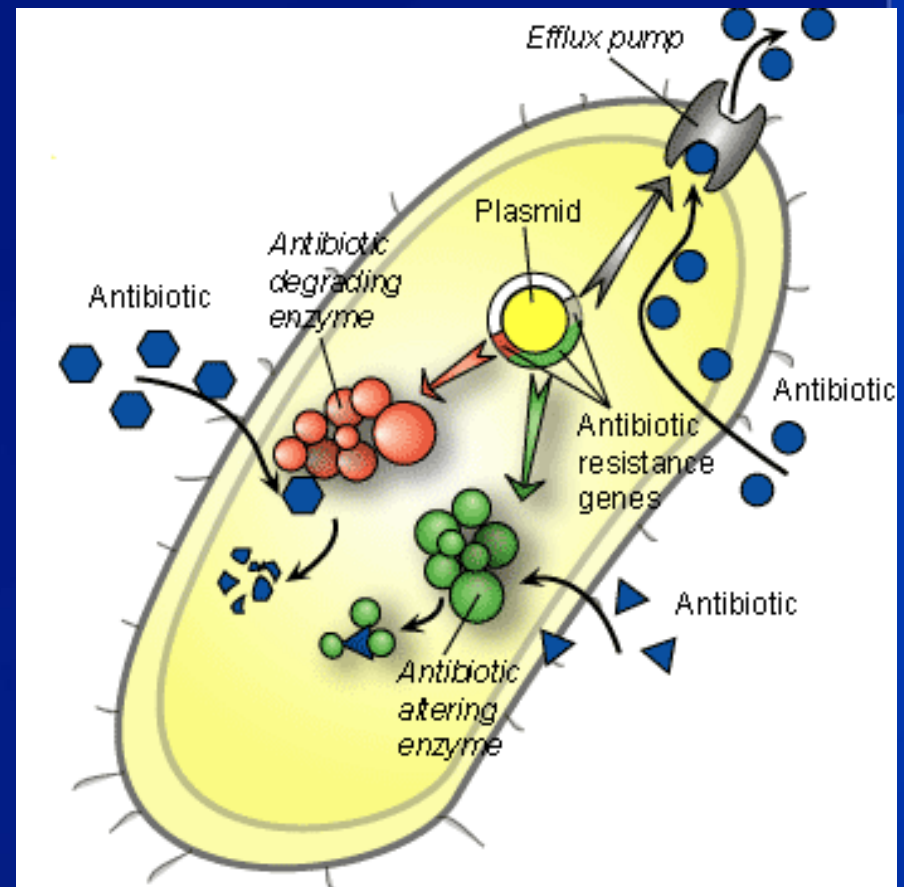
ABC's of MDROs



Bacteria	Abbrev.	Antibiotic Resistance
<i>Staphylococcus aureus</i>	MRSA	Methicillin-resistance
<i>Enterococcus (faecalis/faecium)</i>	VRE	Vancomycin-resistance
<i>Enterobacteriaceae (E coli/Klebsiella, etc)</i>	CRE	Carbapenem-resistance
<i>Pseudomonas/ Acinetobacter</i>	MDR	Multiple drug-resistance

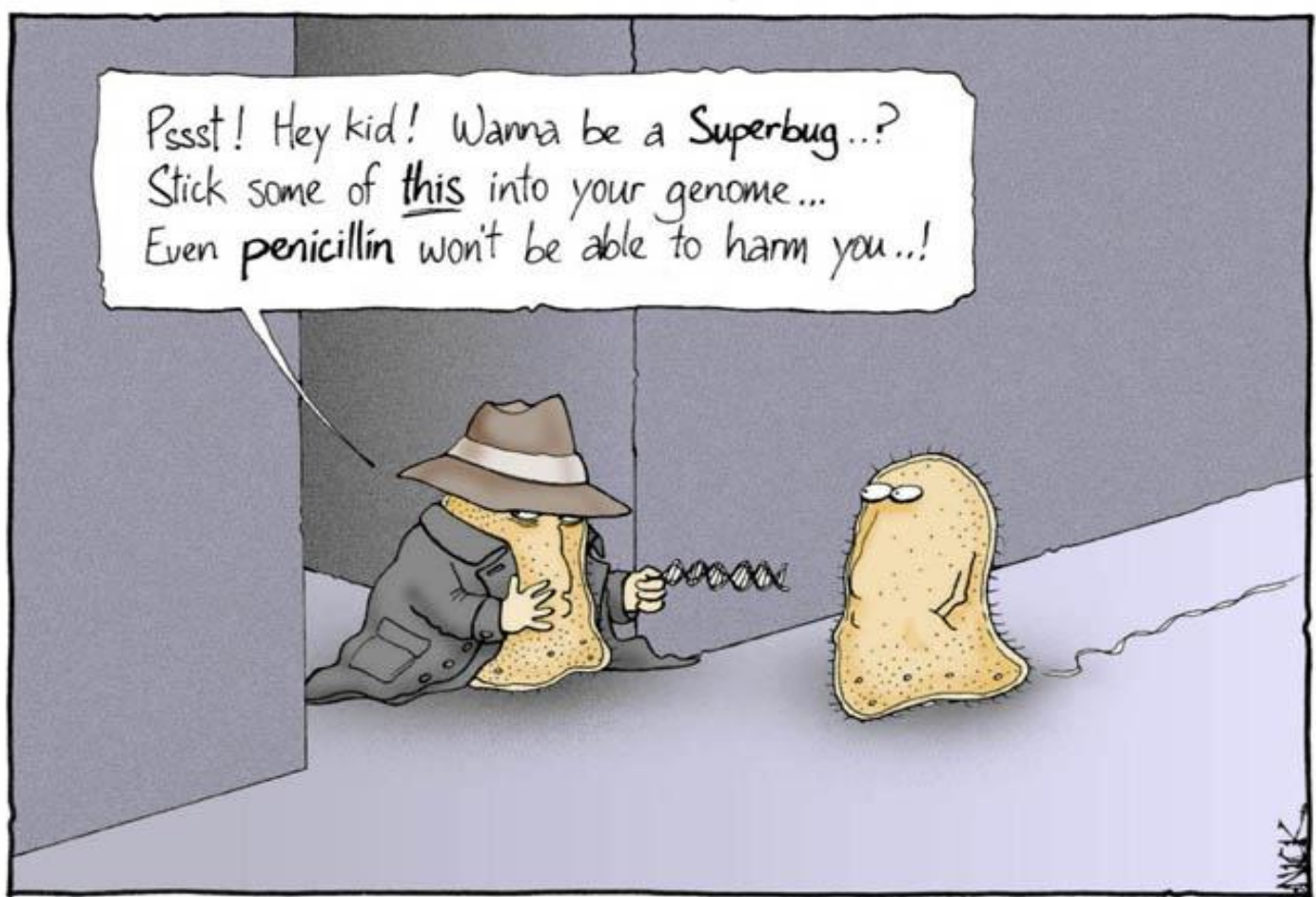
Mechanisms of antibiotic resistance

- ❑ Production of proteins that destroy antibiotics
 - ❑ Beta-lactamases
 - ❑ Carbapenemases
- ❑ Change their cell structure so antibiotics can't bind and block their function
- ❑ Reduce their antibiotic exposure
 - ❑ Pump drugs out
 - ❑ Increase cell barriers to keep drug out



Understanding carbapenem-resistance

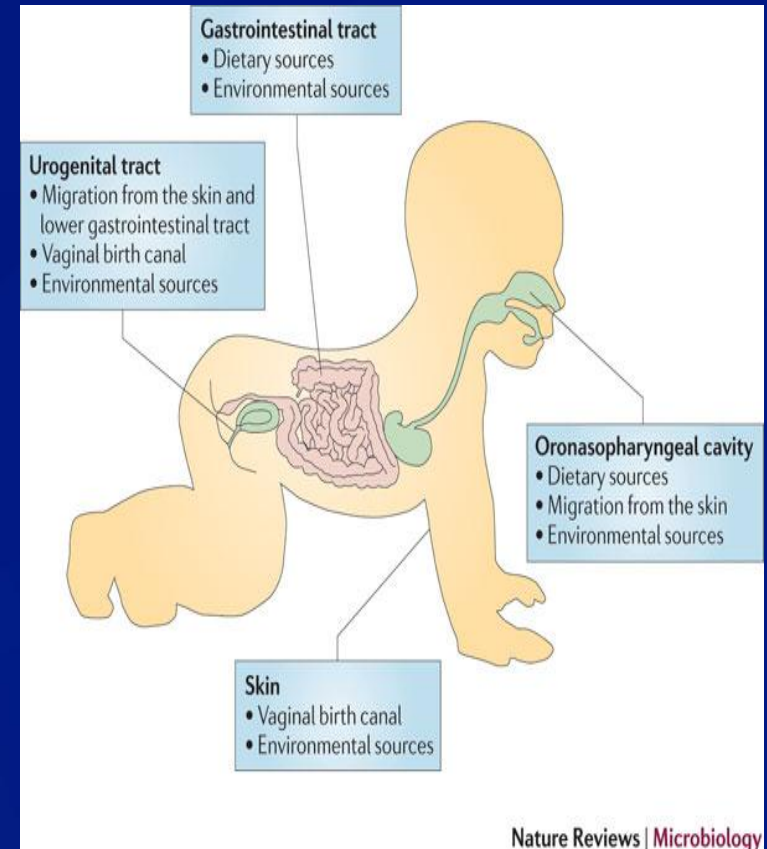
- ❑ There are different ways that these gram-negative bacteria become resistant to Carbapenems.
- ❑ Some bacteria have to make lots of changes to become resistance.
 - ❑ Step 1: Acquire or produce a cephalosporinase (to break down beta-lactam antibiotics)
 - ❑ Step 2: Lose a porin protein in the cell wall to prevent carbapenems from getting into the cell.
 - ❑ Step 3: Gain a pump to remove the carbapenem from the cell
- ❑ Others acquire resistance by a genetic element, called a plasmid, which carries the genes for carbapenem resistance
 - ❑ These resistance genes are called "Carbapenemases"
- ❑ But, no matter HOW they became resistance, we need to stop these bacteria from spreading further



It was on a short-cut through the hospital kitchens that Albert was first approached by a member of the Antibiotic Resistance.

Normal bacterial colonization

- ❑ People have bacteria living in and on us all the time
- ❑ Some live on our skin, some in our nose and throats, others in our GI tracts (i.e., bowels)
- ❑ Our bodies rely on colonizing bacteria
- ❑ In the GI tract bacteria will
 - ❑ Aid digestion/provide nutrients
 - ❑ Block harmful bacteria from invading (e.g. *C. difficile*)
- ❑ Gram-negative bacteria colonize the lower GI tract and easily spread from there to the urinary tract , and other sites



Separating colonization from infection

- ❑ “Colonizing” bacteria may not be harmful, even when they are antibiotic-resistant
 - ❑ Example: MRSA cultured from a nasal swab may not harm the colonized person
- ❑ Only when bacteria invade our bodies and cause signs/symptoms of illness do we need treatment with antibiotics
- ❑ Separating colonization from infection can be difficult
 - ❑ Examples: Bacteriuria in an older adult; respiratory secretions from a person on a ventilator
- ❑ However, both colonized and infected people can serve as a source for spreading resistant organisms

Resistance emerging in a community

Clinical Infectious Diseases 2010;50(12):1611–1616

MAJOR ARTICLE

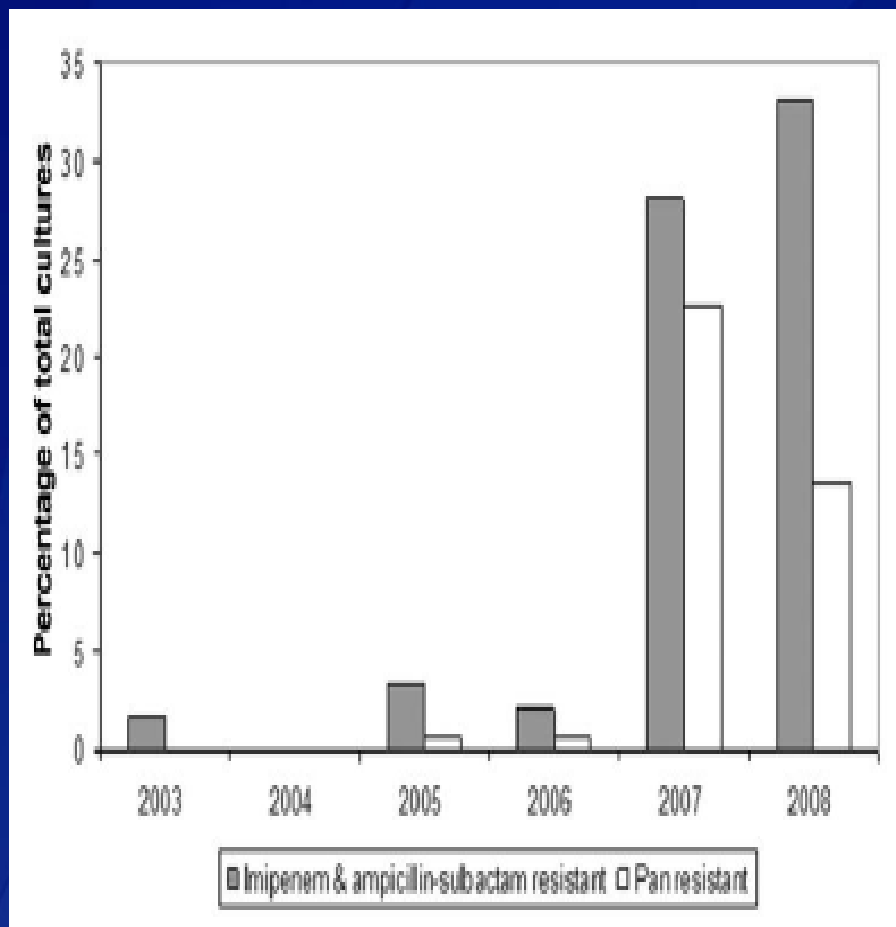
Multidrug-Resistant *Acinetobacter baumannii*: An Emerging Pathogen among Older Adults in Community Hospitals and Nursing Homes

D. M. Sengstock,^{1,2} R. Thyagarajan,^{1,2} J. Apalara,¹ A. Mira,¹ T. Chopra,² and K. S. Kaye²

¹Internal Medicine/Geriatrics, Oakwood Hospital, Dearborn, and ²Department of Internal Medicine, Wayne State University, Detroit, Michigan

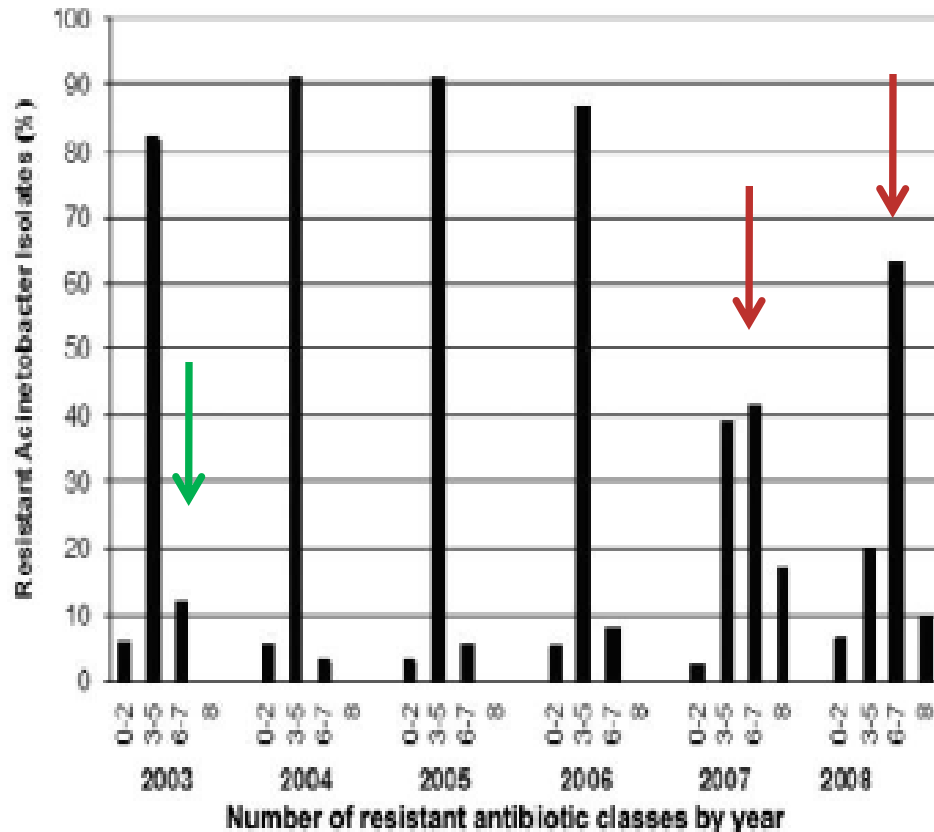
- ❑ Reviewed lab records for all *Acinetobacter baumannii*
 - Identified all clinical isolates from 4 community hospitals over a 5 year period
- ❑ Classified isolates as nosocomial, NH-associated, or community-associated
- ❑ Analysis limited to individuals >60 yrs old and not presenting from any other hospital setting

Multidrug-resistance emerges quickly



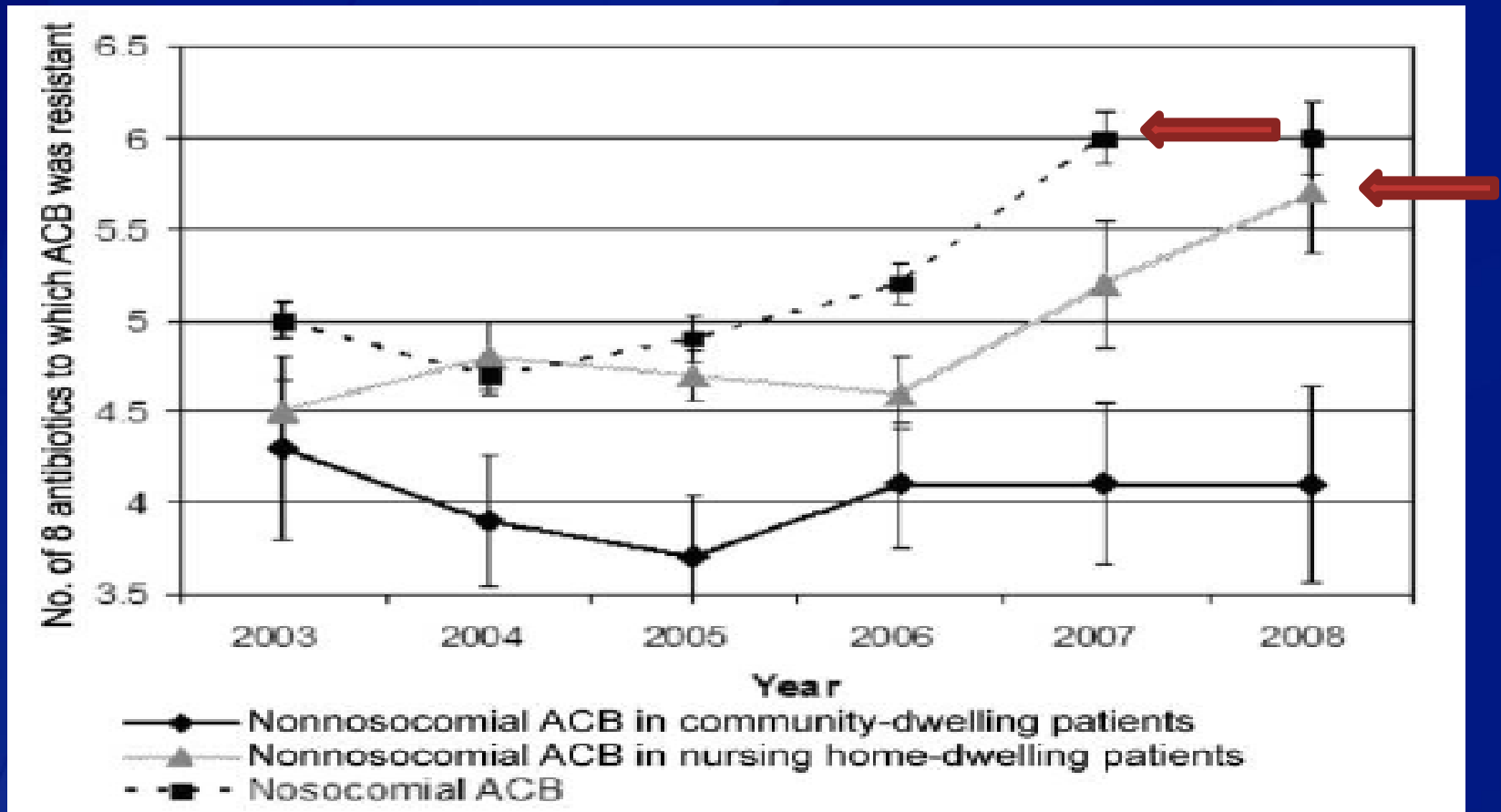
- Over 5 year period, antibiotic resistance in *Acinetobacter* increased dramatically
 - In 2003, there were zero pan-resistant isolates
 - In 2008, over 10% of isolates were pan-resistant; >30% had resistance to a carbapenem
- Culture sources: Respiratory secretions (56%); Wounds (22%); Urine (12%)

Resistance increases over time



- Over the 5 years, *Acinetobacter* isolates became resistant to more and more drug classes
 - In 2003, 80% of resistant bacteria were to 3-5 classes of drug
 - In 2008, 80% were resistant to >6 classes

Healthcare is the source of resistance



- Isolates from hospitals and nursing homes have the increasing antibiotic resistance; NOT isolates from the community

Healthcare drivers of antibiotic resistance

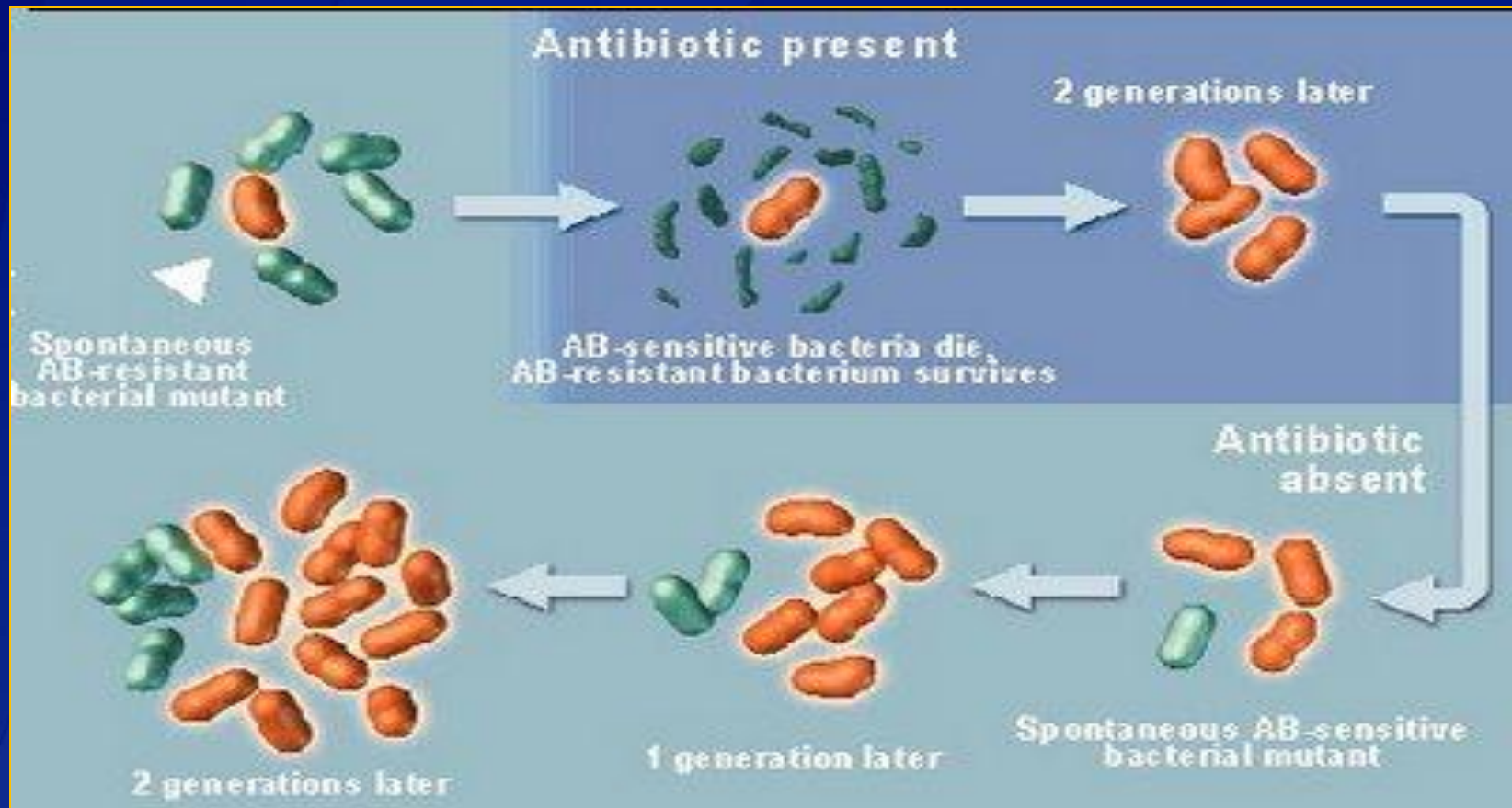
DEVELOPMENT

- ❑ Antibiotic pressure
 - ❑ Risk for both acquisition and infection
- ❑ Medical devices and wounds
 - ❑ Biofilm formation

SPREAD

- ❑ Colonization pressure
- ❑ Patient to patient transmission via hands of healthcare personnel
- ❑ Contamination of shared environment / equipment

Resistance from antibiotic pressure



- ❑ At first most of the bacteria can be killed by the drug (green)
- ❑ But, once they are wiped out, the resistant bugs take over (red)

Antibiotic use drives resistance

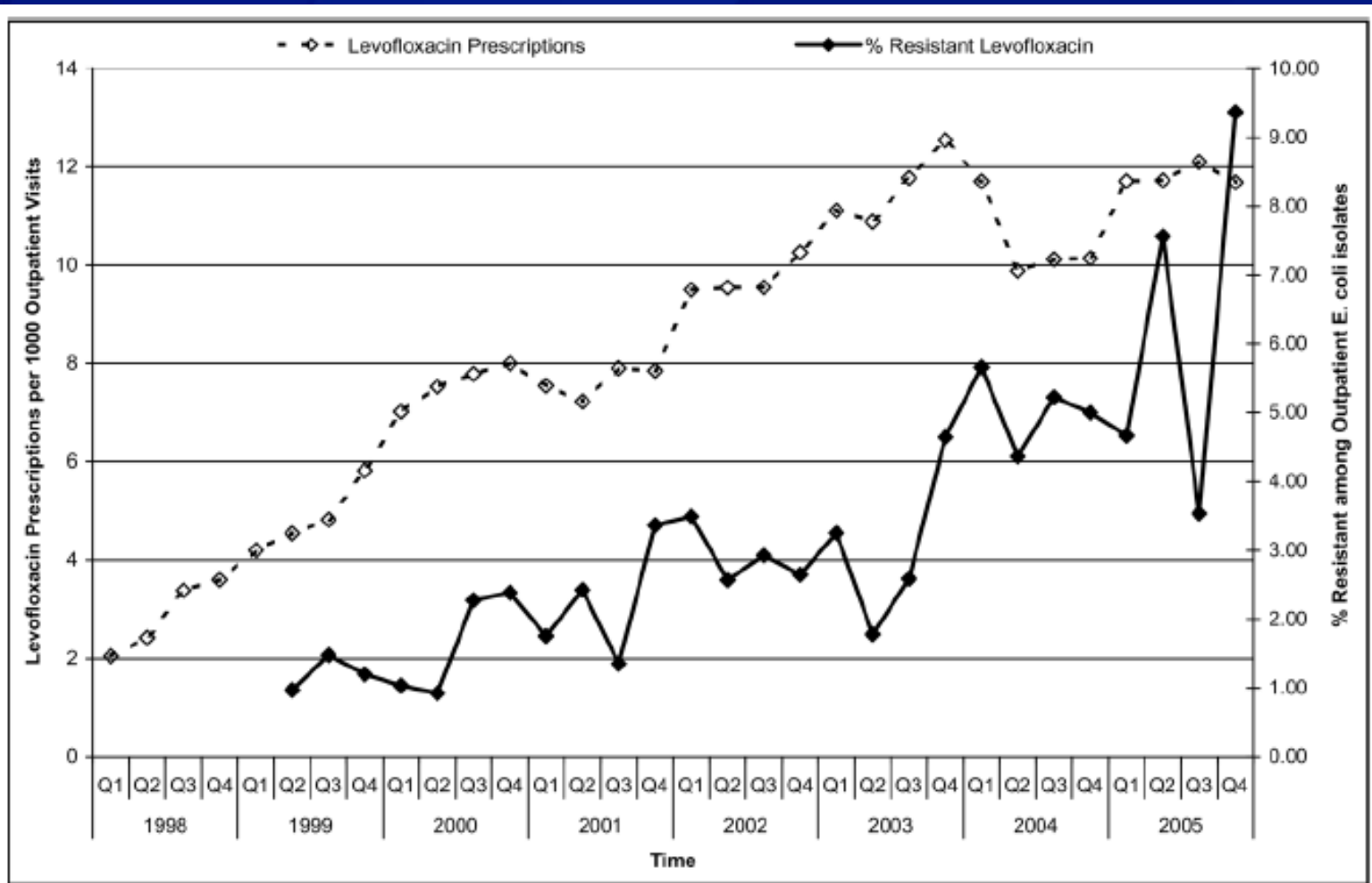


Figure 1 Levofloxacin use and outpatient *Escherichia coli* resistance to levofloxacin versus time.

□ Antibiotic resistance increases as antibiotic use increases

Antibiotic use leads to colonization and acquisition of resistant organisms

TABLE 5 Risk factors for not being colonized versus having new acquisition of AROs

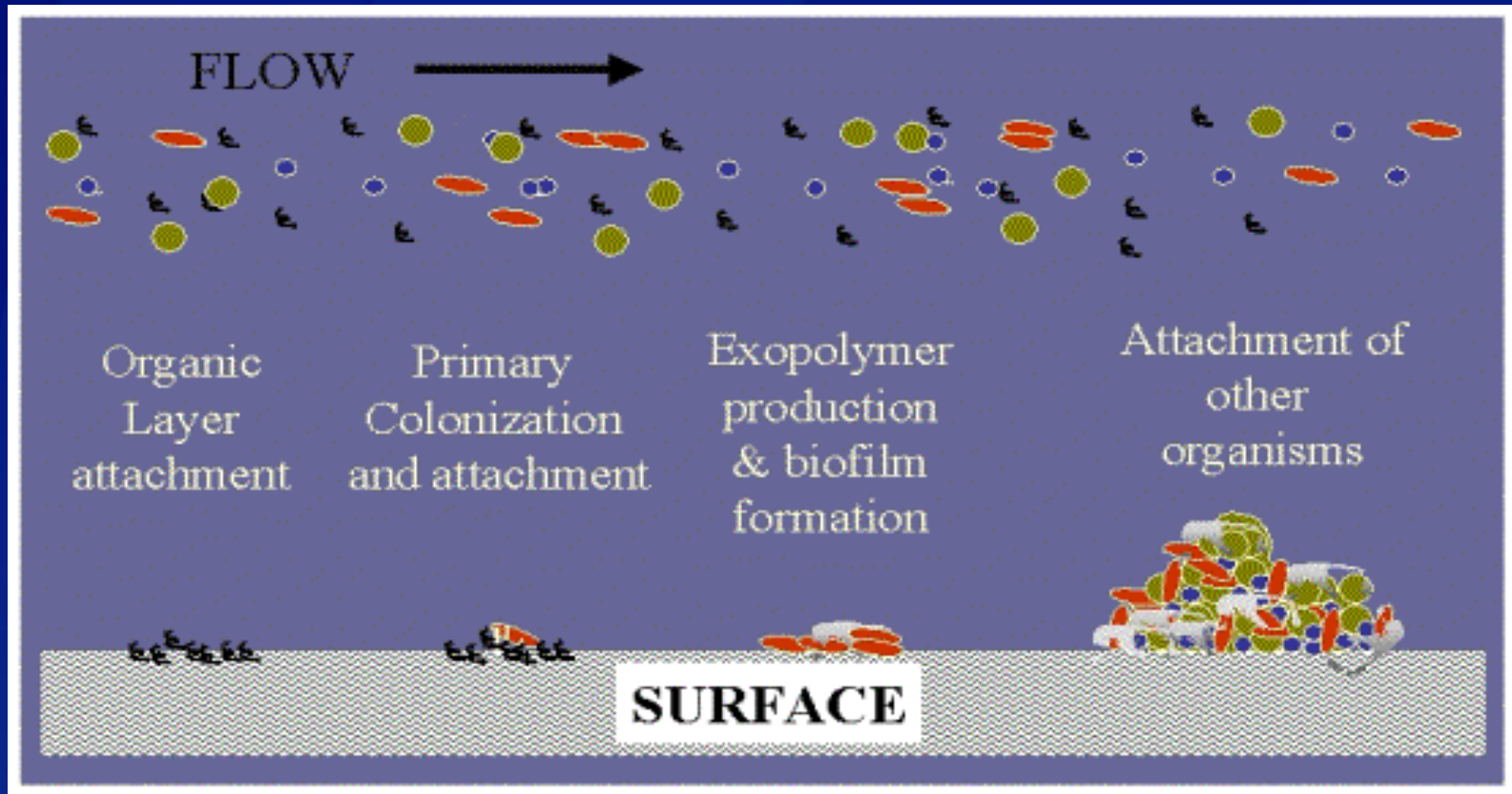
Risk factor	Value for residents:	
	Not colonized with any ARO (<i>n</i> = 11)	Having new acquisition of any ARO (<i>n</i> = 57)
PSMS, mean ± SD	15.9 ± 5.61	20.9 ± 5.35 ^a
Charlson's comorbidity score, mean ± SD	2.36 ± 2.34	2.51 ± 1.51
Any hospital visit, no./total (%)	1/11 (9)	16/57 (28)
Any antibiotic use, no./total (%)	6/11 (55)	42/57 (74)
Device use, no./total (%)	1/11 (9)	14/57 (25)

^a *P* ≤ 0.05.

- ❑ Recent antibiotic use is a risk factor for being colonized with MDROs
- ❑ Antibiotics disrupt normal bacterial flora and increase the risk of acquiring MDROs
- ❑ Inappropriate use of antibiotics can lead to MDROs

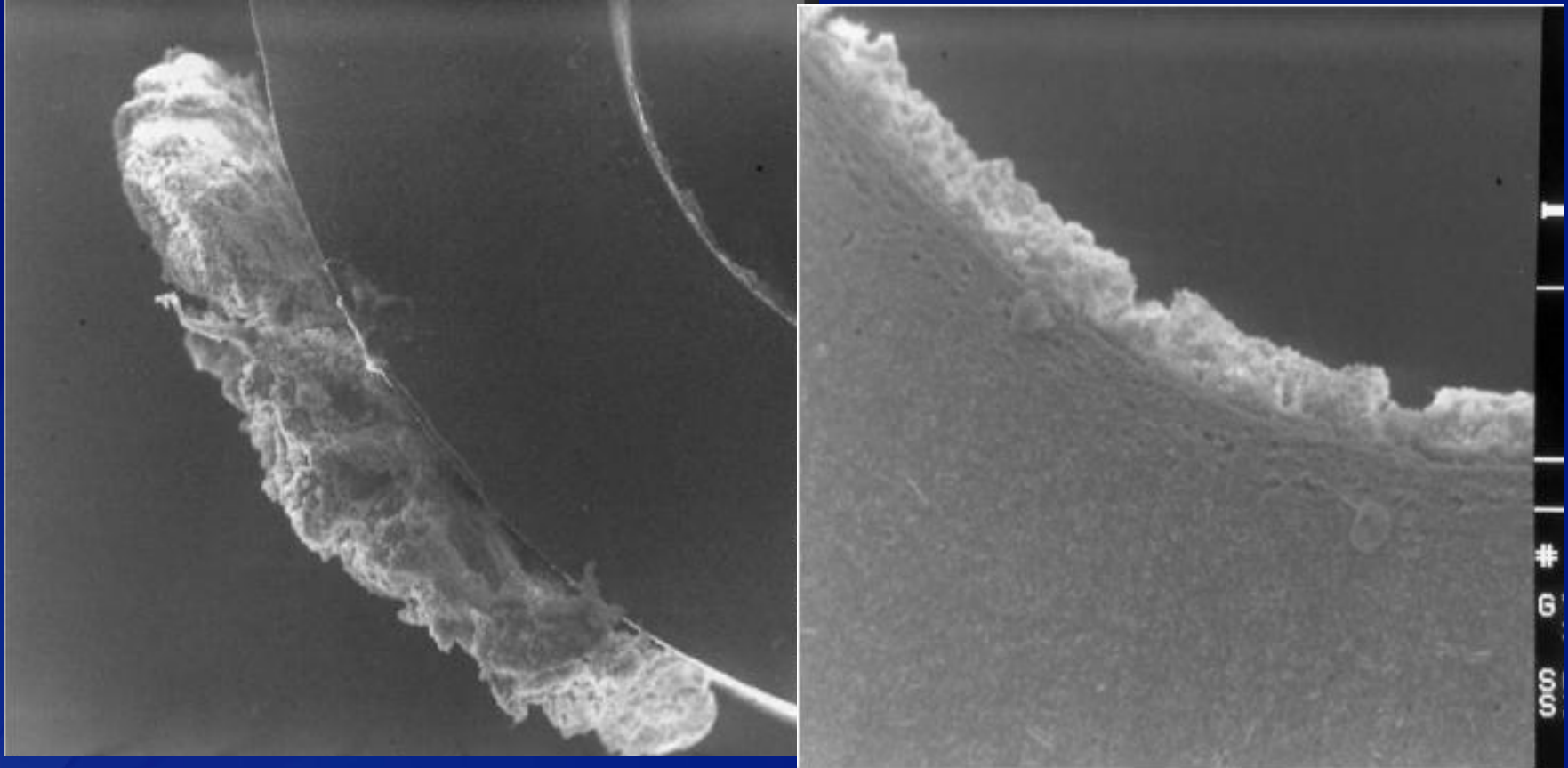
Fisch et al. *J Clin Micro* 2012; 50: 1698-1703; Mody et al. *Clin Infect Dis* 2008; 46(9): 1368-73; Stone et al. *ICHE* 2012; 33(6): 551-7; Pop-Vicas et al *J Am Geriatr Soc.* 2008 56(7):1276-80;

Biofilm formation on device surfaces



- Biofilm: An collection of bacteria within a sticky film that forms a community on the surface of a device

Biofilm on an indwelling urinary catheter



Resistance develops within biofilms

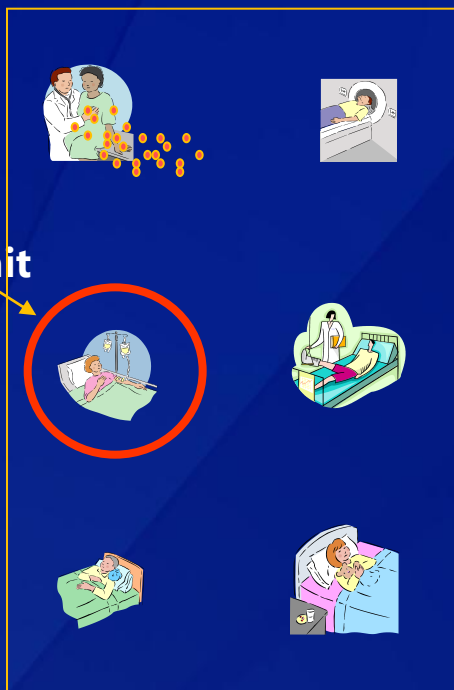
- ❑ Bacteria within a biofilm are grow every differently from those floating around freely
 - ❑ These changes in their growth make our antibiotics less effective
- ❑ Antibiotics can't penetrate the biofilm to get to the bacteria
 - ❑ This leads to much less drug available to treat the bugs
- ❑ Bacteria within the biofilm can exchange information including the traits that cause resistance
 - ❑ Some carbapenem-resistance can be easily shared among different bacteria

Colonization pressure leading to MDRO acquisition

- ❑ Colonization pressure: High burden of other MDRO carriers on a unit will increase the risk of MDRO acquisition for others
- ❑ Studies have demonstrated the impact of colonization pressure on acquisition of many resistant bacteria and *C. difficile*
- ❑ Both colonized and infected individuals act as a source for spread on a unit or within a facility

Colonization pressure: Example

CDI pressure
= 1 × days in unit



Unit A

Fewer patients with active CDI
= lower risk of acquiring CDI

CDI pressure
= 5 × days in unit



Unit B

More patients with active CDI
= higher risk of acquiring CDI



Patient Safety

STANDARD OF CARE FOR ALL PATIENTS

CLEAN HANDS SAVE LIVES

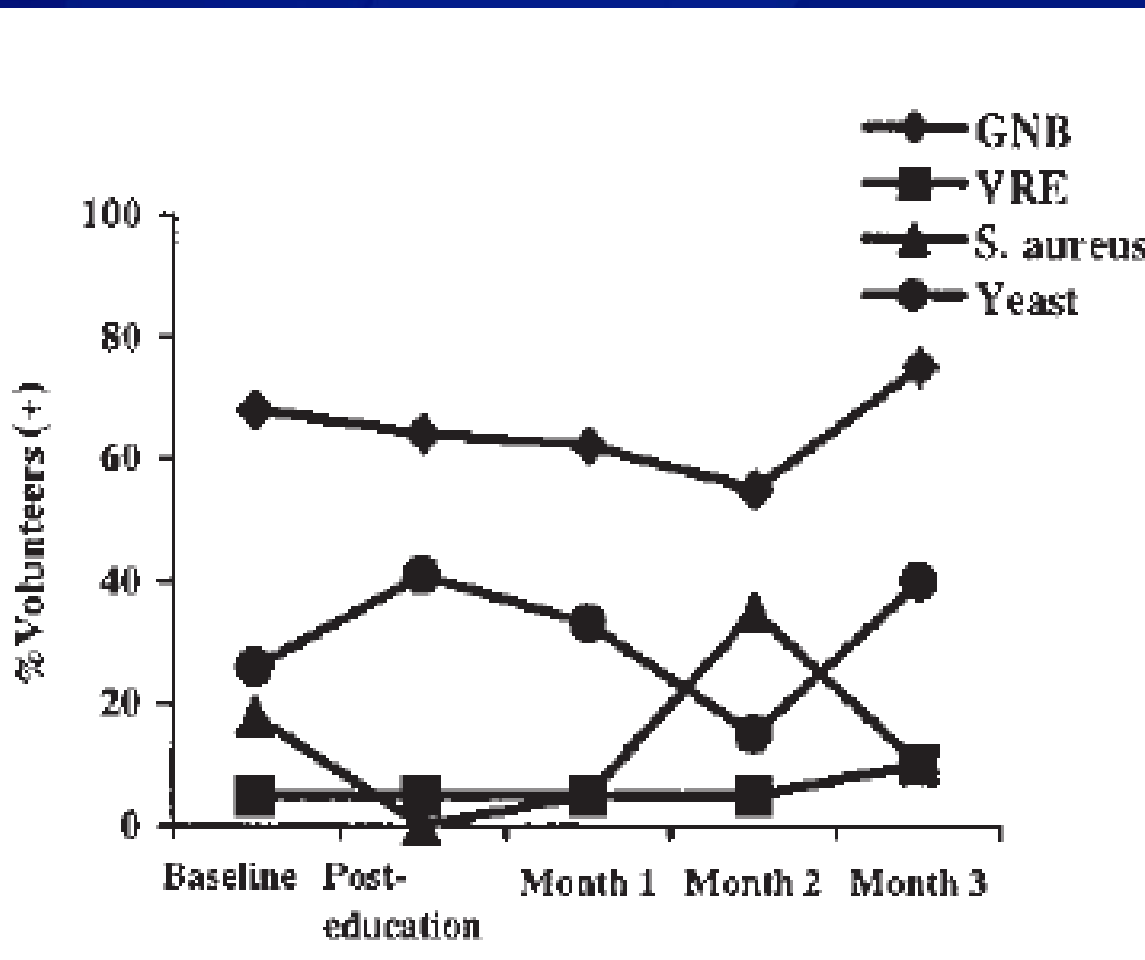
Protect patients, protect yourself



Alcohol-rub or wash
before and after **EVERY** contact.



Bacterial contamination of HCW hands prior to hand hygiene in a LTCF



- Gram negative bacteria were the most common bugs cultured from hands of staff
- Most Gram neg. bacteria live in the GI tract or colonize the urine

The invisible reservoir of MDROs



X marks the locations where VRE was isolated in this room

- Image from Abstract: The Risk of Hand and Glove Contamination after Contact with a VRE (+) Patient Environment. Hayden M, ICAAC, 2001, Chicago, IL.

Slide courtesy of Teresa Fox, GA Div PH

Duration of environmental contamination by MDROs

Pathogen	Survival	Data Strength	Transmission Settings
<i>C difficile</i>	Months	3+	Healthcare facilities
MRSA	Days-weeks	3+	Burn units
VRE	Days-weeks	3+	Healthcare – higher risk areas
<i>Acinetobacter</i>	33 days	2/3+	Wet or dry environments
<i>Pseudomonas aeruginosa</i>	7 hours	1+	Wet environments

Adapted from Hota. *Clin Infect Dis*. 2004;39:1182-1189.

Prevention strategies for MDROs

- ❑ **Identifying resistant organisms in your facility**
- ❑ **Recognizing individuals with risk factors for resistant organisms**
- ❑ **Using gowns and gloves appropriately**
- ❑ **Consistent performance of hand hygiene (HH)**
- ❑ **Cleaning and disinfection of shared equipment, rooms/surfaces**
- ❑ **Assessment of antibiotic use in the facility**
- ❑ **Awareness of use and management of medical devices**

Take Home Points

- ❑ Antibiotic resistance is a growing problem across all healthcare settings
 - ❑ This collaborative is focused on carbapenem-resistance, but all MDROs develop/spread in similar ways
- ❑ Understanding how MDROs emerge and spread can focus infection prevention at the bedside
 - ❑ Step one: Understand the problem of MDROs in your facility
 - ❑ Step two: Improve communication about MDROs within your facility and at time of transfer
- ❑ Educating staff will highlight their role in preventing the spread of MDROs at the bedside

Thank you!!

**Email: nstone@cdc.gov with
questions/comments**

For more information please contact Centers for Disease Control and Prevention

1600 Clifton Road NE, Atlanta, GA 30333
Telephone, 1-800-CDC-INFO (232-4636)/TTY: 1-888-232-6348
E-mail: cdcinfo@cdc.gov Web: www.cdc.gov

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

**National Center for Emerging and Zoonotic Infectious Diseases
Division of Healthcare Quality Promotion**



Carbapenem-resistant
Enterobacteriaceae (CRE):
A Bird's Eye View from the US

Jesse T. Jacob, MD
Assistant Professor of Medicine
Emory University

Objectives

- Understand the context of CRE among resistant among gram negative bacteria
- Recognize the epidemiology and national threat of CRE
- Integrate approaches to CRE prevention

Overview of Gram Negative Bacteria



E. coli, Klebsiella, Proteus, Enterobacter, Serratia, Pseudomonas, Salmonella, Shigella, Bacteroides



Vibrio, Campylobacter jejuni, Helicobacter pylori



*Neisseria meningitidis
N. gonorrhoeae (gonococcus)
Moraxella catarrhalis*



Fusobacterium

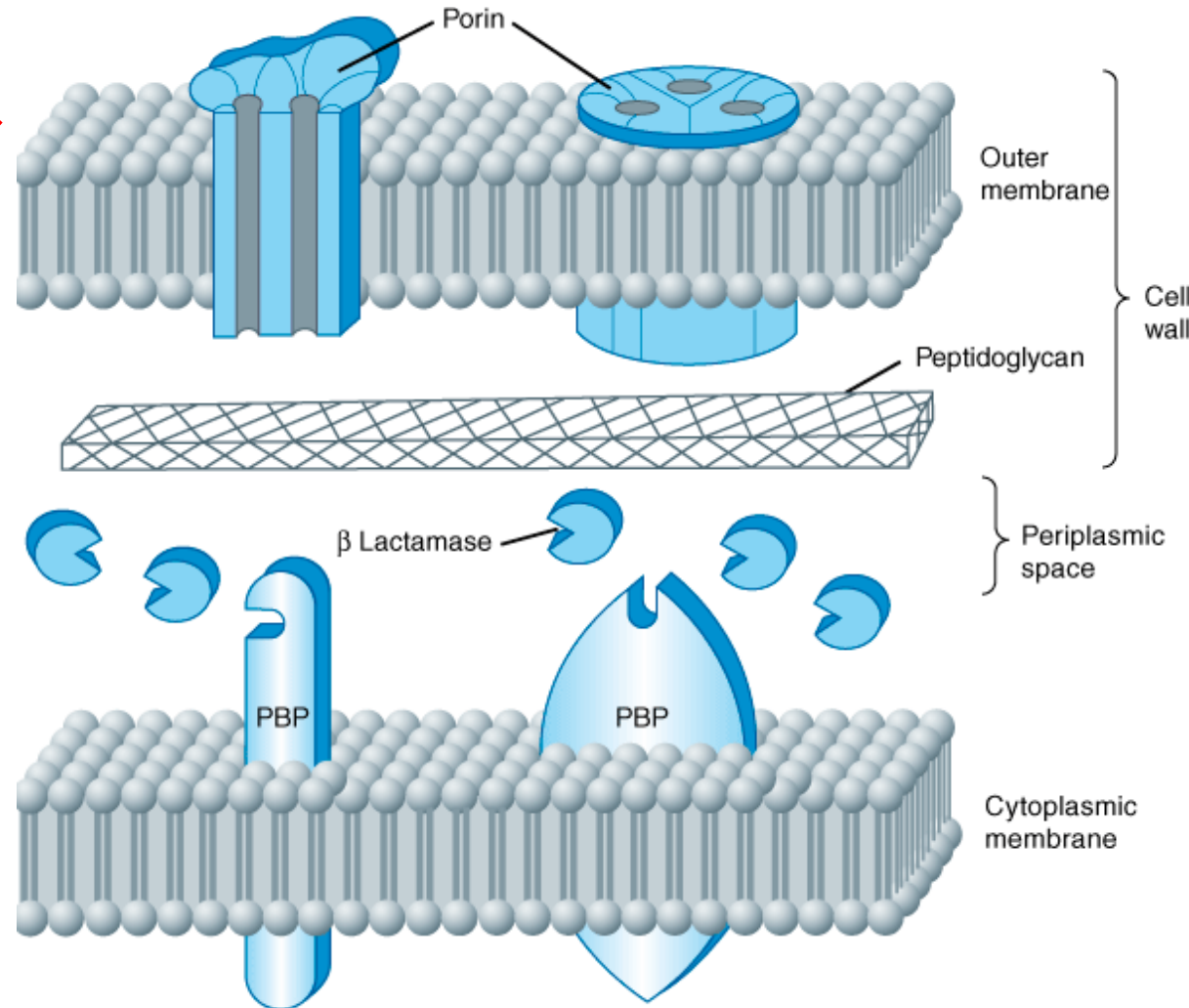
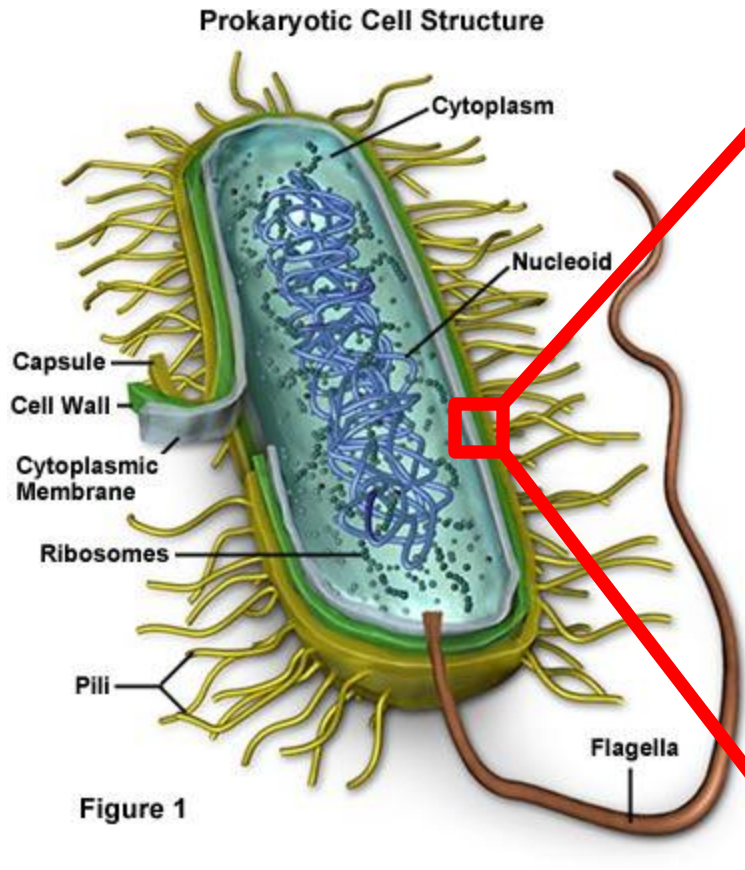
Enterobacteriaceae

- Large family of bacteria
- Normal human (animal) gut microbiota
 - Most common: *E. coli* and *Klebsiella pneumoniae*
- Agents of common and serious infections in both healthcare setting and the community
 - Urinary tract infections, post-operative infections, pneumonia, bloodstream infections, meningitis, and intra-abdominal infections
 - Typhoid, plague, dysentery

Carbapenems\Carbapenem Resistance

- Carbapenems (i.e. imipenem)
 - Broadest spectrum β -lactams available
 - “Antibiotics of last resort”, only given by vein
- Carbapenem resistance
 - Potentially transferrable (plasmid mediated)
 - Two major mechanisms
 - Carbapenemase
 - Porin mutation + β -lactamase

Resistance to β -lactam Antibiotics



Source: Katzung BG, Masters SB, Trevor AJ: *Basic & Clinical Pharmacology*, 11th Edition: <http://www.accessmedicine.com>

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Klebsiella pneumoniae Carbapenemase

ANTIMICROBIAL AGENTS AND CHEMOTHERAPY, Apr. 2001, p. 1151–1161
0066-4804/01/\$04.00+0 DOI: 10.1128/AAC.45.4.1151–1161.2001
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Vol. 45, No. 4

Novel Carbapenem-Hydrolyzing β -Lactamase, KPC-1, from a Carbapenem-Resistant Strain of *Klebsiella pneumoniae*

HESNA YIGIT,¹ ANNE MARIE QUEENAN,² GREGORY J. ANDERSON,¹
ANTONIO DOMENECH-SANCHEZ,³ JAMES W. BIDDLE,¹ CHRISTINE D. STEWARD,¹
SEBASTIAN ALBERTI,⁴ KAREN BUSH,² AND FRED C. TENOVER^{1*}

- First US isolate described in North Carolina
- Isolated 1996, reported in 2001
- Became endemic in the NE US

Molecular Characterization of an Enterobacterial Metallo β -Lactamase Found in a Clinical Isolate of *Serratia marcescens* That Shows Imipenem Resistance

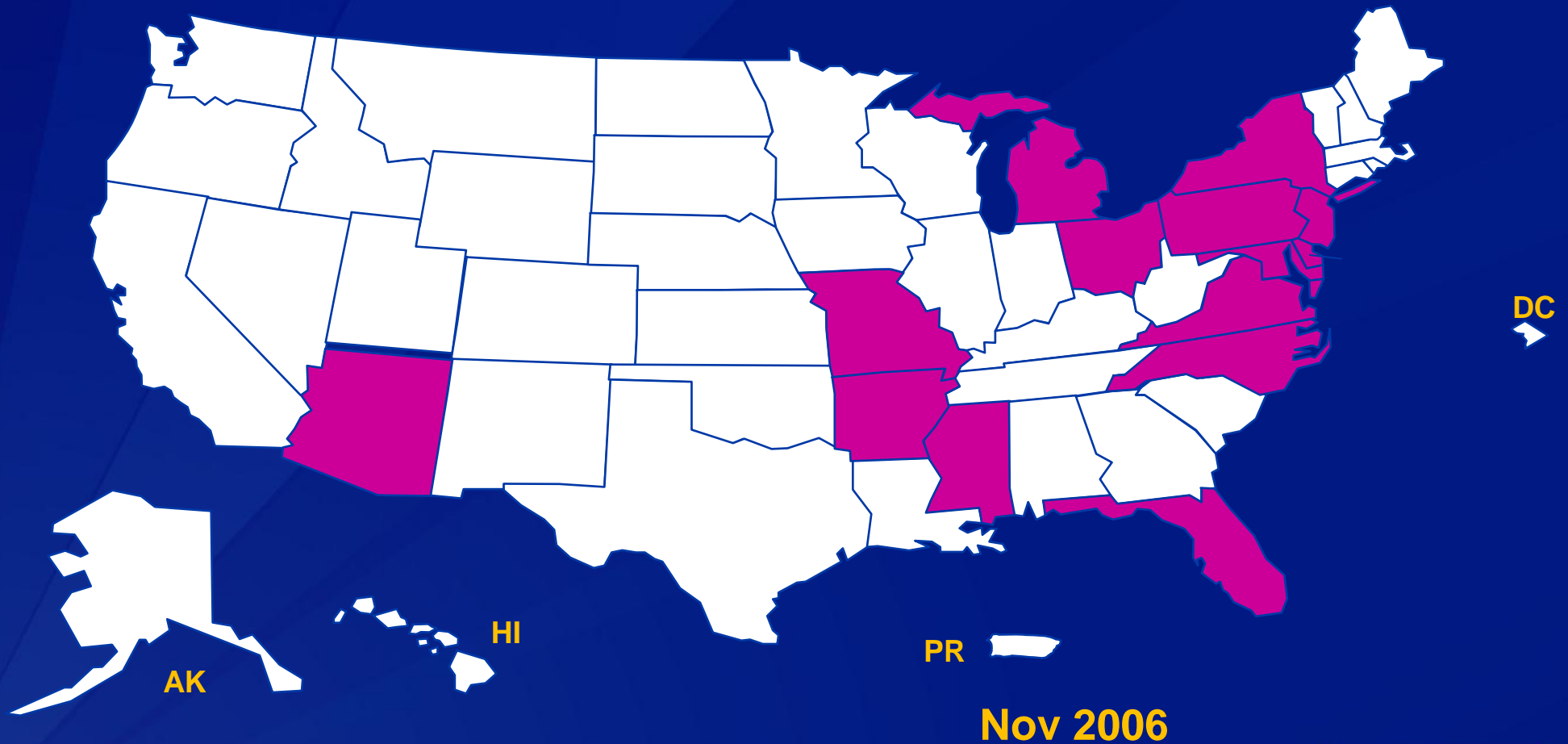
ETSUO OSANO,[†] YOSHICHIKA ARAKAWA,* ROCHAPORN WACHAROTAYANKUN,[‡] MICHIO OHTA,
TOSHINOBU HORII, HIDEO ITO, FUMINOBU YOSHIMURA,[†] AND NOBUO KATO

Department of Bacteriology, Nagoya University School of Medicine, Nagoya 466, Japan

Received 28 June 1993/Returned for modification 14 September 1993/Accepted 28 October 1993

A clinical isolate of *Serratia marcescens* (TN9106) produced a metallo β -lactamase (IMP-1) which conferred resistance to imipenem and broad-spectrum β -lactams. The *bla*_{IMP} gene providing imipenem resistance was cloned and expressed in *Escherichia coli* HB101. The IMP-1 was purified from *E. coli* HB101 that harbors pSMBNU24 carrying *bla*_{IMP}, and its apparent molecular mass was calculated to be about 30 kDa by sodium dodecyl sulfate-polyacrylamide gel electrophoresis. Kinetic studies of IMP-1 against various β -lactams revealed that this enzyme hydrolyzes not only various broad-spectrum β -lactams but also carbapenems. However, aztreonam was relatively stable against IMP-1. Although clavulanate or cloxacillin failed to inhibit IMP-1, Hg²⁺, Fe²⁺, or Cu²⁺ blocked the enzyme's activity. Moreover, the presence of EDTA in the reaction buffer resulted in a decrease in the enzyme's activity. Carbapenem resistance was not transferred from *S. marcescens* TN9106 to *E. coli* CSH2 by conjugation. A hybridization study confirmed that *bla*_{IMP} was encoded on the chromosome of *S. marcescens* TN9106. By nucleotide sequencing analysis, *bla*_{IMP} was found to encode a protein of 246 amino acid residues and was shown to have considerable homology to the metallo β -lactamase genes of *Bacillus cereus*, *Bacteroides fragilis*, and *Aeromonas hydrophila*. The G+C content of *bla*_{IMP} was 39.4%. Four consensus amino acid residues, His-95, His-97, Cys-176, and His-215, which form putative zinc ligands, were conserved in the deduced amino acid sequence of IMP-1. By determination of the amino acid sequence at the N terminus of purified mature IMP-1, 18 amino acid residues were found to be processed from the N terminus of the premature enzyme as a signal peptide. These results clearly show that IMP-1 is an enterobacterial metallo β -lactamase, of which the primary structure has been completely determined, that confers resistance to carbapenems and other broad-spectrum β -lactams.

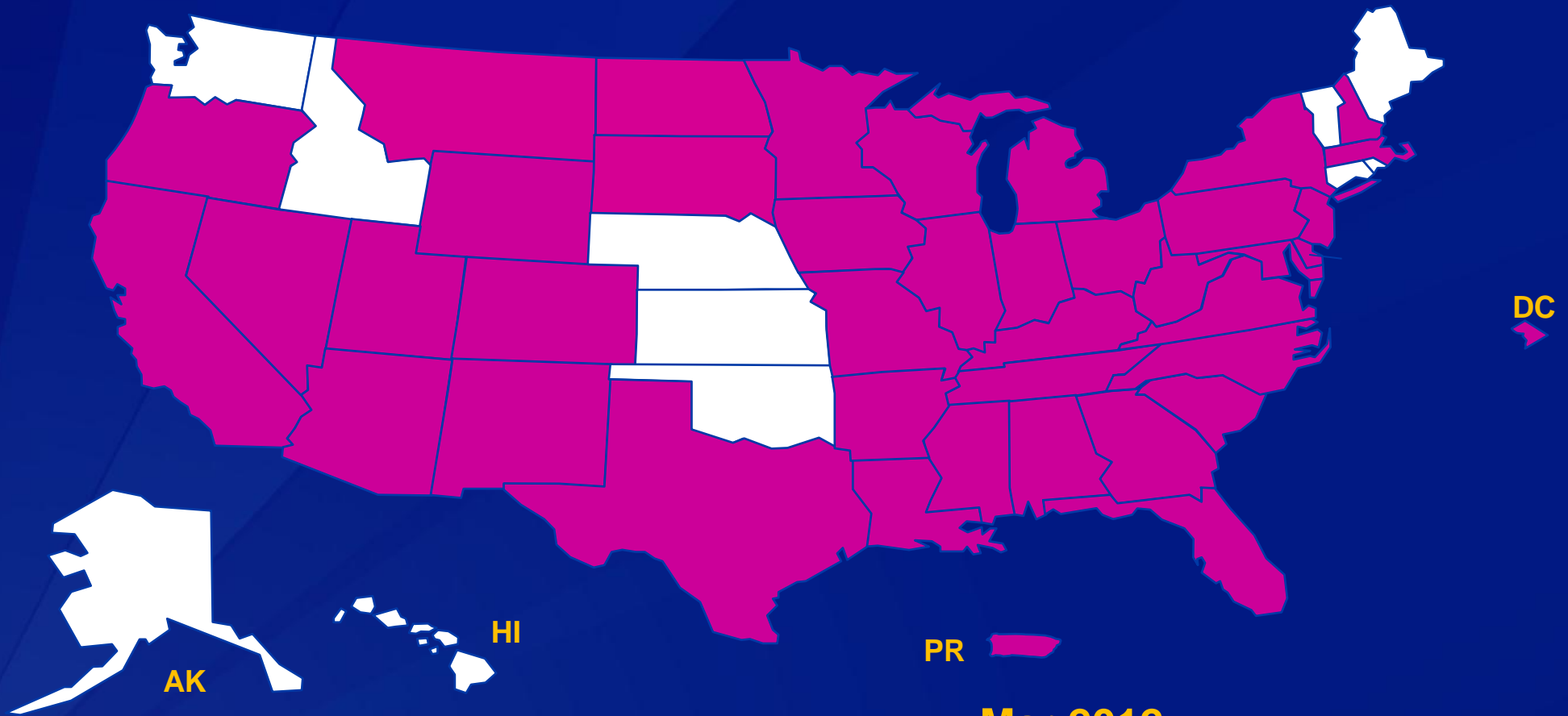
KPC-producing CRE in the United States



- Patel, Rasheed, Kitchel. 2009. Clin Micro News
- CDC, unpublished data



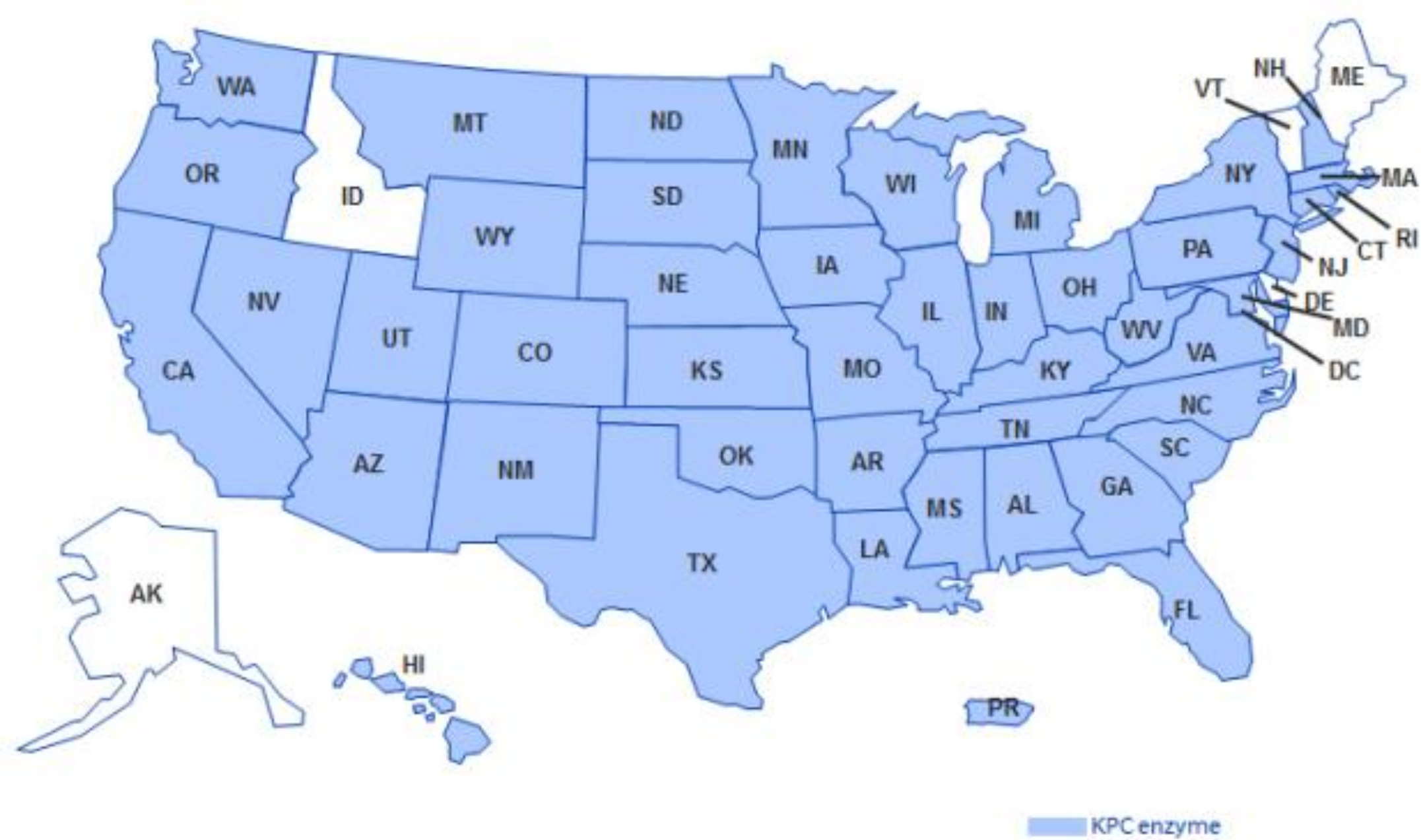
KPC-producing CRE in the United States



Mar 2012

- Patel, Rasheed, Kitchel. 2009. Clin Micro News
- CDC, unpublished data





This map was last updated on December 31, 2013

CRE in the National Healthcare Safety Network (NHSN), 2009-2010

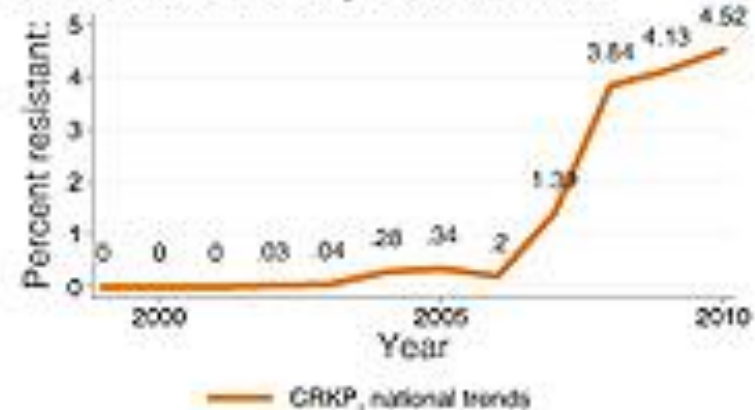
	Central line-associated bloodstream infections	Catheter-associated urinary tract infections	Ventilator-associated pneumonia	Surgical site infections
<i>E. coli</i>	1.9%	2.3%	3.5%	2.0%
<i>Klebsiella</i> spp.	12.7%	12.5%	11.2%	8.2%

Carbapenem-resistant *Klebsiella pneumoniae*

US Regions, 2009-2010



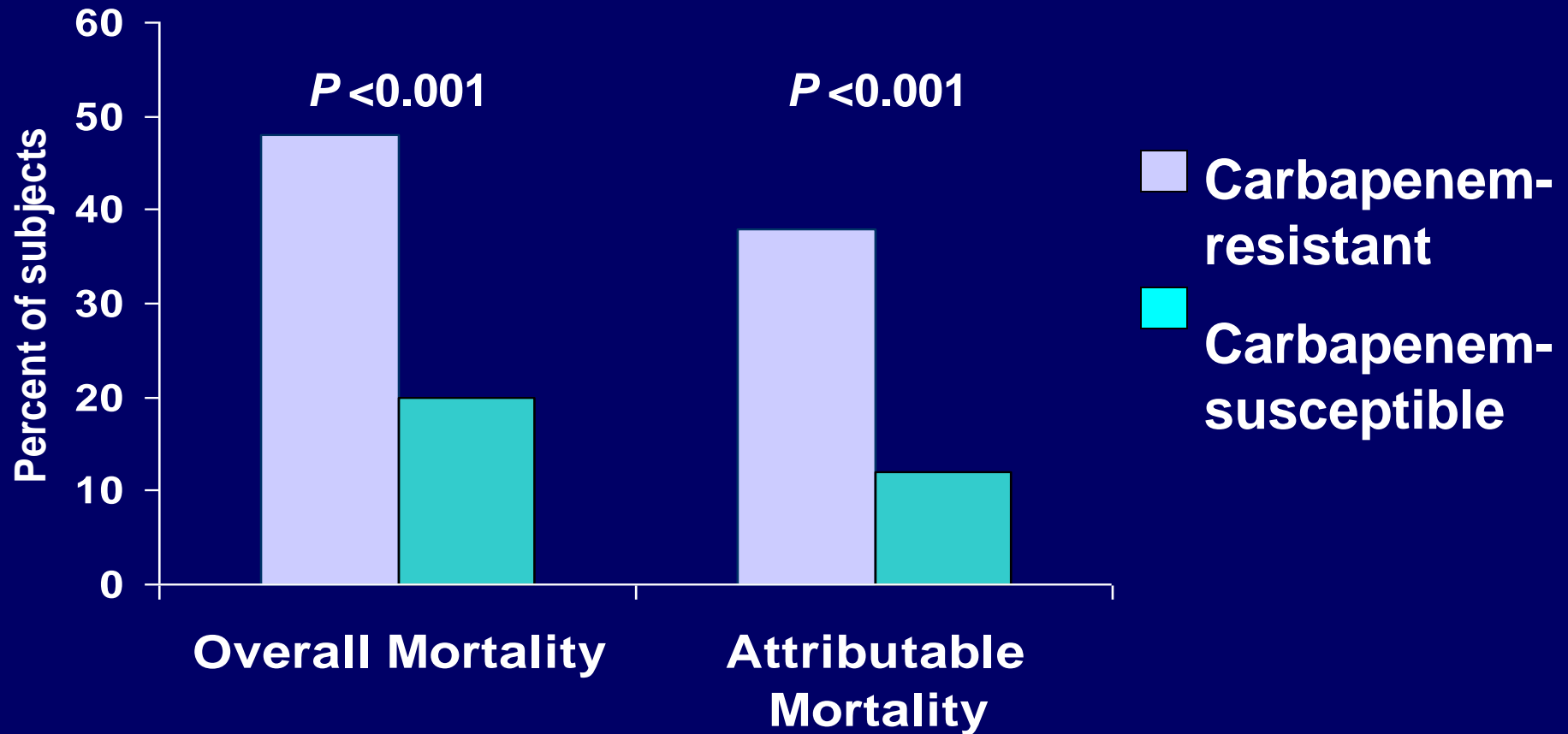
National trends, 1999-2010



ResistanceMap

cddep.org/map

Mortality in CRE Bacteremia



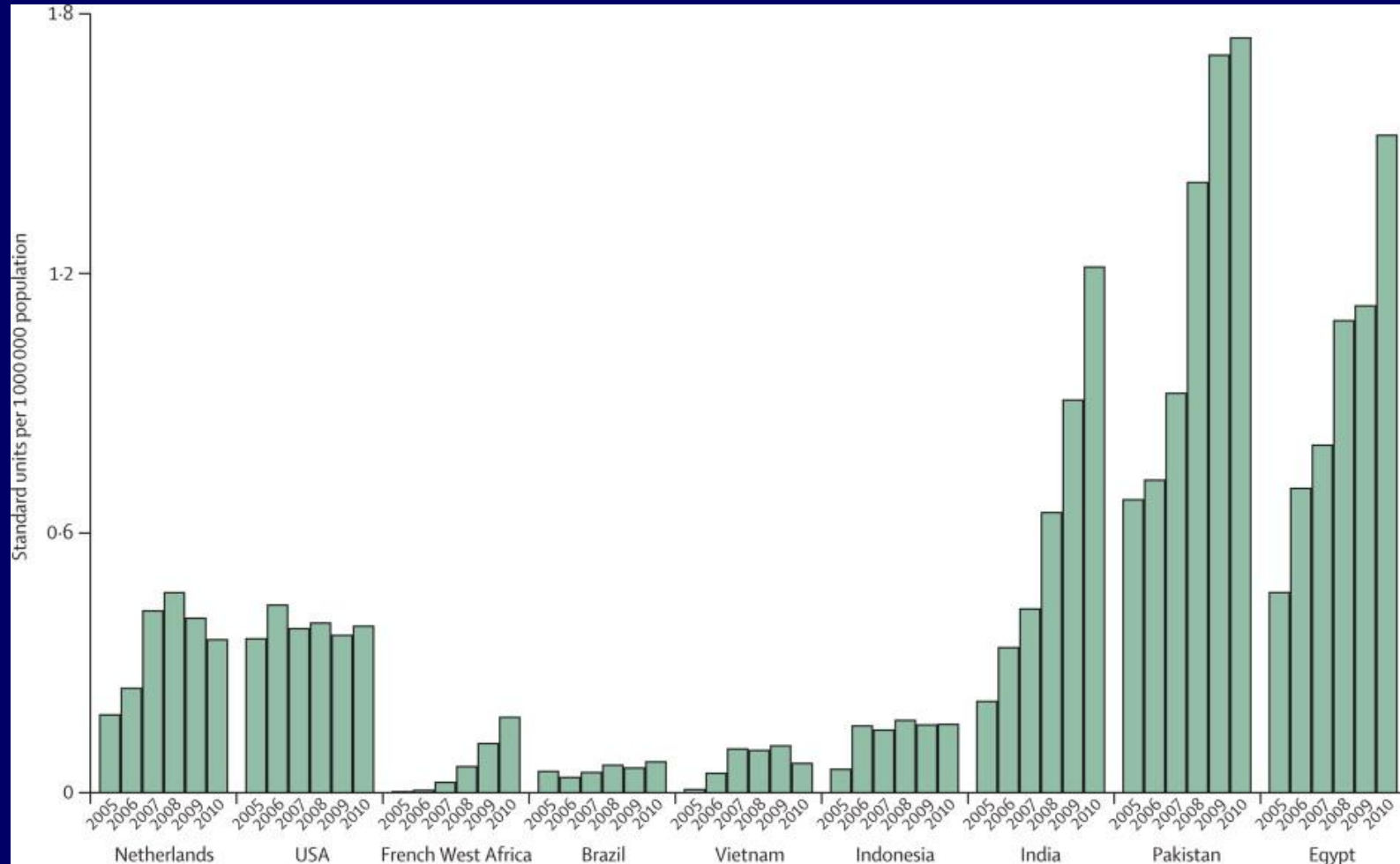
International dissemination of *Klebsiella pneumoniae* carbapenemase (KPC)–producing Enterobacteriaceae.





- Result of clinical summit in 2012
- Developed a roadmap to tackling antibiotic resistance (not just CRE) over 5 years
 - Aims to be practical, not ideal
 - Medical school curriculum
 - Standardize microbiology labs
 - Implement hospital antimicrobial stewardship
 - Regulation of over the counter antibiotics

Carbapenem Use in Selected Countries



Challenges in CRE Surveillance: Laboratory

- Evolving, disparate resistance definitions
 - Clinical Laboratory Standards Institute (labs)
 - Federal Drug Administration (manufacturers)
- Complex, sequential testing
 - Different automated instruments & panels/cards
 - Manual confirmatory testing (modified Hodge test)
- Same phenotype, different genotype
- Multiple species and drugs

Challenges in CRE Surveillance: Epidemiology

- Limitation of current surveillance systems
 - SENTRY Program (assesses % resistance)
 - NHSN (rates based on patient-days)
- Importance of non-sterile sites
 - Frequently colonize urine and airway

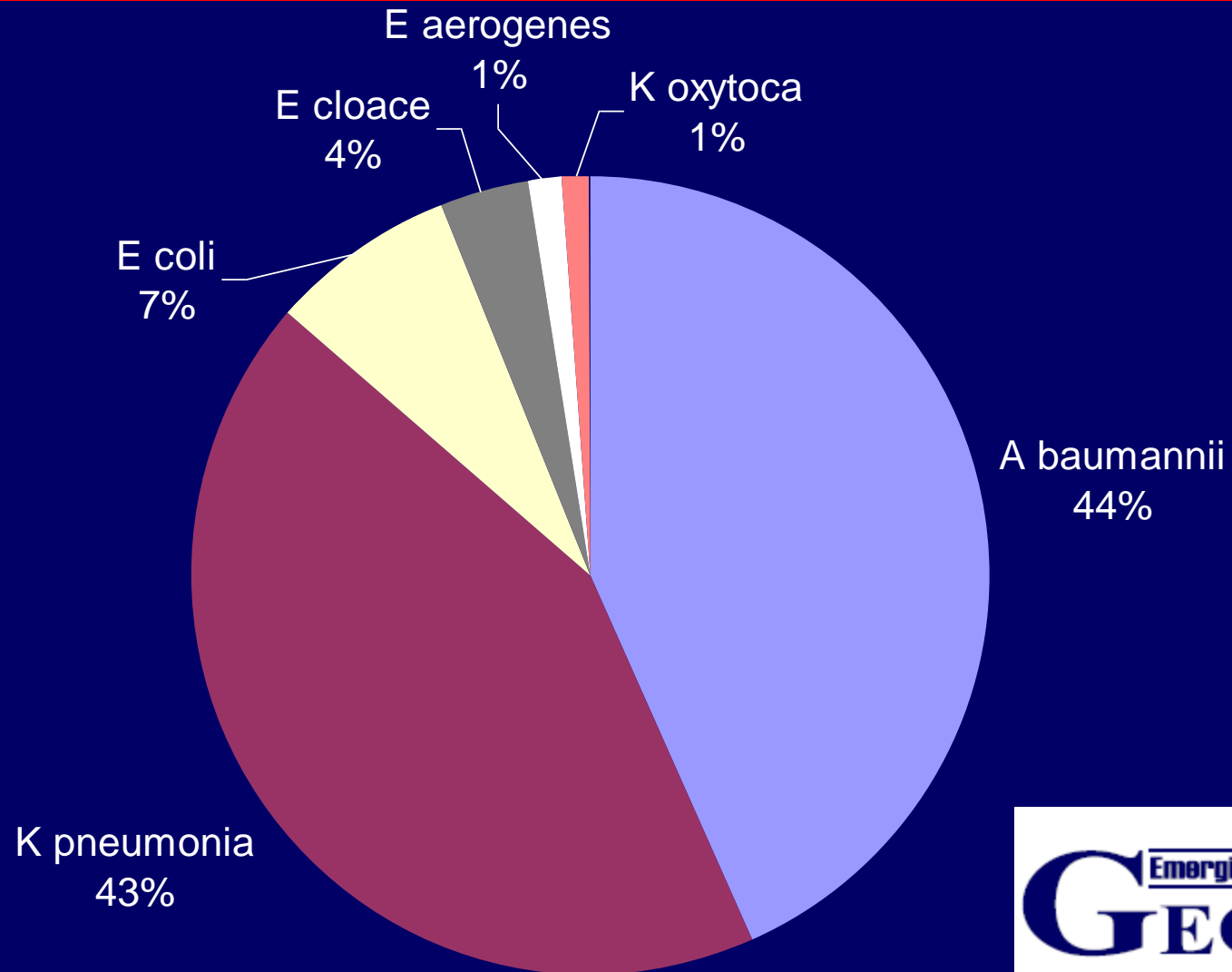
Multi-state Gram negative Surveillance Initiative (MuGSI)

- Evaluate population-based incidence of non-susceptibility to carbapenems
 - Assess changes over time
- Inform prevention efforts
- Describe resistance mechanisms

EIP (GA, MN, OR) Data

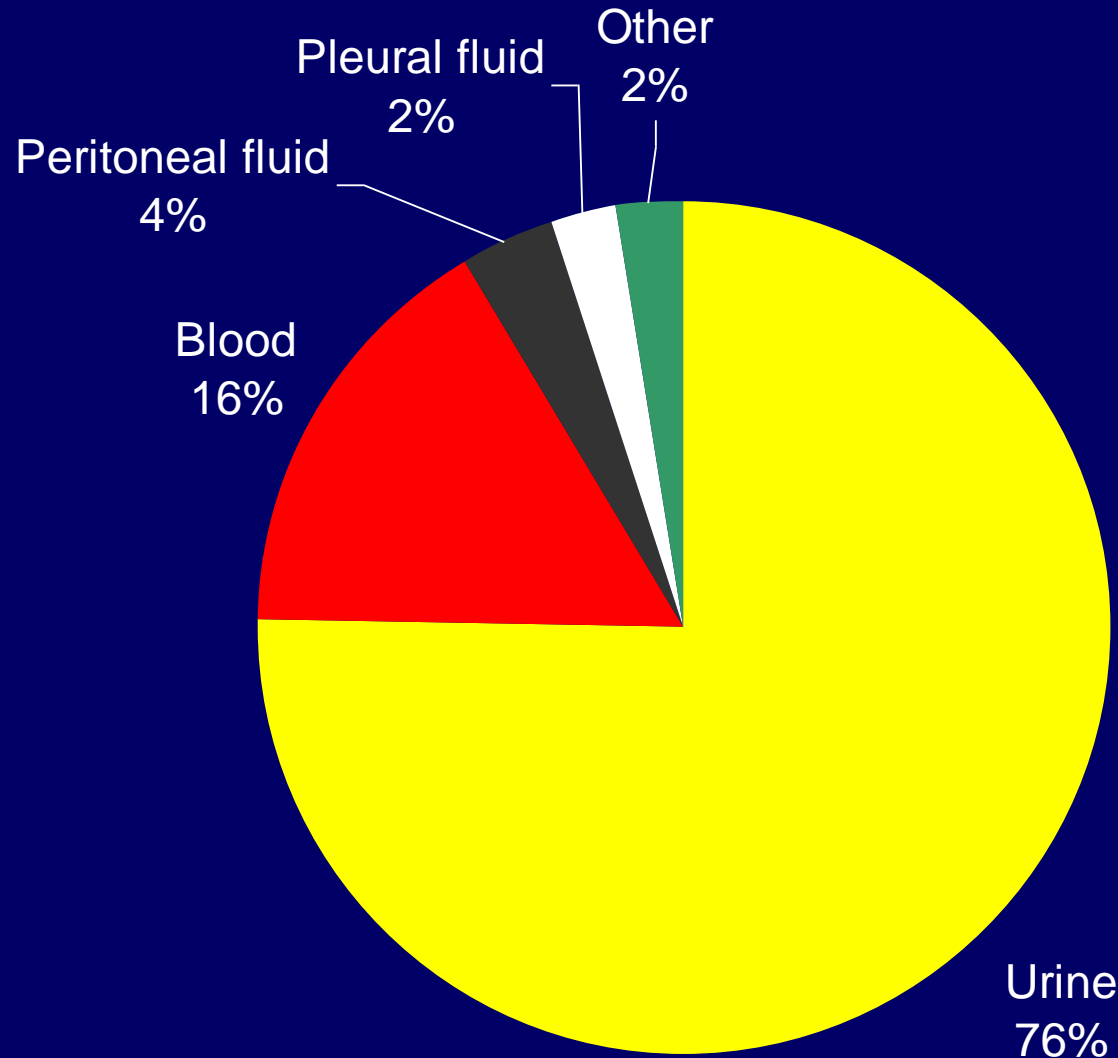
- 72 CRE were identified from 64 patients over 5 months
 - 59 from Atlanta metropolitan area (59)
 - Most were *Klebsiella* species (49) followed by *Enterobacter* species (14) and *E. coli* (9)
 - Urine most common source (89%), blood (10%)
 - 47/71 collected outside of acute care hospitals, but 41 of these had recent healthcare exposures

Organisms



n=81

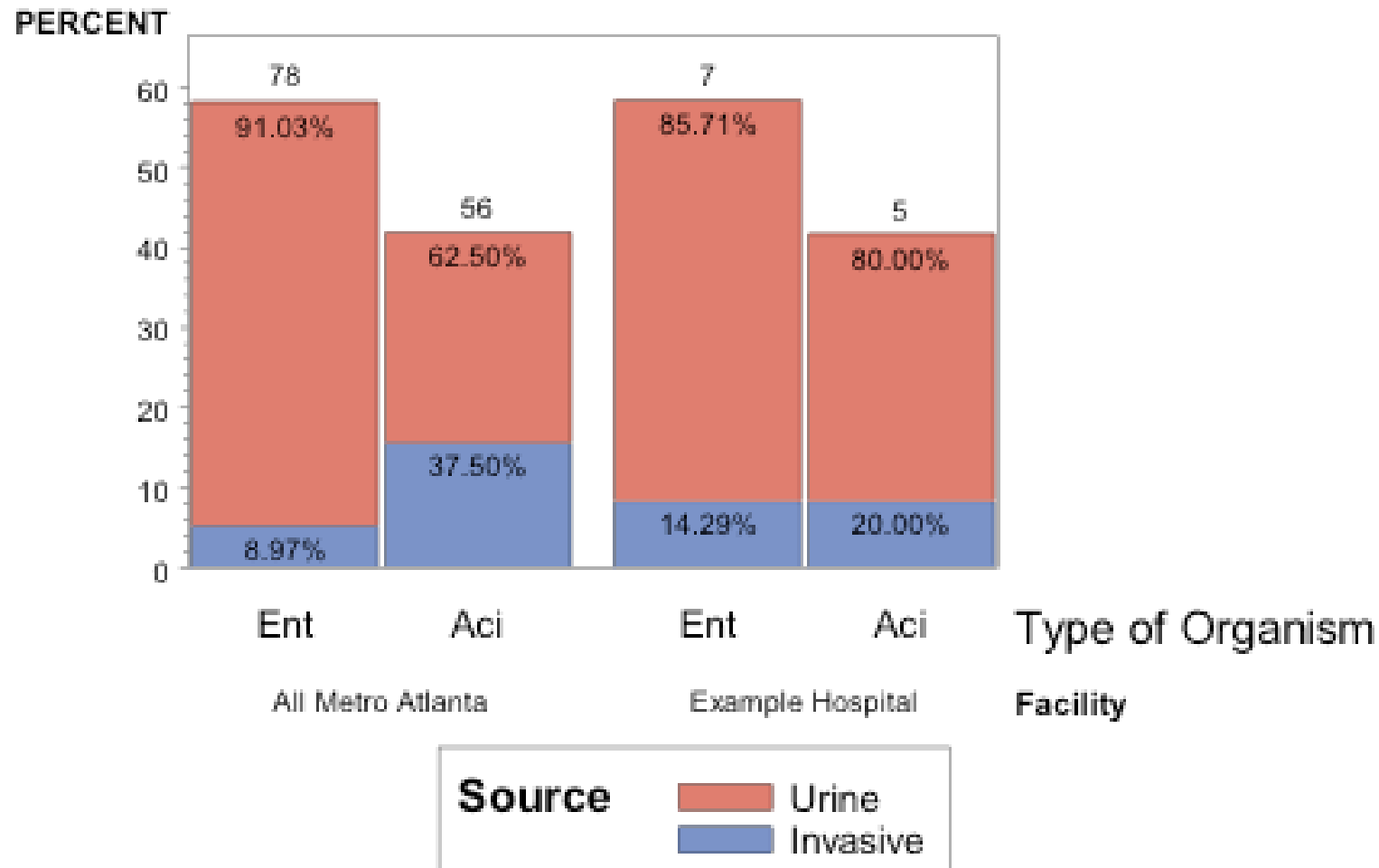
Distribution by Body Site



n=81

Example Hospital Carbapenem-Nonsusceptible Cases

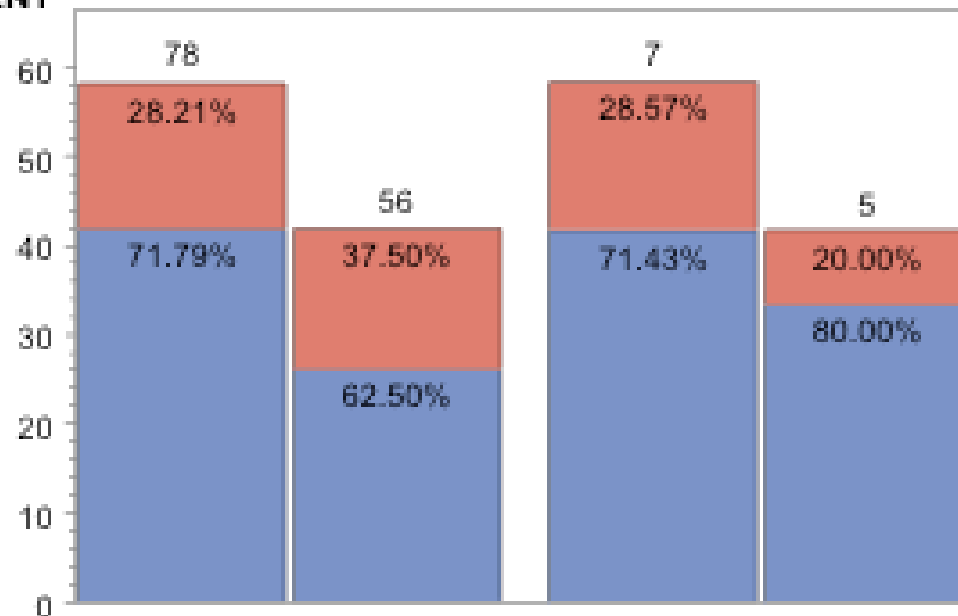
Culture Source August-December 2011



Example Hospital Carbapenem-Nonsusceptible Cases

Days Admitted before Infection August-December 2011

PERCENT



Ent

Aci

Ent

Aci

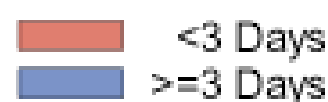
Type of Organism

All Metro Atlanta

Example Hospital

Facility

Days Admitted



CRE: A Call to Antibiotic Stewardship

J Antimicrob Chemother 2011; **66**: 689–692
doi:10.1093/jac/dkq520 Advance Access publication 28 January 2011

**Journal of
Antimicrobial
Chemotherapy**

Does broad-spectrum β -lactam resistance due to NDM-1 herald the end of the antibiotic era for treatment of infections caused by Gram-negative bacteria?

Patrice Nordmann^{1*}, Laurent Poirel¹, Mark A. Toleman² and Timothy R. Walsh²

- Collaboration of infection prevention & control, microbiology, pharmacy and clinicians (ID)

CRE by EIP Site (2012*-2013)

Site	E. coli	Enterobacter spp.	Klebsiella spp.	Total CRE
CO	2	16	7	25
GA	42	43	223	308
MD	5	10	33	48
MN	9	43	14	66
NY	3	4	12	19
OR	3	11	5	19
Total	64 (13%)	127 (26%)	294 (61%)	485

*2012 cases reported for GA, MN and OR only

Guidance for Control of Infections with Carbapenem-Resistant or Carbapenemase-Producing *Enterobacteriaceae* in Acute Care Facilities

- Infection prevention and control
 - Contact precautions
- Laboratory
 - Establish a protocol for carbapenemase production (MHT) using CLSI guidelines
 - Establish system to promptly notify infection prevention staff when CRE isolated

Recommendations for Surveillance

- Review clinical cultures for last 6-12 months
- If CRE is identified:
 - Conduct point prevalence survey of patients
 - in the same unit
 - cared for by same healthcare workers
 - Perform weekly active surveillance until no new cases identified

Importance of Diagnostics on Surveillance

- Accurate surveillance depends on accurate diagnostic testing
- Current reliance on manual phenotypic testing
- New technologies emerging
 - Costs, implementation and standardization



Available online at www.sciencedirect.com

 ScienceDirect

Diagnostic Microbiology and Infectious Disease 70 (2011) 119–123

DIAGNOSTIC
MICROBIOLOGY
AND INFECTIOUS
DISEASE

www.elsevier.com/locate/diagmicrobio

Multiplex PCR for detection of acquired carbapenemase genes

Laurent Poirel^{a,*}, Timothy R. Walsh^b, Vincent Cuvillier^a, Patrice Nordmann^a



Available online at www.sciencedirect.com

SciVerse ScienceDirect

Diagnostic Microbiology and Infectious Disease 71 (2011) 442–445

DIAGNOSTIC
MICROBIOLOGY
AND INFECTIOUS
DISEASE

www.elsevier.com/locate/diagmicrobio

Notes

Updated multiplex polymerase chain reaction for detection of 16S rRNA methylases: high prevalence among NDM-1 producers[☆]

Béatrice Berçot^{a,b}, Laurent Poirel^{a,*}, Patrice Nordmann^a



Multiplex Real-Time PCR Detection of *Klebsiella pneumoniae* Carbapenemase (KPC) and New Delhi metallo- β -lactamase (NDM-1)

Background

This procedure provides instructions for Taqman-based real-time PCR detection of *bla*_{KPC} and *bla*_{NDM-1} in a single reaction from gram-negative bacteria. The universal 16S rRNA gene is used as a control for DNA extraction and amplification for each reaction. If desired, either KPC or NDM-1 can be assayed independently by excluding the other set of primers and probe. Although KPC and NDM appear to be the most common carbapenemases in the United States, it is important to note that there are other less common carbapenemases, as well as other mechanisms of carbapenem resistance.

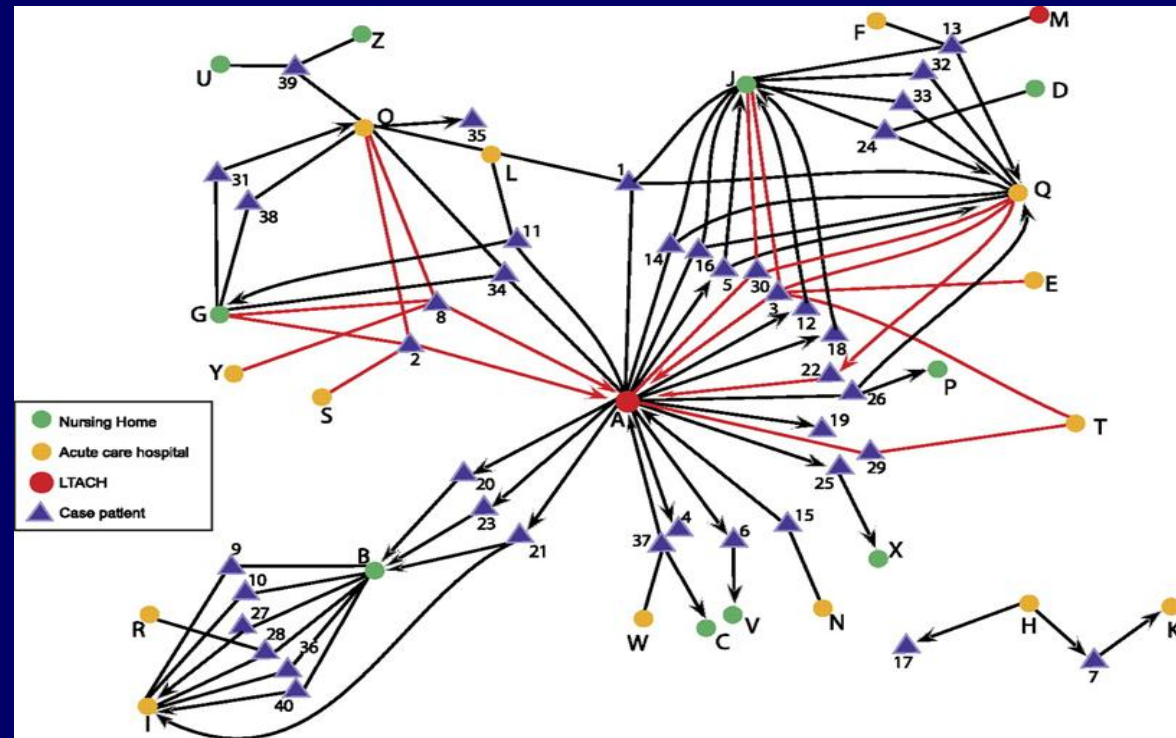
Importance of CRE

- Common
- Deadly (high mortality rates observes)
- Transmissible (between patients, bacteria)
- Few therapeutic options (toxicity, efficacy)

- Will this spread into the community?

Outbreak of CRE with Regional Dissemination, Chicago, 2008

- Extensive network of facilities: 14 acute care hospitals, 2 LTACHs, and 10 NHs
- 40 patients with KPC-producing CRE
 - 4 acquired in acute care setting
 - 24 (60%) → 1 LTACH





Guidance for Control of Carbapenem-resistant Enterobacteriaceae (CRE)

2012 CRE Toolkit

National Center for Emerging and Zoonotic Infectious Diseases
Division of Healthcare Quality Promotion



<http://www.cdc.gov/hai/organisms/cre/cre-toolkit>

Regional Approach to Prevention is Essential

- Rationale for regional approach
 - Events in 1 facility impacts surrounding facilities
 - Individual facilities can reduce MDRO prevalence only to a certain point
- Successful regional coordination by public health
 - VRE control in Siouxland region
 - MRSA in Pittsburg region
 - CRE containment in Israel

Regional Surveillance for CRE

- Determine CRE prevalence within a given jurisdiction
 - Make CRE laboratory reportable (in regions with no known or few CRE)
 - Survey IPs or lab directors
- Feedback of surveillance results
- Depends on CRE Prevalence

Regions With No CRE Identified

Aggressive efforts at detection:

- Perform periodic surveillance and feedback
 - Frequency may depend on CRE prevalence in neighboring regions (establish mechanism for communication)
- Educate facility staff to increase awareness
 - Epidemiologic importance of CRE
 - Recommended surveillance and prevention measures

Regions With Few CRE Identified

Aggressive efforts at containment, may target select areas:

- Implement infection prevention measures
 - Reinforce core prevention measures in all facilities
 - Facilities with CRE: Enhance CRE screening and consider supplemental measures
 - Facilities without CRE: targeted surveillance testing, preemptive CP
- Use inter-facility patient transfer forms
 - Indicate CRE status, open wounds/devices, antimicrobial therapy
- Educate facility staff to increase awareness
- Perform periodic surveillance and feedback

Regions Where CRE Are Common

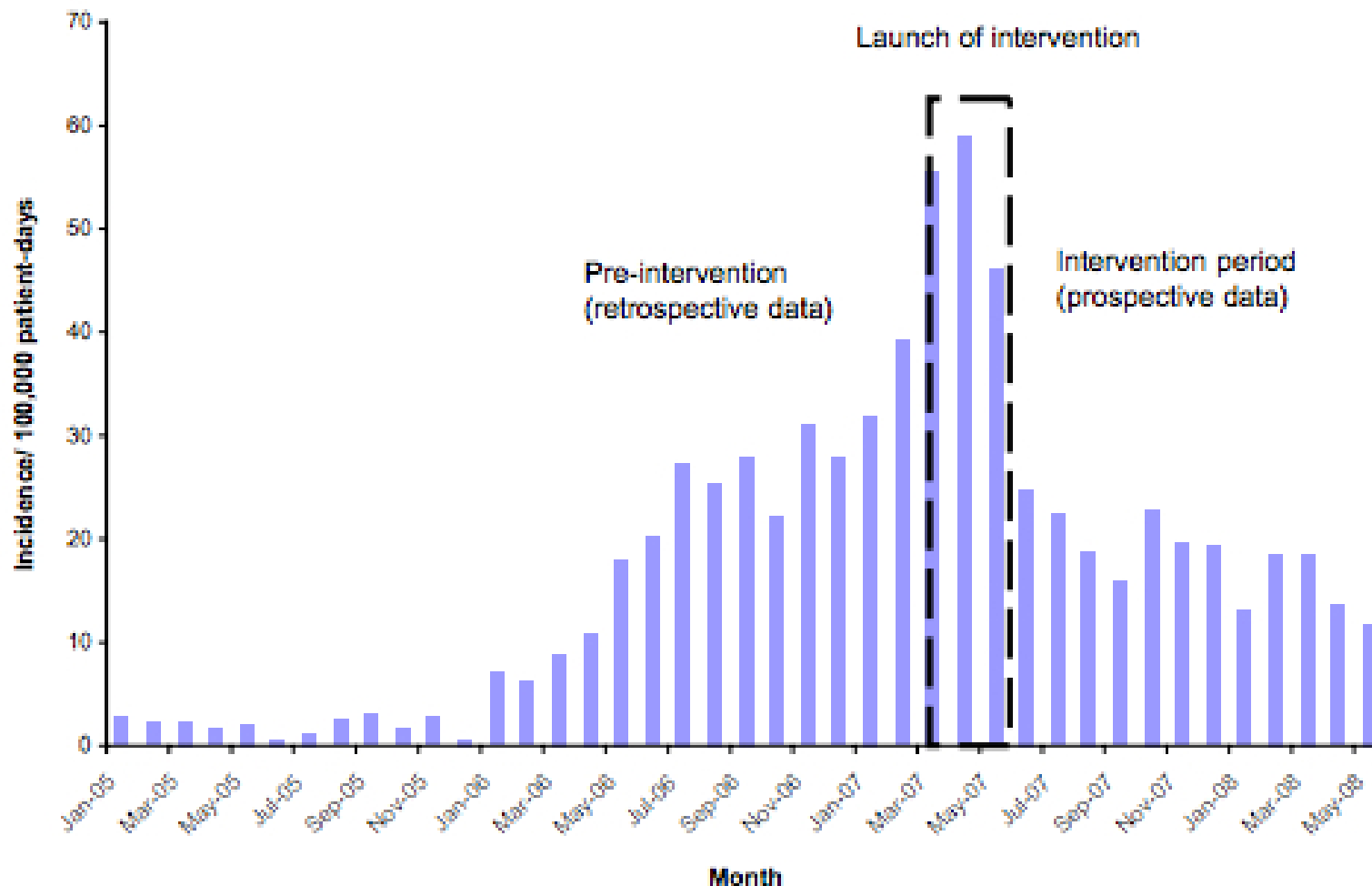
Implementation of measures across all facilities:

- Dedicated HD personnel to engage facilities (including facility leadership)
- Reinforce core prevention measures and implement supplemental measures
- Regularly assess for compliance to prevention measures
 - Share performance measures with facility leadership
- Use inter-facility patient transfer forms
- Perform periodic surveillance and feedback
 - Assess efficacy of interventions
 - Consider reporting of certain CRE events (e.g., fatalities)

Containment of a Country-wide Outbreak of Carbapenem-Resistant *Klebsiella pneumoniae* in Israeli Hospitals via a Nationally Implemented Intervention

Clinical Infectious Diseases 2011;52(7):848–855

Mitchell J. Schwaber,¹ Boaz Lev,² Avi Israeli,² Ester Solter,¹ Gill Smollan,¹ Bina Rubinovitch,¹ Itamar Shalit,¹ Yehuda Carmeli,¹ and the Israel Carbapenem-Resistant Enterobacteriaceae Working Group^a



Risk of Highly Resistant Bacteria Importation from Repatriates and Travelers Hospitalized in Foreign Countries: About the French Recommendations to Limit Their Spread

Table 1 French guidelines to control the emergence and spread of carbapenemase producing *Enterobacteriaceae* (CPE) producing carbapenemase and vancomycin-resistant *Enterococcus* (VRE) among repatriated patients or travelers hospitalized in foreign countries¹⁶

Recommendations

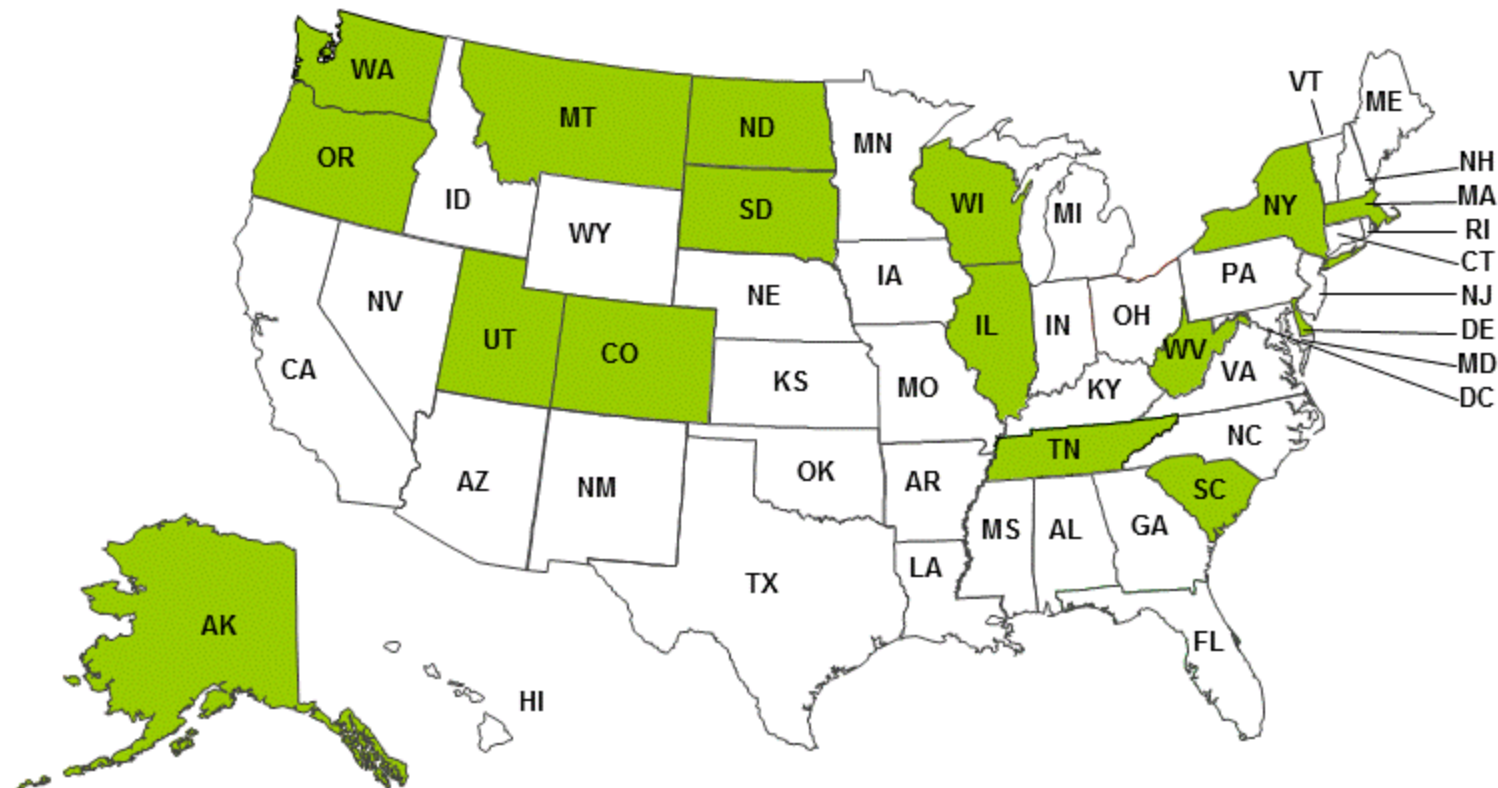
Upon patient admission


1. Hospital administration must alert the Infection Control Team to identify the situation by an automatic alert system.
2. The Infection Control Team or the medical staff must inform the patient of the situation to explain the control measures.
3. Medical staff must notify the situation in the medical record of the patient.
4. The Infection Control Team must implement the control measures upon patient's admission, following the French Guidelines "Prevention of cross-transmission: contact precautions" published in 2009.⁴⁸ These measures will be reevaluated after the results of the microbiological testing.
5. The patient must be screened immediately and systematically to detect CPE and VRE digestive carriage by rectal swab or stool sample.
6. If the control measures were implemented upon admission, it is not necessary to perform a systematic screening of the contact patient (defined as patients cared for by the same health-care workers).

When the patient or the traveler is detected positive for KPC-producing bacteria or VRE

7. The hospital laboratory must alert the Infection Control Team and the medical staff of the CPE or VRE positive screening.
 8. The Infection Control Team must alert the French Health Authorities by using the national Healthcare-Associated Infections Early Warning and Response System.
 9. The resistance mechanism (e.g., resistance to imipenem: VIM, KPC, OXA) must be identified at the local laboratory or otherwise by transferring the strain to the National Reference Centre for Antibiotic Resistance.
 10. Infection control measures and epidemiological survey must be maintained until the repatriate or traveler has three successive negative rectal swabs (performed every week). In case of an epidemic spread, the national program initially designed to contain the spread of VRE must be applied to each outbreak.⁴⁰
-

State CRE Reporting Requirements



 Statewide CRE Reporting

Poultry found to carry carbapenem-resistant bacteria

BROILERS

448

0

A novel type of antibiotic resistant bacteria has been causing worries in the German livestock industry. The bacteria, resistant to carbapenems, has been found in poultry and pigs.



Carbapenems are usually considered to be last-line antibiotics for hospitalised patients suffering from severe microbial infections.

Until now, it used to be possible to combat resistant ESBL and MRSA bacteria by using carbapenems.

Prof Dr Dick Mevius, Utrecht

University, the Netherlands, recently expressed his worries about this development. The type of resistance is simply exchangeable between different types of bacteria.

Recent publications in 2012 and 2013 by the German Federal Institute for Risk Assessment (BfR) pointed to the discovery of resistant *E.coli* at a pig farm and resistant *Salmonella enterica* at two finishing pig farms as well as a broiler farm. Mevius said he fears these carbapenemases will get into the food chain.

Summary

- CRE are prevalent and distributed worldwide
- Prevention efforts need to be coordinated at the regional level and beyond
- Public health critical to minimizing spread
- Prevention requires collaboration

Acknowledgements

- Georgia EIP
 - Jessica Reno
 - Surveillance Officers
- CDC
 - Brandi Limbago
 - Alice Guh
 - Alex Kallen

FOCUS PDSA Process Improvement Communication Tool

PROJECT NAME:								
STEP 1: TO BE DONE ONLY ONCE								
STEP	DESCRIPTION	INSERT ACTION TAKEN FOR EACH STEP. <i>Be specific</i>						
Find a process to improve	Identify a care/service process that is “ Key ” to your success.							
	Select the AIM of your improvement:	<table style="width: 100%; border: none;"> <tr> <td style="width: 50%; border: none;"><input type="checkbox"/> Safe</td> <td style="width: 50%; border: none;"><input type="checkbox"/> Effective</td> </tr> <tr> <td style="border: none;"><input type="checkbox"/> Efficient</td> <td style="border: none;"><input type="checkbox"/> Patient centered</td> </tr> <tr> <td style="border: none;"><input type="checkbox"/> Equitable</td> <td style="border: none;"><input type="checkbox"/> Timely</td> </tr> </table>	<input type="checkbox"/> Safe	<input type="checkbox"/> Effective	<input type="checkbox"/> Efficient	<input type="checkbox"/> Patient centered	<input type="checkbox"/> Equitable	<input type="checkbox"/> Timely
	<input type="checkbox"/> Safe	<input type="checkbox"/> Effective						
	<input type="checkbox"/> Efficient	<input type="checkbox"/> Patient centered						
	<input type="checkbox"/> Equitable	<input type="checkbox"/> Timely						
Determine if there is a Best Practice internally or externally. If so, name in next column.								
Is there a Policy or Regulation that is prescriptive? If so, note in next column.								
If the above-mentioned does not exist and you are setting the standard, clearly state the new practice in the next column								
Organize a team	<ul style="list-style-type: none"> Include Key Stakeholders. Stakeholders have the most knowledge about the process and are key to making successful and sustainable improvements. 							
Clarify current knowledge	<ul style="list-style-type: none"> Identify how the process is currently taking place (the real practice). Generate a Process Map to represent the sequential order of each step. Collect/Gather Baseline Data about the current process. 							
Understand the variation	<ul style="list-style-type: none"> Compare the current process steps to the steps in the process that you would like to model. This could be based on Policy, Regulations or a Best Practice Model. Understand the differences between the two practices and determine where non-value added steps exist. Analyze Baseline Data compared to Best Practice data if available. 							
Select the process changes	<ul style="list-style-type: none"> Using the Baseline Data, determine the improvement actions you need to take. Prioritize the list through Rank Order of importance. 							

FOCUS PDSA Process Improvement Communication Tool

FOCUS PDSA Process Improvement Communication Tool

STEP 2: CYCLICAL AND ONGOING		
STEP	DESCRIPTION	INSERT ACTION TAKEN FOR EACH STEP. <i>Be specific</i>
Plan the changes	Based on the rank order, determine how each improvement will be implemented and when ?	
	Answer this Question: “How will we know this change is effective? (define a measure)	
	Where will the pilot test be launched, who will be involved, who needs education, and who will be the key contact?	
Do - Implement the Changes	<ul style="list-style-type: none"> • Pilot the changes • Keep Feedback Log • Adjust process as warranted 	
Study the effect of the Changes	<ul style="list-style-type: none"> • Collect and analyze the data from the measure of success. • Did the improvement action have a negative or a positive effect on the process results? 	
Act on what your analysis reveals	<ul style="list-style-type: none"> • Does the data show favorable results after the change? If so, continue with the improvement. • Unfavorable results? Make further changes and check the results. • OR - If you are satisfied with the results “Maintain the Gain” 	

This material was prepared by Alliant | GMCF, the Medicare Quality Improvement Organization for Georgia, under contract with the Centers for Medicare & Medicaid Services (CMS), an agency of the U.S. Department of Health and Human Services. The contents presented do not necessarily reflect CMS policy. Publication No. 10SOW-GA-ICPC-12-07

PDSA Session Plan~Do~Study~Act



March 20, 2014

Presented by

Nancy Fendler, Technical Advisor, Alliant GMCF

Presented to

CRE Collaborative



Learning Objectives

At the end of this session each participant will be able to:

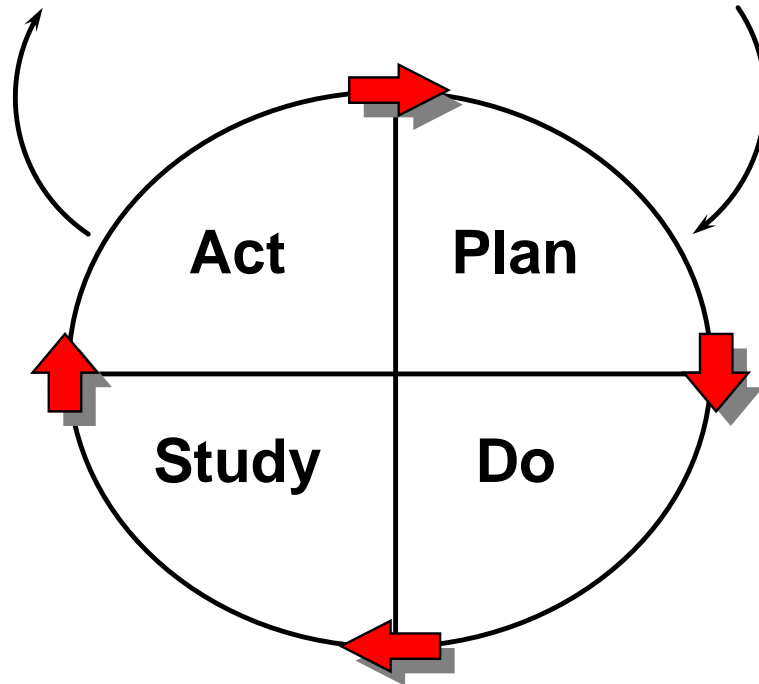
- ▶ Understand the Model for Improvement
- ▶ Learn how to apply PDSA cycles
- ▶ Select measures for their improvement efforts
- ▶ Have strategies for more successful tests

Model for Improvement

What are we trying to accomplish?

How will we know that a change is an improvement?

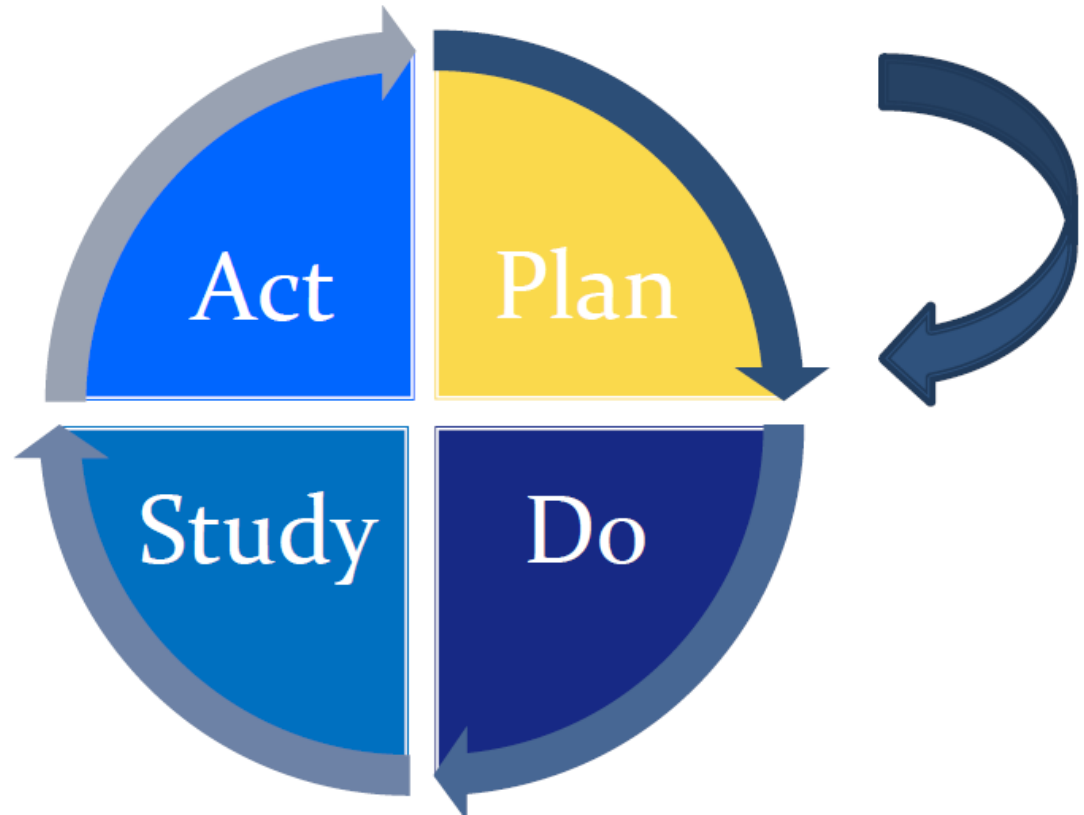
What change can we make that will result in improvement?



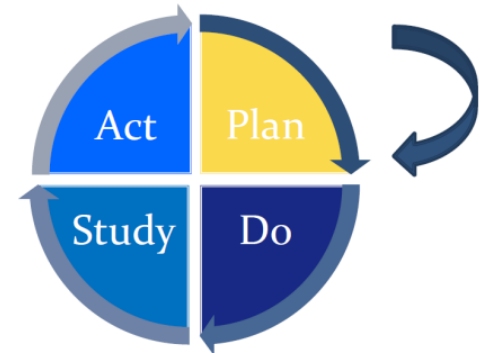
PDSA Model for Improvement

(Nolan, et al.)

- ▶ What are we trying to accomplish?
- ▶ How will we know that a change is an improvement?
- ▶ What changes can we make that will result in an improvement?



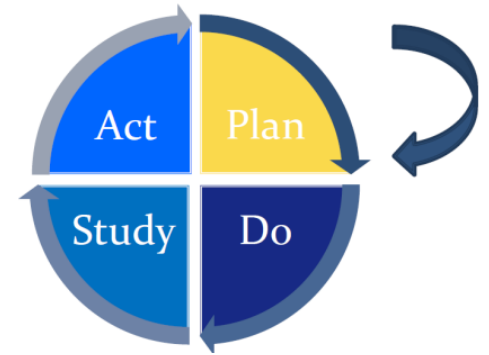
PLAN~DO~STUDY~ACT



PLAN

- ▶ Need to identify an Aim or a Goal
- ▶ **Who?** Identify a leader
- ▶ **What?** A new tool? A new process?
- ▶ **Where?** Which areas will be impacted?
Which areas will be involved?
- ▶ **When?** Set a date!

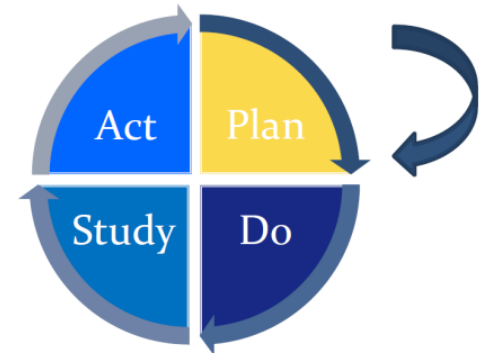
PLAN~DO~STUDY~ACT



DO

- ▶ Carry out your change/test
- ▶ Collect data and begin analysis
- ▶ Identify the person in charge of implementation
- ▶ Keep a time frame for implementing the change

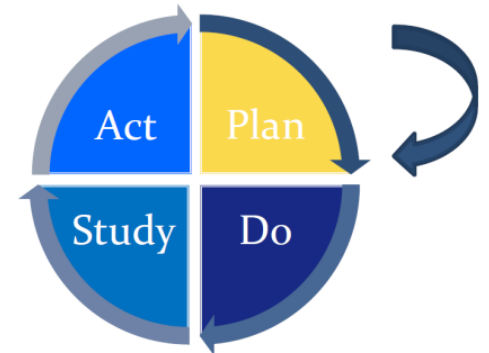
PLAN~DO~STUDY~ACT



STUDY

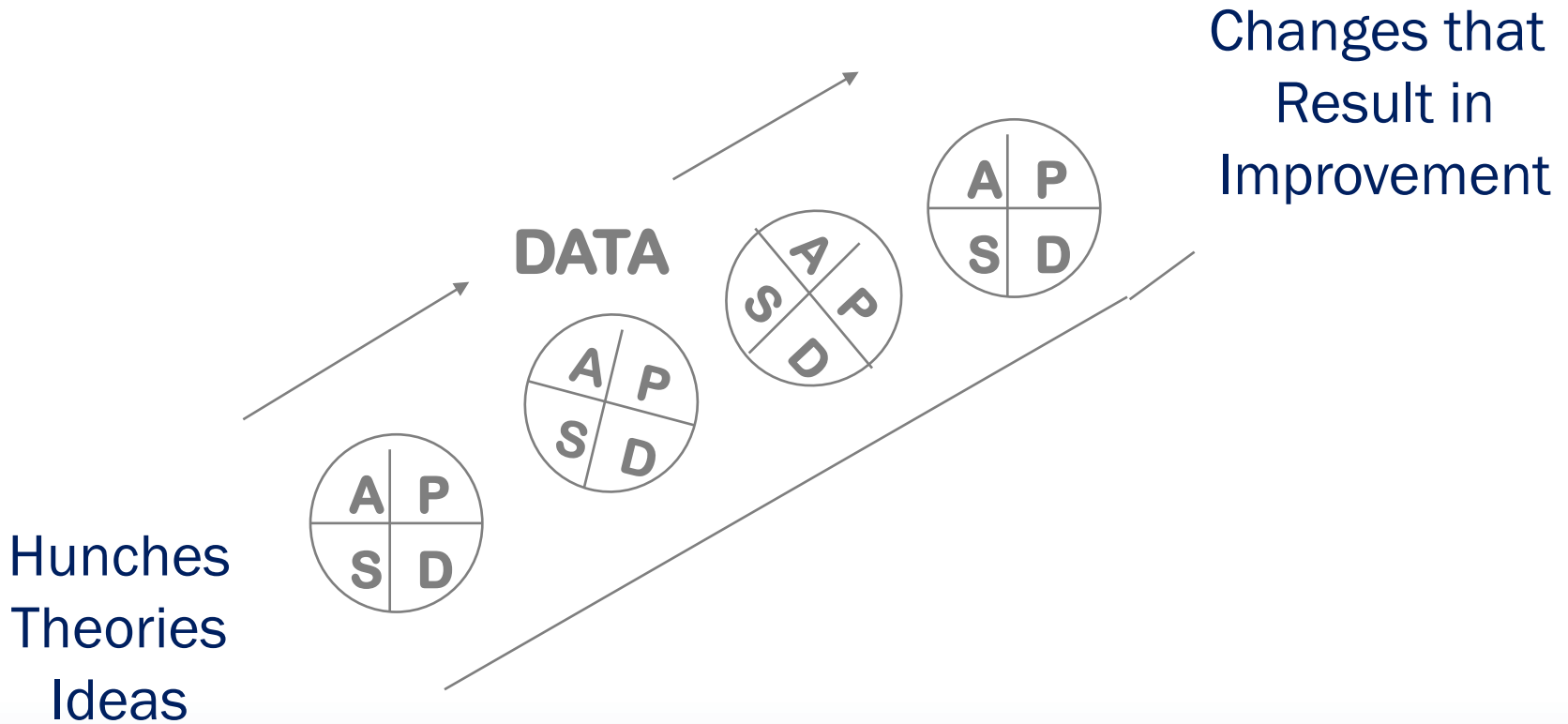
- ▶ Do the results agree with your predictions?
- ▶ Is it working?
- ▶ Summarize what worked and what didn't work

PLAN~DO~STUDY~ACT



ACT

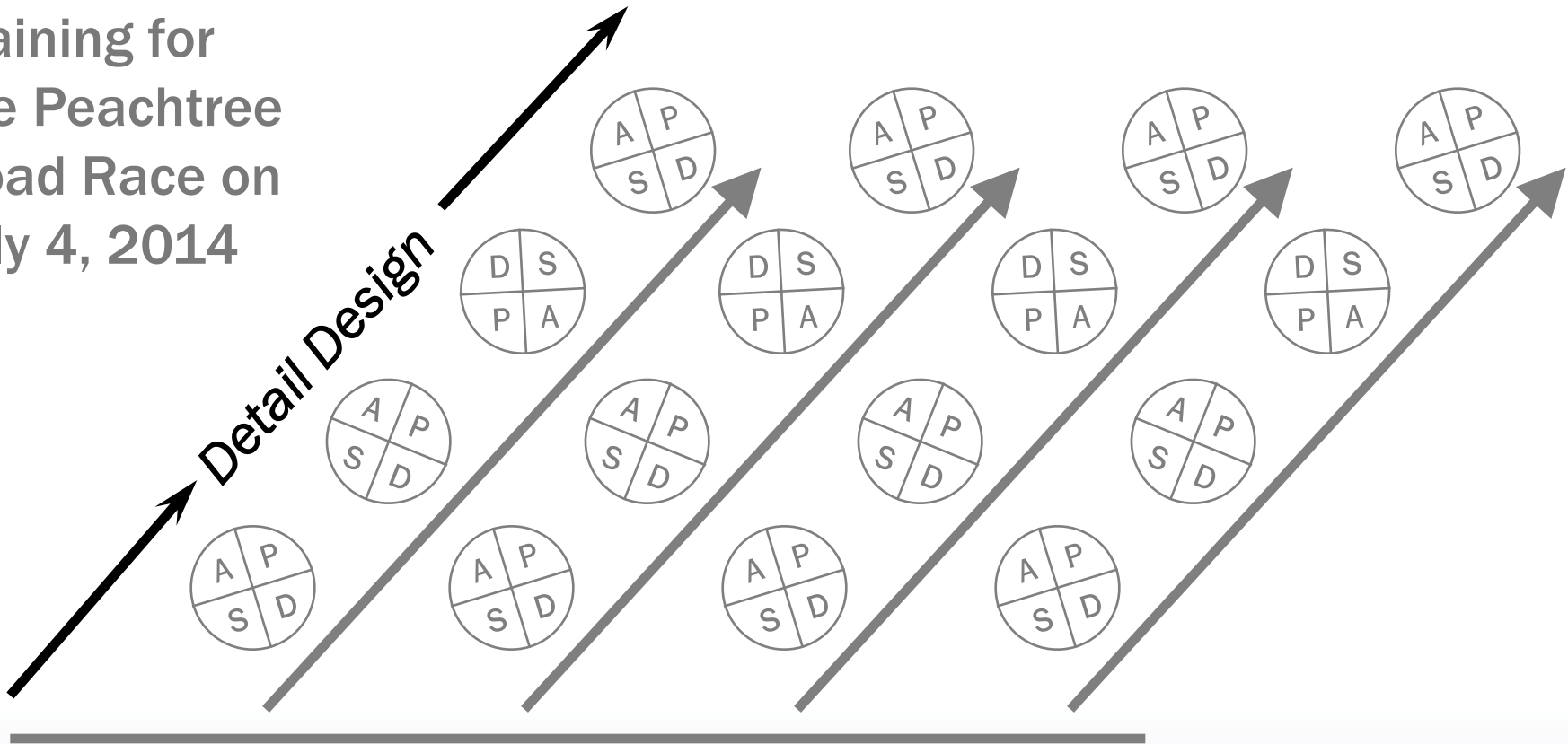
- ▶ As a result of the cycle – list your actions
- ▶ Widen your scope
- ▶ Plan for the next cycle – adapt change?
Another test?
- ▶ IMPLEMENT!



Small Test of Change Worksheet

Goal: Overall goal you would like to reach
Every goal will require multiple smaller tests of change

Training for the Peachtree Road Race on July 4, 2014



Walking
45 minutes
5 times/wk

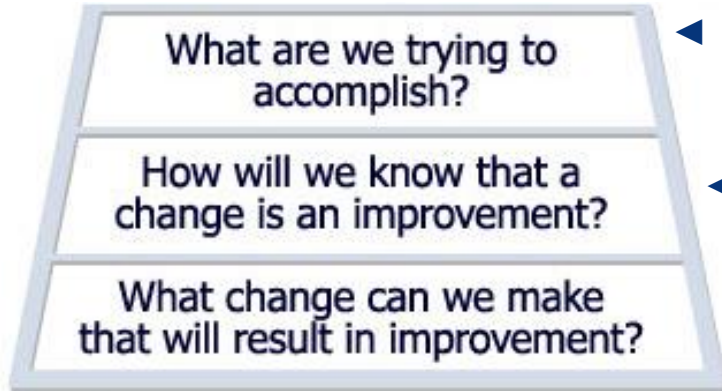
Running
1 mile
w/o walking

Running
3 miles
3 times/wk

Running
5 miles
3 times/wk

Repeated Use of the PDSA Cycle

Model for Improvement



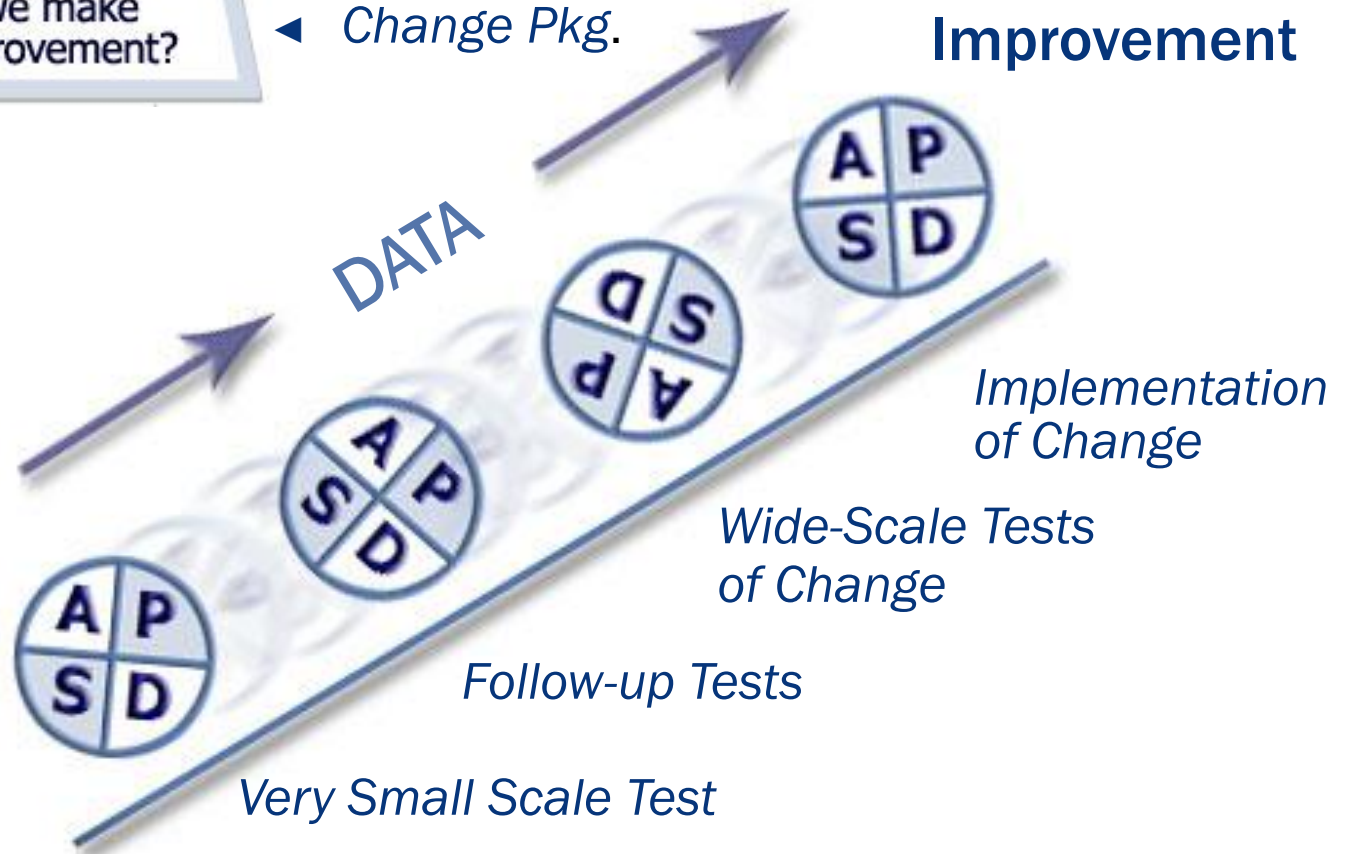
◀ Reduce BMI to less than 30 by March 31

◀ Weigh before shower in morning

◀ Change Pkg.

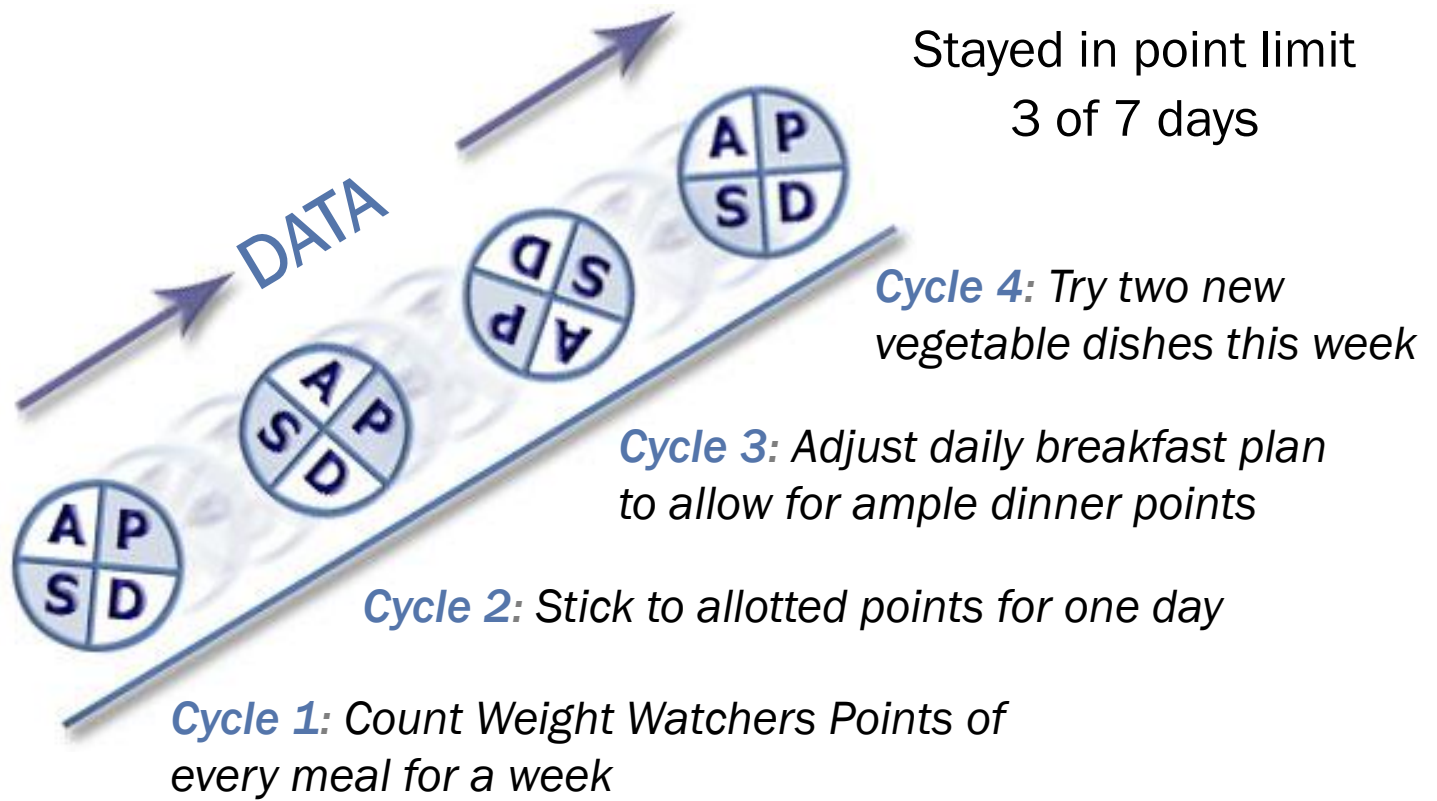
Changes That Result in Improvement

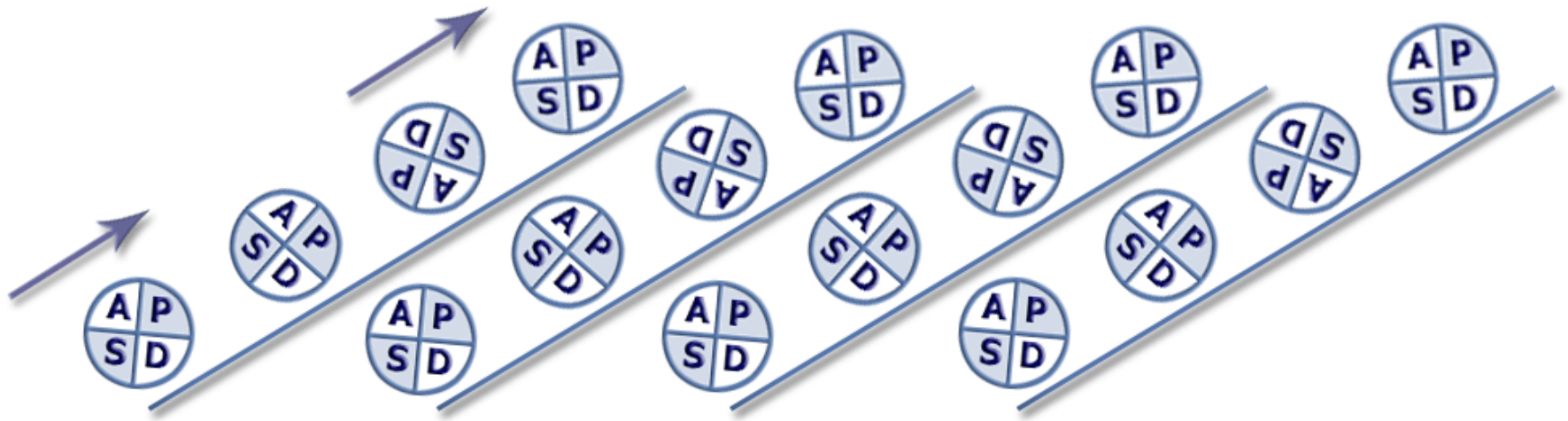
**Hunches
Theories
Ideas**



Using Multiple PDSA Cycles to Test & Adapt Change Ideas

Strategy: *Remain aware of diet and manage intake.
Find options to eat better.*





Improve
breakfast

Add
veggies

Cut lunch
portion
& add fruit

Add long
walk every
day

Change Concepts

**Multiple
PDSA Cycle
“Ramps”**

Before you get started... **FOCUS!**

Find a process to improve

Organize a team

Clarify current knowledge

Understand the variation

Select the process changes

Set a Goal ~ Think **SMART**

Your Goal should be **SMART**

Specific

Measurable

Attainable

Relevant

Time-bound

(becomes standard process)

Pilot Testing

- ▶ Gives team chance to see how to implement a change on a small scale
- ▶ Give team early results, to see if the change you make has any impact
- ▶ The team has a role to play in helping to implement any change that is recommended

Pilot Testing

- ▶ Who will train staff?
- ▶ Who will update/revise/remove tool, if necessary?
- ▶ Who will monitor to see if process has changed?
- ▶ Who will team contact if they need support implementing change?
- ▶ Who will audit outcome of process change?

Pilot Testing

- ▶ Evaluating the pilot test allows your team to organize observations that the team has made through the pilot test
- ▶ Evaluation also includes collecting data to check whether the change has helped you reach your goal

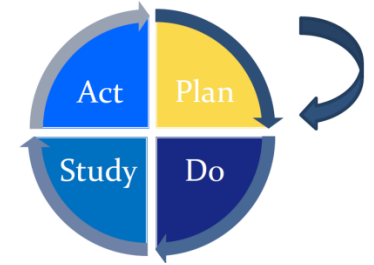
Pilot Testing

- ▶ Do we need to re-evaluate our initial goal?
- ▶ What is working well? WHY?
- ▶ What is not working? WHY?
- ▶ What can be done differently?

Pilot Testing

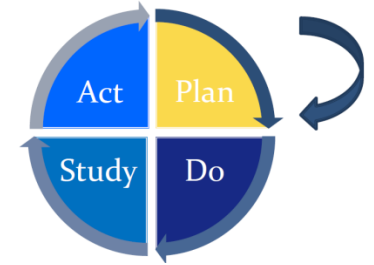
- ▶ Do we need to revise materials we are using (if any)?
- ▶ How does staff feel about the change in process?
- ▶ Are patients/residents positively affected by the change in process?

WHY Test Change?



- ▶ Increase your belief that the change will result in improvement
- ▶ Provide an opportunity for learning from “failures” without impacting performance
- ▶ Document how much improvement can be expected from the change

WHY Test Change?



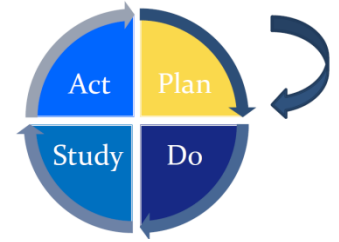
- ▶ Learn how to adapt the change to conditions in your hospital/nursing home
- ▶ Evaluate costs and side-effects of the change
- ▶ Minimize resistance upon implementation

Deciding on the Scale of the Test

CURRENT SITUATION		CURRENT COMMITMENT WITHIN ORGANIZATION		
		NO Commitment	SOME Commitment	STRONG Commitment
Low degree of belief that change idea will lead to improvement	LARGE Cost of failure	Very Small-Scale Test	Very Small-Scale Test	Very Small-Scale Test
	SMALL Cost of failure	Very Small-Scale Test	Very Small-Scale Test	Small-Scale Test
High degree of belief that change idea will lead to improvement	LARGE Cost of failure	Very Small-Scale Test	Small-Scale Test	Large-Scale Test
	SMALL Cost of failure	Small-Scale Test	Large-Scale Test	IMPLEMENT

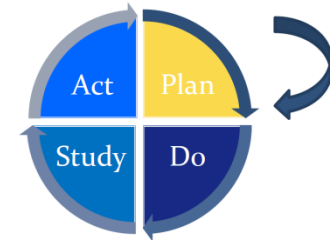
Source: Langley, et al., Improvement Guide

Successful Cycles to Test & Adapt Changes



- ▶ Plan multiple cycles (to test & adapt change)
- ▶ Think a couple of cycles ahead
- ▶ Scale down the size of the test
- ▶ Do not try to get buy-in or consensus for the test
- ▶ Be innovative to make testing feasible
- ▶ Collect USEFUL data during each test
- ▶ Eventually, test over a wide range of conditions

PDSA Cycles for IMPLEMENTATION



If you are ready to IMPLEMENT...

- ▶ The change is ready to be PERMANENT
 - Develop all support processes to maintain & sustain the change
- ▶ High expectations to see improvement
 - This is the time for NO FAILURES
- ▶ Increased scope will lead to increased resistance
- ▶ Generally takes more time than tests

Test Ideas on a Small Scale ~ IT WORKS

Small Scale Test:

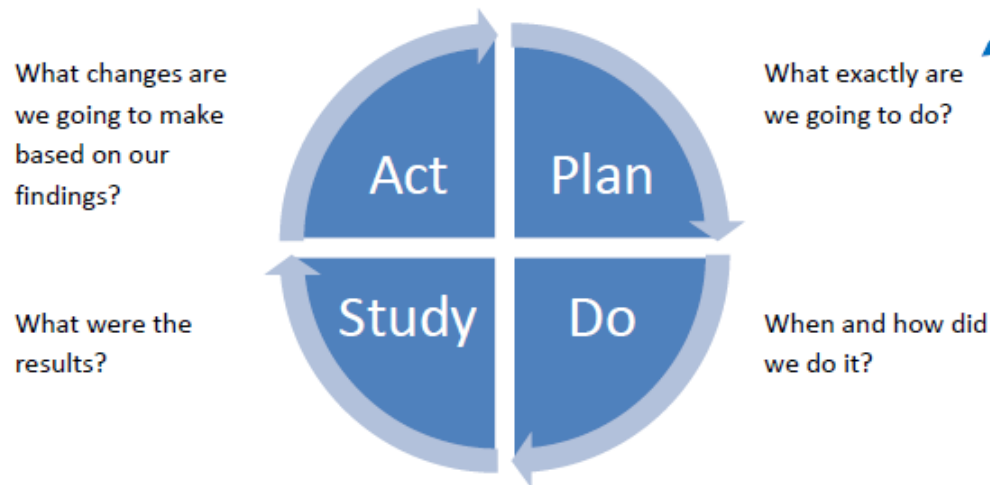
- ▶ Provides reduced complexity
 - Fewer actors, fewer items to consider
- ▶ Is the ultimate in trial-ability
- ▶ Requires observability
- ▶ Minimizes the problems with relative advantage

*Compatibility can still
be a concern*

PDSA Cycle Template

Model for Improvement: Three questions for improvement

1. What are we trying to accomplish (aim)?
2. How will we know that change is an improvement (measures)?
3. What change can we make that will result in an improvement (ideas, hunches, theories)?



Plan

- What is the objective of the test?
- What do you predict will happen and why?
- What change will you make?
- Who will it involve (e.g. one unit, one floor, one department)?
- How long will the change take to implement?
- What resources will they need?
- What data need to be collected?

List your action steps along with person(s) responsible and time line

<p>Do</p> <ul style="list-style-type: none"> • Implement the change. Try out the test on a small scale. • Carry out the test. • Document problems and unexpected observations. • Begin analysis of the data. 	<p>Describe what actually happened when you ran the test</p>
<p>Study</p> <p>Set aside time to analyze the data and study the results and determine if the change resulted in the expected outcome.</p> <ul style="list-style-type: none"> • Complete the analysis of the data. • Compare the data to your predictions. • Summarize and reflect on what was learned. Look for: unintended consequences, surprises, successes, failures. 	<p>Describe the measured results and how they compared to the predictions</p>
<p>Act</p> <p>If the results were not what you wanted you try something else Refine the change, based on what was learned from the test.</p> <ul style="list-style-type: none"> • Adapt – modify the changes and repeat PDSA cycle • Adopt – consider expanding the changes in your organization to additional residents, staff, units • Abandon – change your approach and repeat PDSA cycle 	<p>Describe what modifications to the plan will be made for the next cycle from what you learned</p>

Small Test of Change Worksheet

PLAN

Describe your first (or next) test of change	Person Responsible	When to be done	Where to be done

Small Test of Change Worksheet

PLAN

List the tasks needed to set up this test of change	Person Responsible	When to be done	Where to be done
1.			
2.			
3.			
4.			

Predict what will happen when the test is carried out	Measures to determine if prediction succeeds
1.	1.
2.	2.
3.	3.

Small Test of Change Worksheet

DO	Describe what actually happened when you ran the test of change
STUDY	Describe the measured results and how they compare to the predicted results
ACT	Describe what changes to the plan will be made for the next cycle from what you learned

Now it is YOUR Turn...

Complete a small test of change with a group of eight participants

- ▶ Define the measures
 - *What will you test?*
 - *How will you measure it?*
 - *How will you know if you are improving?*
- ▶ Identify three changes using the PDSA worksheet
- ▶ Run at least two tests of change

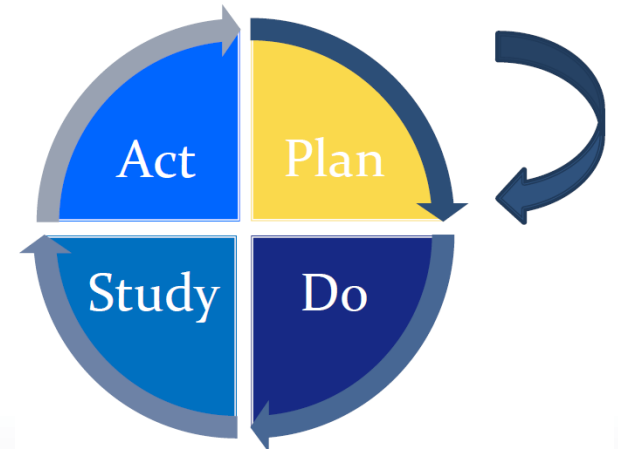
Tennis Ball PDSA Game

- ▶ Divide into teams of 8 people
- ▶ One person will need a cell phone with a stop watch



Tennis Ball PDSA Game Debrief

- ▶ How many more PDSA cycles would you need to complete improvements on the time of the process?
- ▶ What did you learn about PDSA from this exercise?



MAKING HEALTH CARE BETTER

Practical Implementation of Carbapenem-Resistant Enterobacteriaceae Prevention Practices



Date: March 20, 2014

Presented by

Cindy Prosnak, RN BSN CIC, Technical Advisor, Infection Prevention

Presented to

CRE Collaborative,
Learning Session #1



What is a QIO?

Each state has a **Quality Improvement Organization**, contracted with the Centers for Medicare & Medicaid Services (CMS) to work with Medicare beneficiaries and providers in the state to make health care better through use of quality initiatives. Alliant GMCF is the Medicare QIO for Georgia.

What is a QIO?

Embracing “boundarylessness” as a prerequisite for system-wide change, QIOs like ours are breaking down organizational, cultural and geographic barriers to improvement. Initiatives are open to providers at all levels of clinical performance that make a commitment to improvement.

What is a QIO?

Everyone teaches and learns – Through statewide learning and action networks, we are accelerating the pace of change and rapidly spreading best practices. Improvement initiatives include collaboratives, online interaction and peer-to-peer education.

Objectives for this presentation:

Participants will be able to:

- ▶ Recognize differences in planning and implementing standard and transmission-based precautions in acute and long term care settings with focus on patients and residents with suspected or confirmed carbapenem-resistant enterobacteriaceae
- ▶ Distinguish between appropriate practices for standard, enhanced or modified contact precautions, and contact precautions
- ▶ Discuss measures to apply with individual emphasis to retain optimum patient- or resident-centered care

What is our common goal?

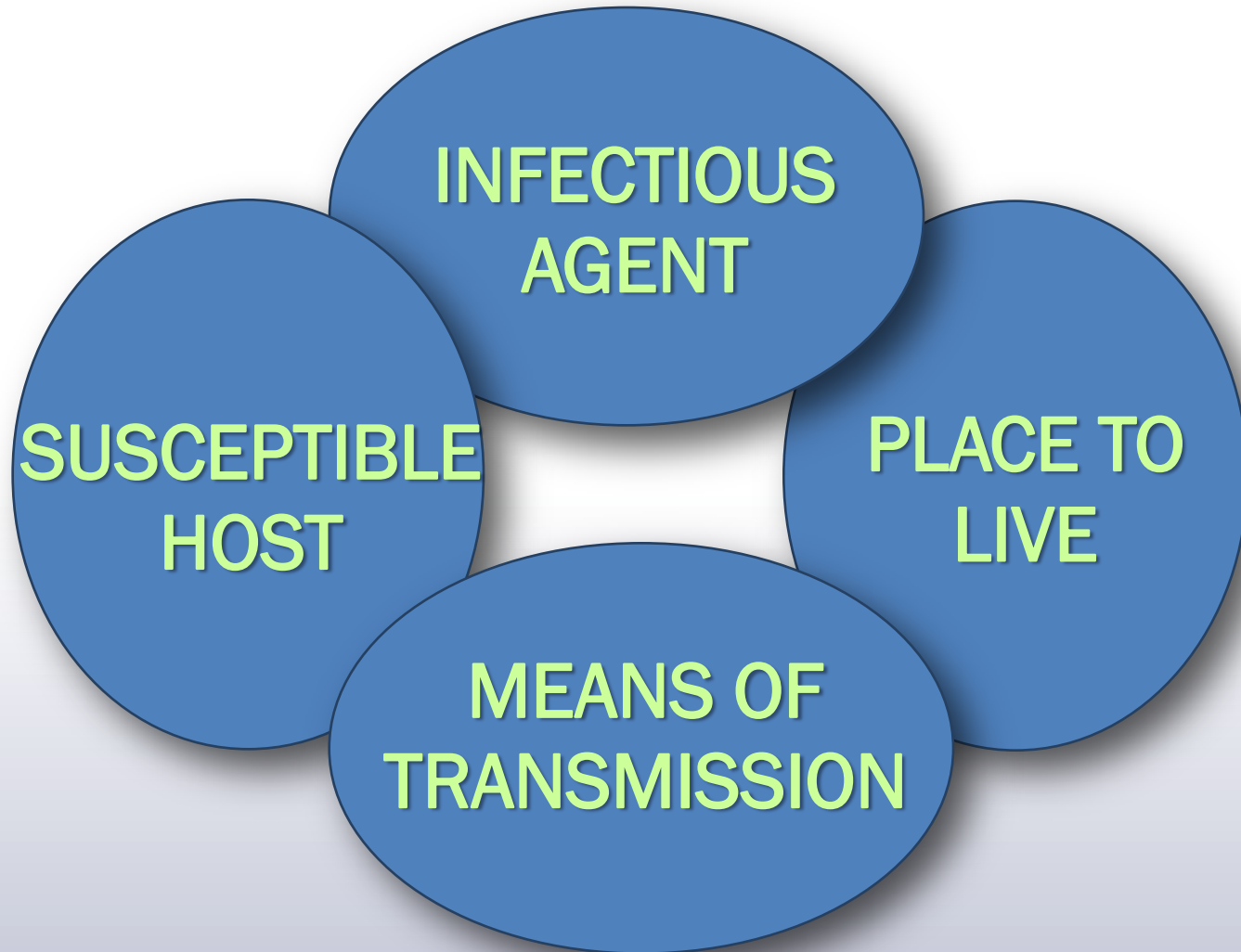
No matter in which health care setting we work, we all have a common goal:

To Keep Our Patients
and Residents Safe

Health care-associated infections

- ▶ There are over 2 million cases of health care-associated infections per year in the U.S.
- ▶ These infections cause approximately 90,000 deaths each year
- ▶ These infections add over \$10 billion to the cost of health care each year
- ▶ It has been proven that almost 40 percent of these infections could be prevented *just* by improving hand hygiene

The Chain of Infection



What puts patients and residents at a higher risk for infection?

- ▶ If they have been on antibiotics in the past 30 days
- ▶ If they have a chronic illness such as diabetes or cancer
- ▶ If they have a Foley catheter or other device, such as a central line or ventilator
- ▶ If they are on certain medications, such as steroids
- ▶ If they have impaired responses
- ▶ If they have a recent hospitalization

What makes implementing infection prevention practices different in LTC?

- ▶ Length of stay in the facility
 - 3-5 days for hospital stays
 - Weeks to months for rehab in LTC facility
 - Years when the LTC facility becomes a primary residence
 - Short term treatment for patients
- ▶ Primary living facility for residents

A typical resident of your LTC facility

- ▶ Admitted to the facility 3 years ago
- ▶ Roommate has been at the facility for 5 years
- ▶ Personal property
- ▶ Routine daily and weekly activities
- ▶ Visitors

Imagine this scenario for our typical resident

- ▶ Develops signs and symptoms of a urinary tract infection with a fever
- ▶ Physician orders an antibiotic for treatment
- ▶ Symptoms persist and resident is sent to the local Emergency Department
- ▶ Resident is admitted to the hospital for IV antibiotics

What happens in the hospital

- ▶ Our resident stays in the hospital for 5 days
- ▶ The resident is found to have CRE in the urine culture and antibiotics are adjusted appropriately
- ▶ Placed on Contact Precautions while hospitalized
- ▶ Discharged back to LTC on day 5

Contact precautions in the hospital

- ▶ HCW would have used gowns and gloves each time they entered the room
- ▶ There might have been some restrictions for visitors
- ▶ Patient activities outside the room would have been restricted in some ways
- ▶ Patient probably had private room or had been cohorted with another patient with same organism/infection

Upon return to LTC our resident still shows CRE in urine

Are Contact Precautions indicated?

Consider the following challenges:

- ▶ Asymptomatic roommate
Do we consider cohorting?
- ▶ If we decide not to change rooms,
what about toileting?
- ▶ Should long term roommates be separated
and if so, for how long?

Challenges

- ▶ The resident has always enjoyed taking meals in the group dining area. Should this be restricted?
- ▶ What about the daily exercise program that the resident always participates in with her friends?
- ▶ What about field trips outside the facility?
- ▶ How long should Contact Precautions for CRE continue?

CDC Guidance and Recommendations for CRE Prevention

2012 CRE Toolkit can be found at this link:

<http://www.cdc.gov/hai/organisms/cre/cre-toolkit/>

“This document contains two parts.

Part 1 contains recommendations for health care facilities and is intended to expand upon the March 2009 “Guidance for Control of Carbapenem-Resistant or Carbapenemase-Producing Enterobacteriaceae in Acute-Care Facilities.”

Part 2 reviews the role of public health authorities in the control of carbapenem-resistant Enterobacteriaceae.

Unless otherwise specified, health care facilities refer to all acute care hospitals and any long-term care facility that cares for patients who remain overnight and regularly require medical or nursing care (e.g., maintenance of indwelling devices, intravenous injections, wound care, etc.). This would ...generally exclude assisted living facilities and nursing homes that do not provide more than basic medical care. In addition, this toolkit is not intended for use in ambulatory care facilities.”

Surveillance activities for CRE

- ▶ Inpatient facilities should have an awareness of whether or not CRE have ever been cultured from patients admitted to their facility and, if so, whether these positive cultures were collected within 48 hours of admission
- ▶ If CRE have been present, facilities should also determine:
 - If there is evidence of intra-facility transmission
 - Which wards/units are most affected

Core measures for prevention of CRE in all acute and long-term care facilities

1. Hand hygiene
2. Contact Precautions
3. Health Care Personnel Education
4. Use of Devices
5. Patient and Staff Cohorting
6. Laboratory Notification
7. Antimicrobial Stewardship
8. CRE Screening

There are 8 Core Measures recommended by the CDC within their 2012 CRE Toolkit (<http://www.cdc.gov/hai/organisms/cre/cre-toolkit/>)
In today's presentation, we will be concentrating on the **bolded** items. Others will come in later learning sessions.

Hand hygiene

These interventions are applicable in all health care settings:

- ▶ It is not enough to have policies and procedures on hand hygiene
- ▶ Adherence must be monitored and results must be given back to front-line staff
- ▶ Immediate feedback should be provided when opportunities for hand hygiene are missed during patient or resident care
- ▶ Adequate supplies and equipment for hand hygiene need to be available at the point of care

Hand hygiene opportunities

- ▶ Before and after physical contact with a resident
- ▶ Before donning gloves and after removing gloves
- ▶ After handling soiled or contaminated items and equipment, including linens
- ▶ Before performing an invasive procedure
- ▶ Before handling sterile or clean supplies

Hand hygiene opportunities

- ▶ When hands are visibly dirty or soiled with blood and/or bodily fluids*
- ▶ After care of a resident with known or suspected infectious diarrhea*
- ▶ Before and after eating or handling food*
- ▶ After personal use of bathroom*

*Situations where soap and water is preferred over alcohol-based hand rub

Standard precautions

- ▶ Used to be called “Universal Precautions”
- ▶ Applies to EVERYBODY
- ▶ Standard Precautions is more than just using gloves or hand hygiene
- ▶ Can include general measures such as hand hygiene, safe injection practices, proper use of PPE, resident placement, equipment cleaning and disinfection

Contact precautions in acute care settings

- ▶ Patients who are colonized or infected with CRE should be placed on Contact Precautions
- ▶ Systems should be in place to identify patients with a history of CRE colonization or infection at admission so that these patients can be placed on contact precautions as soon as possible
- ▶ In addition, clinical laboratories should have an established protocol for notifying clinical and/or infection prevention personnel when CRE are identified from clinical or surveillance cultures

Contact precautions in acute and long term care settings

- ▶ Involves use of gown and gloves for direct care
 - Don equipment prior to room entry
 - Remove prior to room exit
- ▶ Use of dedicated non-essential items may help decrease transmission due to contamination
 - Blood pressure cuffs; stethoscopes; IV poles and pumps

Contact precautions in acute and long term care settings

- ▶ Private rooms or cohorting patients or residents if possible
 - Separate toileting equipment for roommates who can't be cohorted
- ▶ Observe adherence to practices - particularly high-risk situations – and provide feedback

Tiered strategy: Consider gown/glove use during intimate care

High risk exposures for MDRO transmission if known carrier (also high risk for acquisition if non-carrier)

- ▶ Presence of wounds (fresh/new, multiple, increased stage/size, active drainage)
- ▶ Indwelling devices (IV lines, urinary catheters, tracheostomy, PEG tubes)
- ▶ Incontinence
- ▶ Current antibiotic use

Contact Precautions in long term care settings

- ▶ Contact Precautions might be modified to fit the inherent differences between acute and long-term care facilities
- ▶ Contact Precautions should be used for residents with CRE who are at higher risk for transmission, including patients
 - who are totally dependent upon HCP for their activities of daily living
 - are ventilator-dependent
 - are incontinent of stool
 - or have wounds with drainage that is difficult to control

Contact Precautions in long term care settings (continued)

Contact Precautions might be relaxed for residents who are able to:

- ▶ perform hand hygiene
- ▶ are continent of stool
- ▶ are less dependent on staff for their activities of daily living
- ▶ are without draining wounds

However, in these situations Standard Precautions should still be observed, including the use of gloves and/or gowns when contact with colonized/infected sites or body fluids is possible. The caregiver must assess the individualized nature of the resident and the care being provided at the time in order to appropriately apply transmission-based precautions.

Transitions of Care

- ▶ The presence of CRE infection or colonization alone should not preclude transfer of a patient from one facility to another (e.g., acute care to long-term care)
- ▶ Communication between caregivers and facilities is the key here – use of a common transfer form and/or education on questions to ask and information to give at time of report is very important
- ▶ Many times, however, this information is needed prior to time of transfer in order to properly place resident or patient in receiving facility

Strategic placement of residents based on risk factors

- ▶ Focus on resident risk factors for MDRO carriage
 - High risk: Antibiotic use; presence of medical devices or wounds; bowel/bladder incontinence; lack of mobility
- ▶ New roommate assignments based on resident characteristics and history of MDRO carriage
 - Try to avoid placing two high risk residents together
- ▶ Don't change stable room assignments just because of a culture result unless it poses new risk
 - Roommates who've been together for a long time have already had opportunity to share organisms in the past (even if you only learned about it recently)

LTCF staff perceptions of contact isolation for MRSA/VRE

Table 1. Responses regarding isolation for MRSA and VRE

Question	All, n (%)*	Nurses n (%)*	Nurses' aides, n (%)*	P value
Do you think residents with MRSA should be isolated in their rooms?	216 (61)	59 (52)	157 (66)	<.01
Do you think residents with VRE should be isolated in their rooms?	145 (41)	54 (47)	91 (38)	<.01
If you knew your resident had MRSA or VRE, would you change any of your infection control practices?	129 (36)	35 (31)	94 (39)	<.01

HCW, health care workers; MRSA, methicillin-resistant *Staphylococcus aureus*; VRE, vancomycin-resistant enterococci.

*Number (%) of HCWs with an affirmative response.

- ▶ Responses from 356/440 (81%) nursing staff members in 7 community NHs
 - <40% would change their practices if aware of an MDRO
 - 97% expressed isolation could negatively impact a resident's psychosocial well-being
 - 5% expressed that isolation could lead to neglect of residents

Furuno, JP et al. AJIC. 2011; 1-5 epub

Challenges with contact precautions in LTC settings

- ▶ Lack of private rooms/limited ability to move residents
 - Moving rooms is disrupting to residents and staff
 - Ability to identify carriers to cohort is limited (no active surveillance in most facilities)
- ▶ Determining duration of contact precautions
 - Unable to restrict resident mobility and participation in social events/therapy for prolonged periods
 - Unlikely to document clearance of carriage
- ▶ Large population of residents with unrecognized carriage of MDROs
 - Underestimating the sources of potential transmission

Questions?

Thank you!

Please feel free to contact me at any
time with questions:

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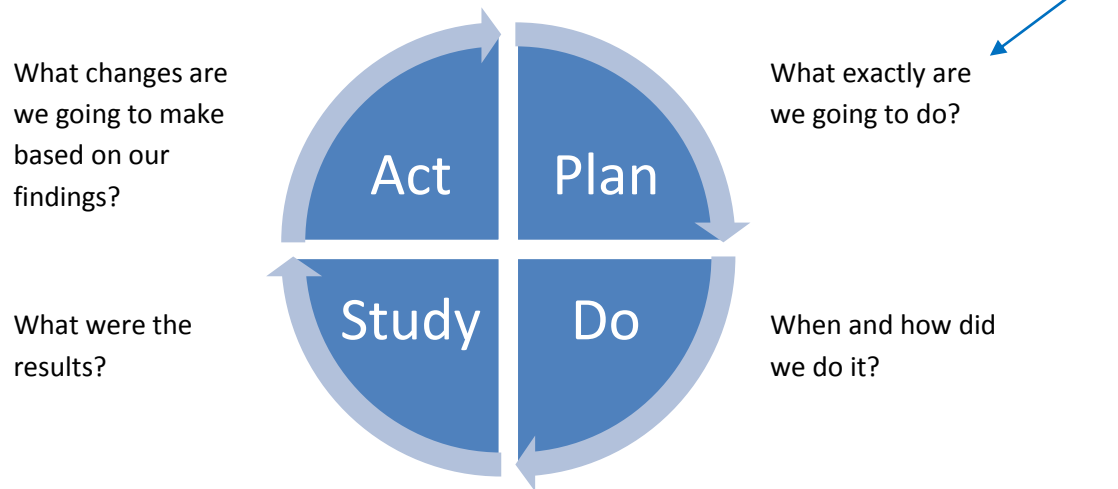
Cell phone: 706-836-8361

MAKING HEALTH CARE BETTER

PDSA Cycle Template

Model for Improvement: Three questions for improvement

1. What are we trying to accomplish (aim)?
2. How will we know that change is an improvement (measures)?
3. What change can we make that will result in an improvement (ideas, hunches, theories)?



<p>Plan</p> <ul style="list-style-type: none"> • What is the objective of the test? • What do you predict will happen and why? • What change will you make? • Who will it involve (e.g. one unit, one floor, one department)? • How long will the change take to implement? • What resources will they need? • What data need to be collected? 	<p>List your action steps along with person(s) responsible and time line</p>
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Source: Adapted with permission from the Institute for Healthcare Improvement (www.IHI.org).

<p>Do</p> <ul style="list-style-type: none"> • Implement the change. Try out the test on a small scale. • Carry out the test. • Document problems and unexpected observations. • Begin analysis of the data. 	<p>Describe what actually happened when you ran the test</p>
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