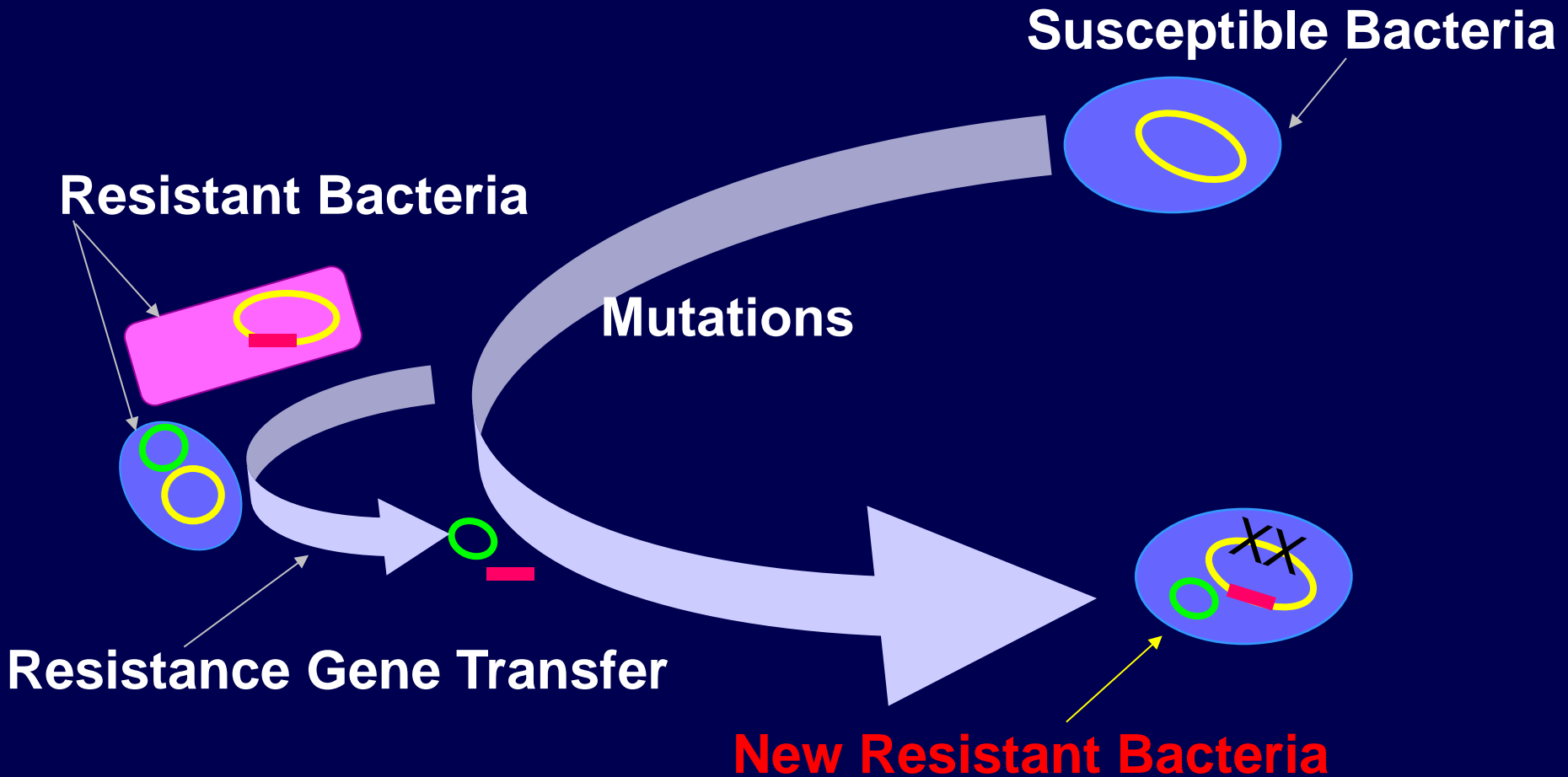


Antibiotic Resistance

Ruth Lynfield, M.D.
Minnesota Department of Health

Emergence of Antimicrobial Resistance



Selective Pressure

When bacteria are exposed to an antibiotic, susceptible cells die

Those that are resistant (or acquire resistance through mutation, genetic rearrangement or acquisition of genes) survive

With reduced competition from susceptible bacteria, resistant bacteria thrive and outcompete others

Antibiotics also impact “normal flora” which otherwise could limit the expansion of pathogens

- Non-pathogenic but resistant bacteria can impact the microbial niche by increasing the reservoir of resistance genes**

Antimicrobial Resistance

- **Resistant infections more difficult to treat**
- **Require use of antibiotics with broader spectrum**
- **May require use of more toxic antibiotics**
- **May require use of antibiotics needing parenteral administration**

Antimicrobial Resistance

- **Recent antibiotic use associated with colonization or infection with resistant bacteria (pneumococcus, *S. aureus*)**
- **Increasing resistance is both an individual and a public health issue**



ANTIBIOTIC RESISTANCE THREATS in the United States, 2013

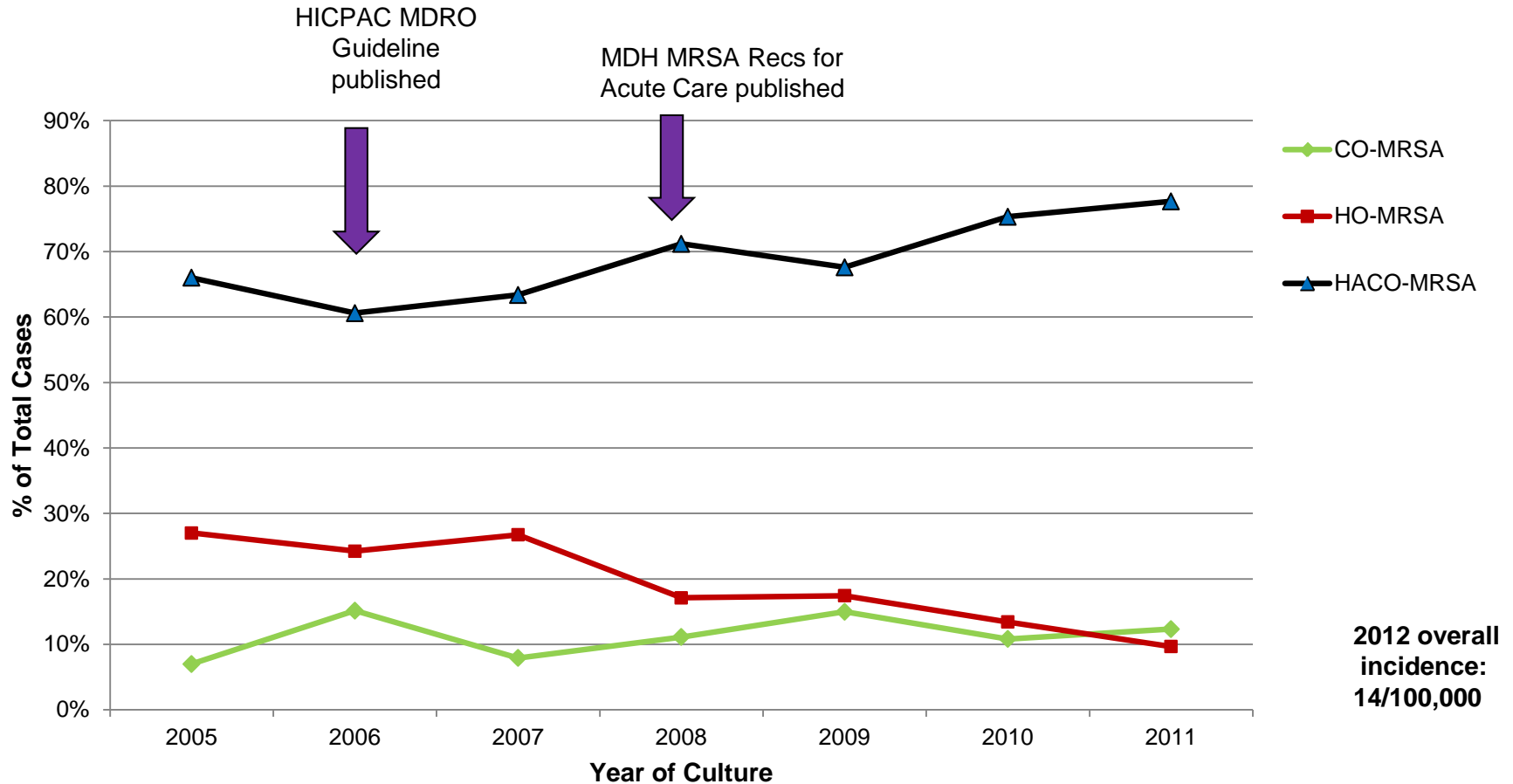


U.S. Department of
Health and Human Services
Centers for Disease
Control and Prevention

MRSA cases reported MN, 2000-2009

Year	CA-MRSA	Total MRSA
2000	131 (12%)	1,111
2001	161 (12%)	1,310
2002	213 (14%)	1,570
2003	316 (18%)	1,731
2004	495 (22%)	2,275
2005	1,004 (34%)	2,955
2006	1,496 (41%)	3,647
2007	1,763 (51%)	3,445
2008	1,917 (53%)	3,639
2009	1,898 (56%)	3,401
Totals	9,339 (37%)	25,084

Reported Invasive MRSA Cases By Epidemiologic Class, Hennepin & Ramsey Counties, MN, 2005-2011

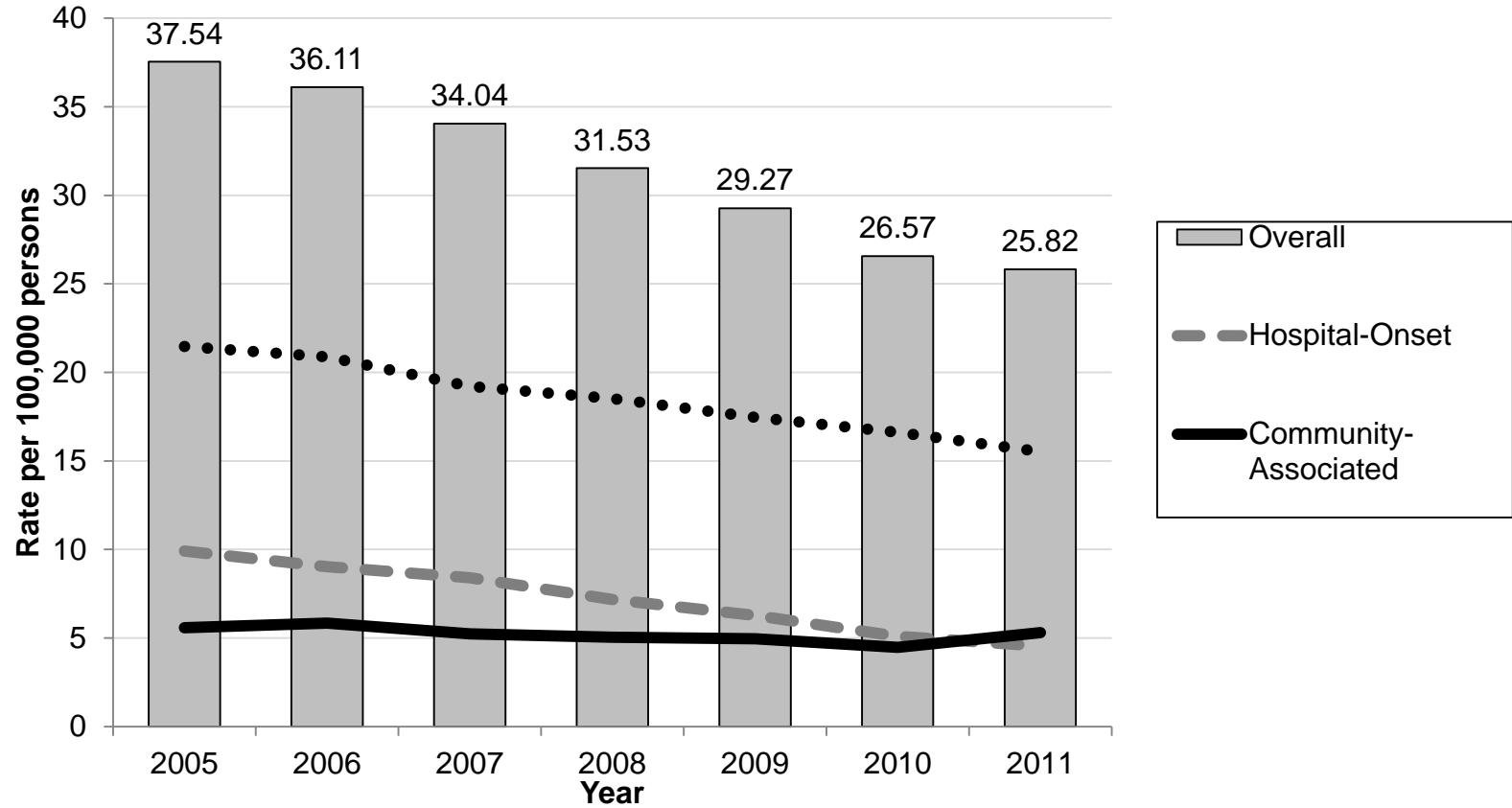


HO-MRSA: hospital-onset MRSA. MRSA isolated > 3 days after admission date.

HACO: healthcare-associated community-onset MRSA. MRSA isolated from an outpatient or ≤3 days after hospital admit but recent healthcare exposure (e.g., surgery, dialysis, long-term care facility) documented.

CO-MRSA: community-onset MRSA. MRSA isolated from an outpatient or ≤3 days after hospital admit and no recent healthcare exposure documented.

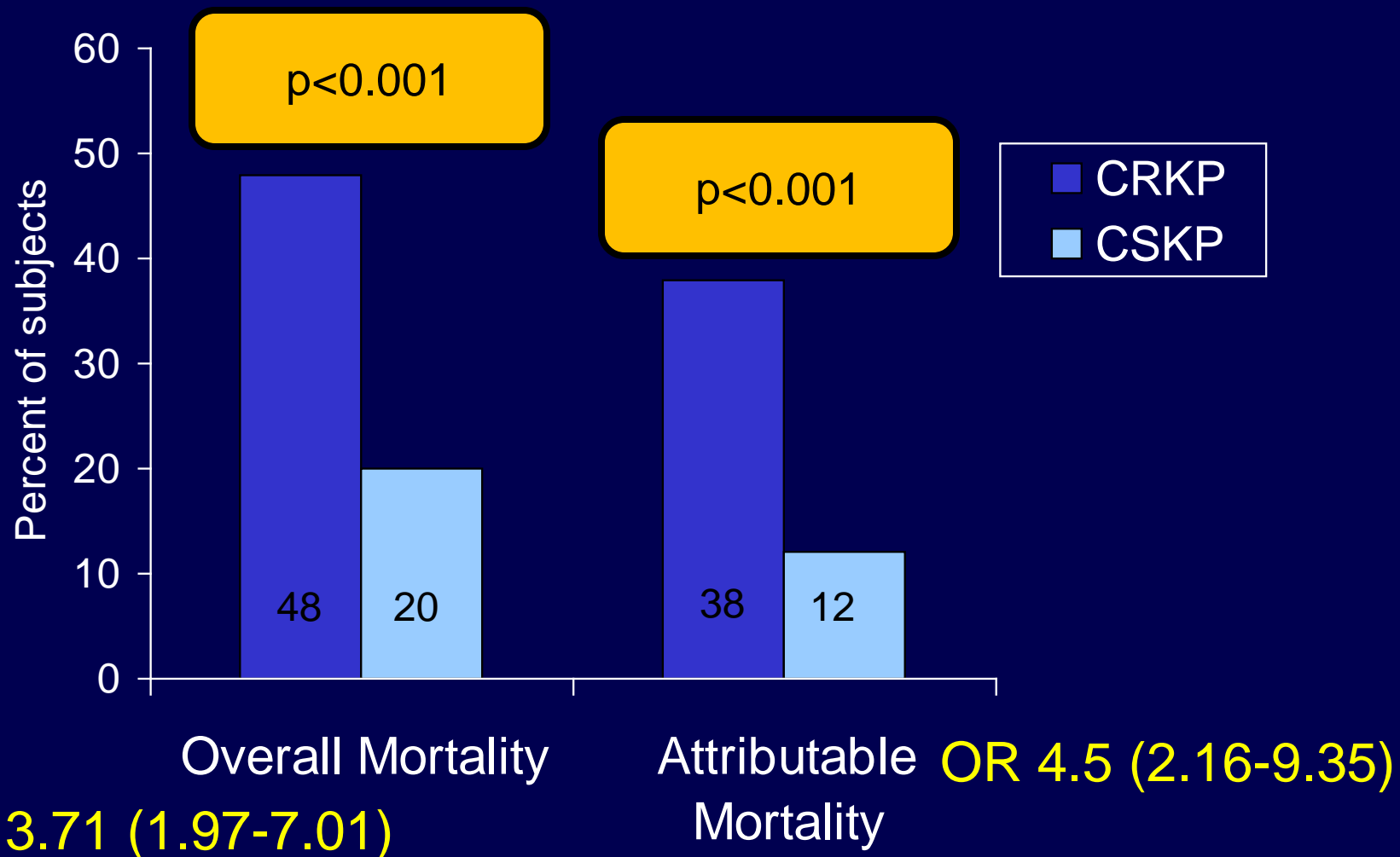
National Estimated Incidence Rates of Invasive MRSA Infections Reported to Emerging Infections Program- Active Bacterial Core Surveillance, 2005-2011



Susceptibility Profile of *Klebsiella pneumoniae* carbapenamase (KPC) Producing *K. pneumoniae*

<u>Antimicrobial</u>	<u>Interpretation</u>	<u>Antimicrobial</u>	<u>Interpretation</u>
Amikacin	I	Chloramphenicol	R
Amox/clav	R	Ciprofloxacin	R
Ampicillin	R	Ertapenem	R
Aztreonam	R	Gentamicin	R
Cefazolin	R	Imipenem	R
Cefpodoxime	R	Meropenem	R
Cefotaxime	R	Piperacillin/Tazo	R
Cetotetan	R	Tobramycin	R
Cefoxitin	R	Trimeth/Sulfa	R
Ceftazidime	R	Polymyxin B	MIC >4µg/ml
Ceftriaxone	R	Colistin	MIC >4µg/ml
Cefepime	R	Tigecycline	S

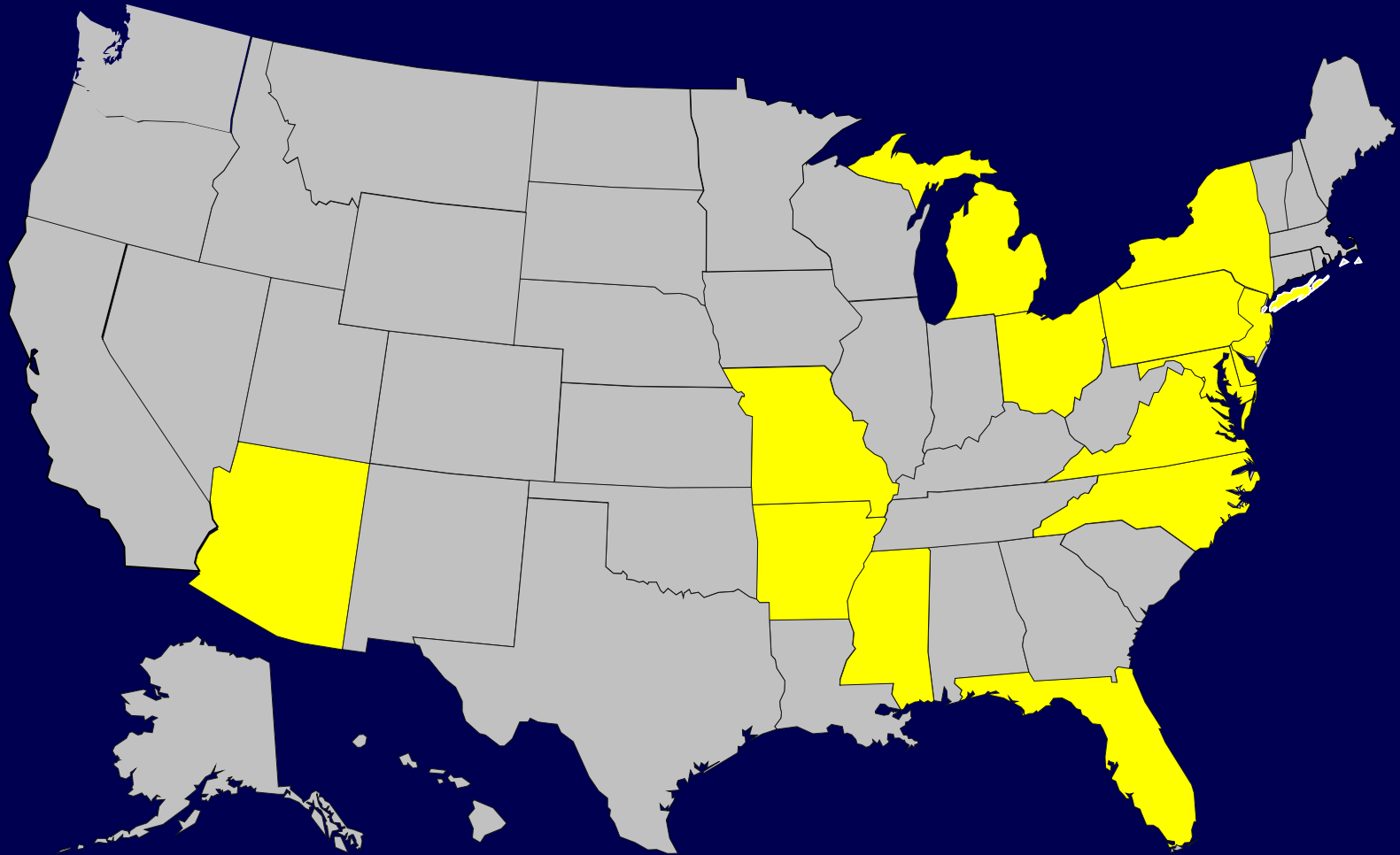
Mortality: Carbapenem Resistant vs. Susceptible *Klebsiella pneumoniae*



Patel et al. Infect Control Hosp Epidemiol 2008;29:1099-1106

A. Srinivasan, J. Patel – DHQP CDC

Geographical Distribution of Highly Resistant *Klebsiella* and Related Bacteria



CDC, Unpublished Data, Nov. 2006

Confirmed by CDC

Highly Resistant Enterobacteriaceae, MN

February 2009: KPC+ *K. pneumoniae* confirmed at MDH

2010: 14 KPC + isolates

- *K. pneumoniae* (6), *E. cloacae* (6), *K. oxytoca* (2)

2011: 21 KPC + isolates

- *E. cloacae* (10), *K. pneumoniae* (10), *C. freundii* (1)
- NDM: 1 *K. pneumoniae* and 1 *E. coli* of same patient

2012: 29 KPC + isolates

- *E. coli* (1), *E. cloacae* (12), *K. pneumoniae* (15), *K. oxytoca* (1)
- NDM: No NDM in MN residents (3 NDM+ isolates in 2 non-MN residents: 2 *K. pneumoniae* and 1 *E. coli*)

2013: 22 KPC + isolates (Jan-Sep preliminary data)

- *K. pneumoniae* (10), *E. cloacae* (9), *K. oxytoca* (1), *C. freundii* (1) *C. koseri* (1)

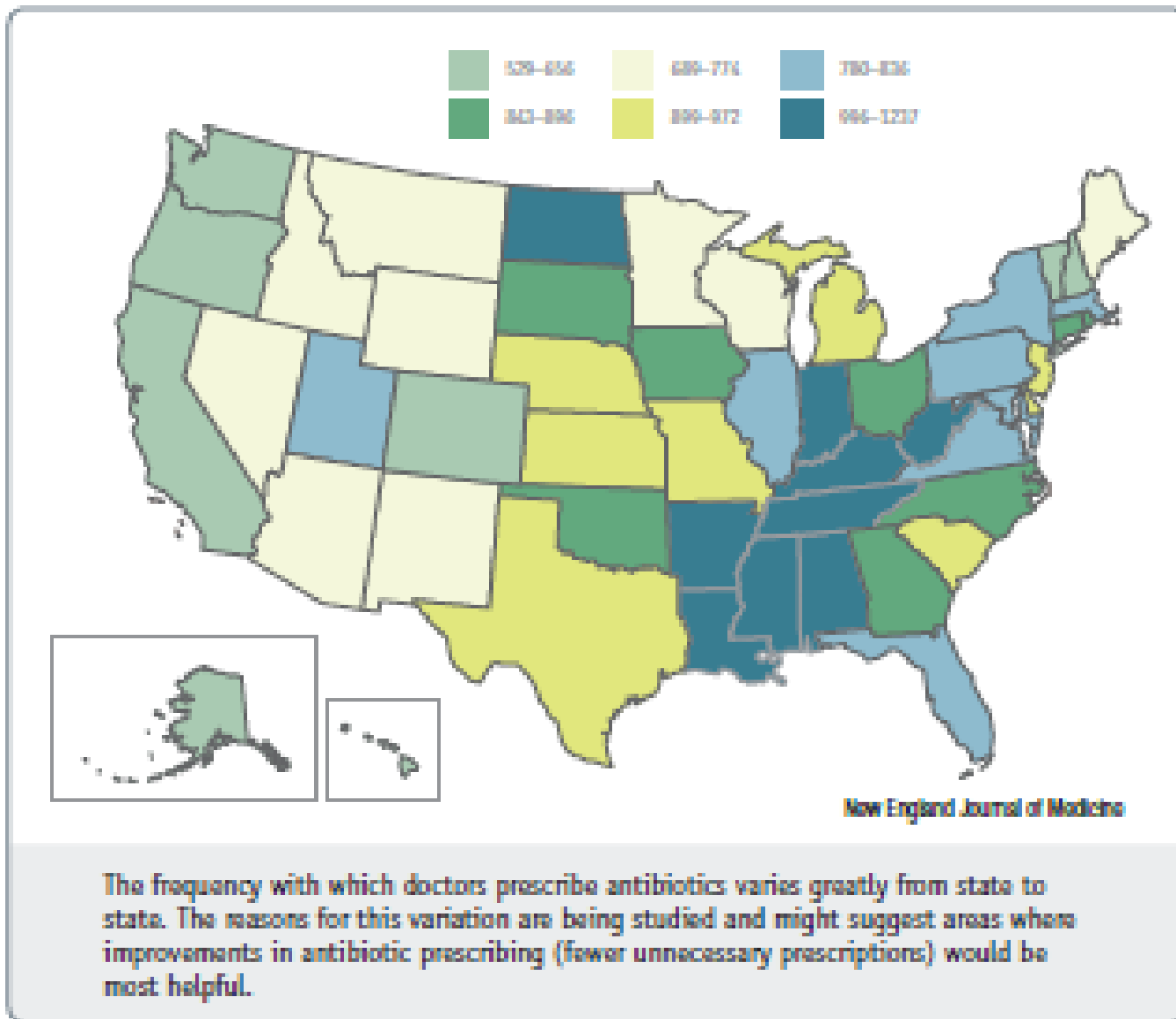
***Clostridium difficile* Infection**

- **Antibiotic exposure is the most important risk factor for the development of *Clostridium difficile* associated disease**
- **According to CDC, 250,000 infections, 14,000 deaths and \$1,000,000 in excess medical costs per year**

Minnesota *C. difficile* Surveillance

- **Todd, Stearns, Morrison, and Benton counties**
 - **Medical record review**
 - **Raw stool submitted for isolation and characterization**
 - **Part of the larger CDC Emerging Infections Program (11 states participating)**
- **Incident cases identified from 2009 – 2012: 1442 (23 deaths)**
 - **59% community-associated**
- **2012 incidence: 186 cases/100,000 persons**

Antibiotic Prescriptions per 1000 Persons of All Ages According to State, 2010



Antibiotics Research Subsidies Weighed by U.S.

By Andrew Pollack Published: November 5, 2010

Margaret A. Hamburg, commissioner of the Food and Drug Administration, said at a news conference last month. The world's weakening arsenal against "superbugs" has prompted scientists to warn that **everyday infections could again become a major cause of death just as they were before the advent of penicillin around 1940.**

"For these infections, we're back to dancing around a bubbling cauldron while rubbing two chicken bones together," said Dr. Brad Spellberg, an infectious disease specialist at Harbor-U.C.L.A. Medical Center in Torrance,

Minnesota Guide to a Comprehensive Antimicrobial Stewardship Program

Minnesota Guide to a Comprehensive
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September 2012

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