The Growing Threat of Antibiotic Resistance in Post-Acute Care

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Perelman School of Medicine
University of Pennsylvania

Disclosures

None to report

philly.com
The Philadelphia Inquirer

Pa. woman first in U.S. diagnosed with new drug-resistant superbug

THE DR. OZ SHOW

Are we headed for an antibiotic apocalypse? Deadly superbugs

USA TODAY

Deadly 'superbugs' invade U.S. health care facilities

DEADLY BACTERIA THAT DEFY DRUGS OF LAST RESORT

NEW YORK POST

‘Nightmare’ bacteria on warpath

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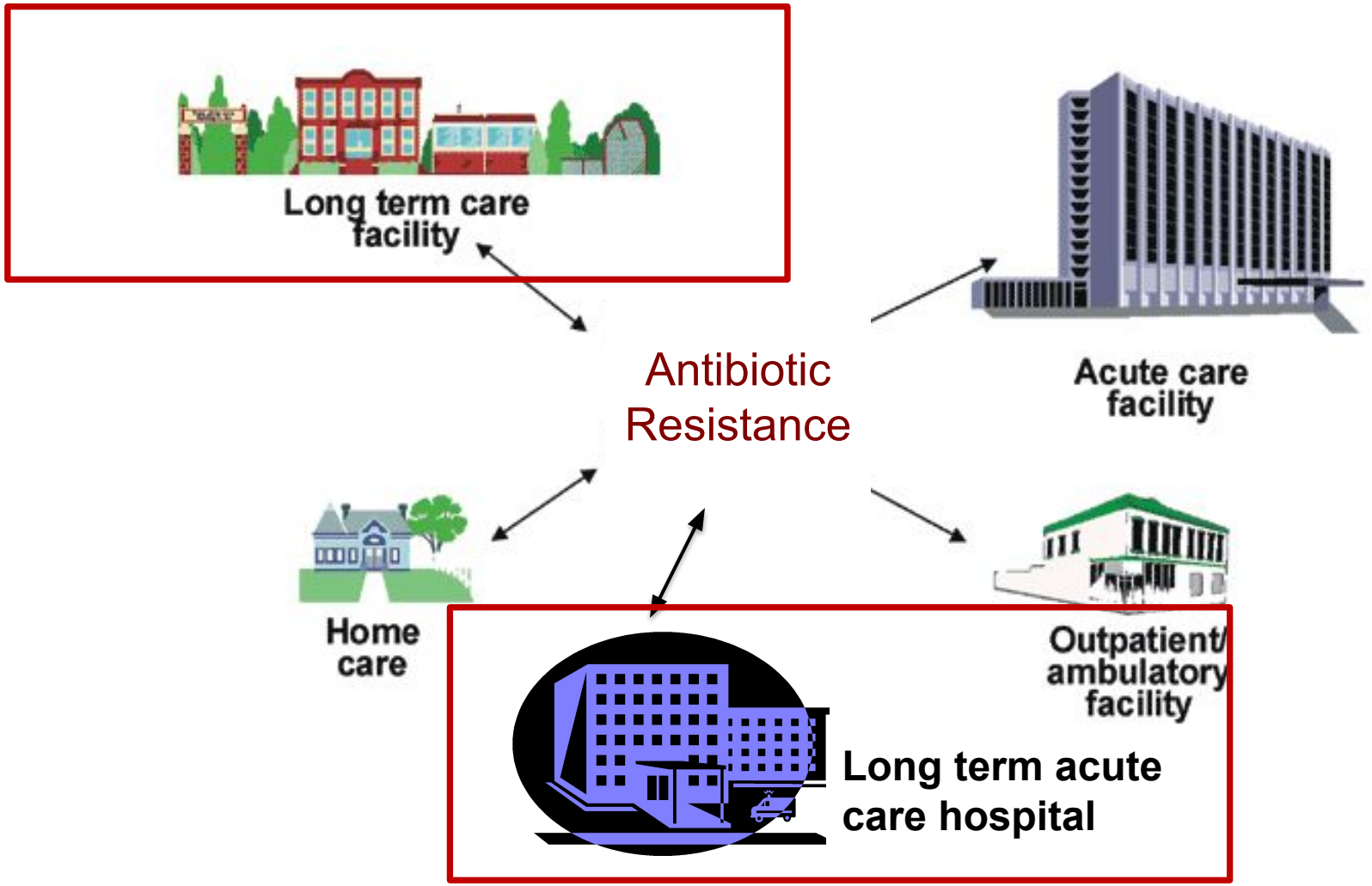
Objectives

- **Discuss the increasing importance of post-acute care facilities in healthcare delivery**
- **Describe the epidemiology of multidrug-resistant organisms (MDROs) in post-acute care facilities**
  - MRSA
  - *Clostridium difficile*
  - Multidrug-resistant gram-negative bacteria
    - Carbapenem-resistant Enterobacteriaceae
- **Discuss interventions and future directions for preventing the emergence of MDROs in long-term care settings**

Antibiotic resistance in the 21st century: "no institution is an island"



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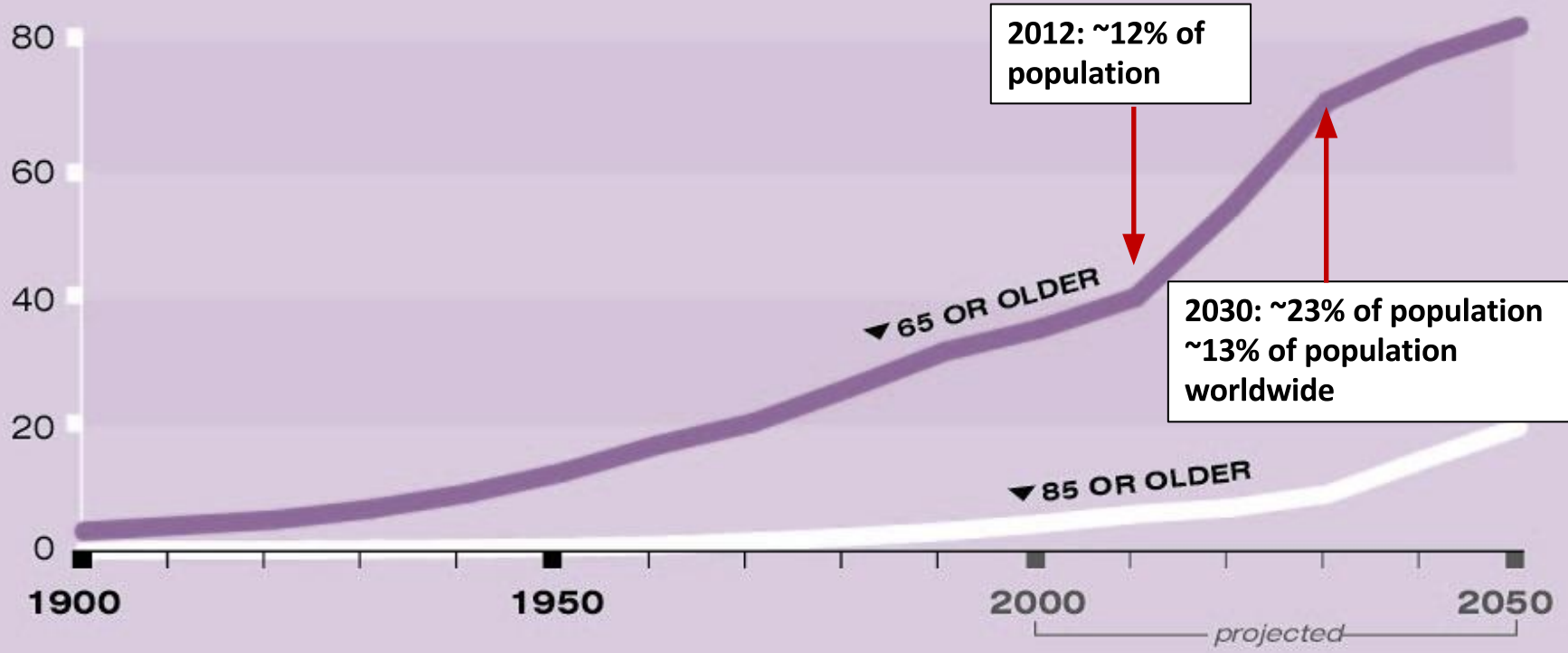
Adapted from Jarvis WR, Emerg Infect Dis 2001;7:170.

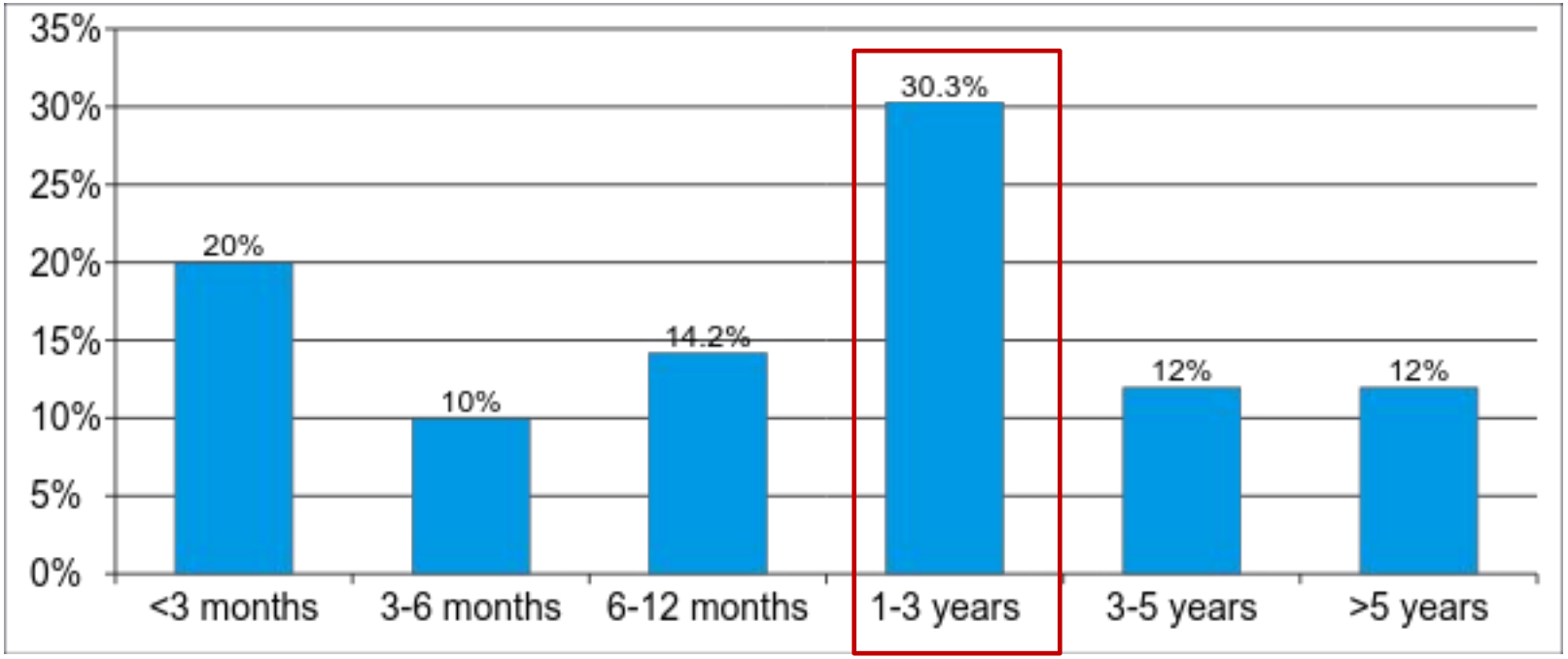
Changes in the aging population



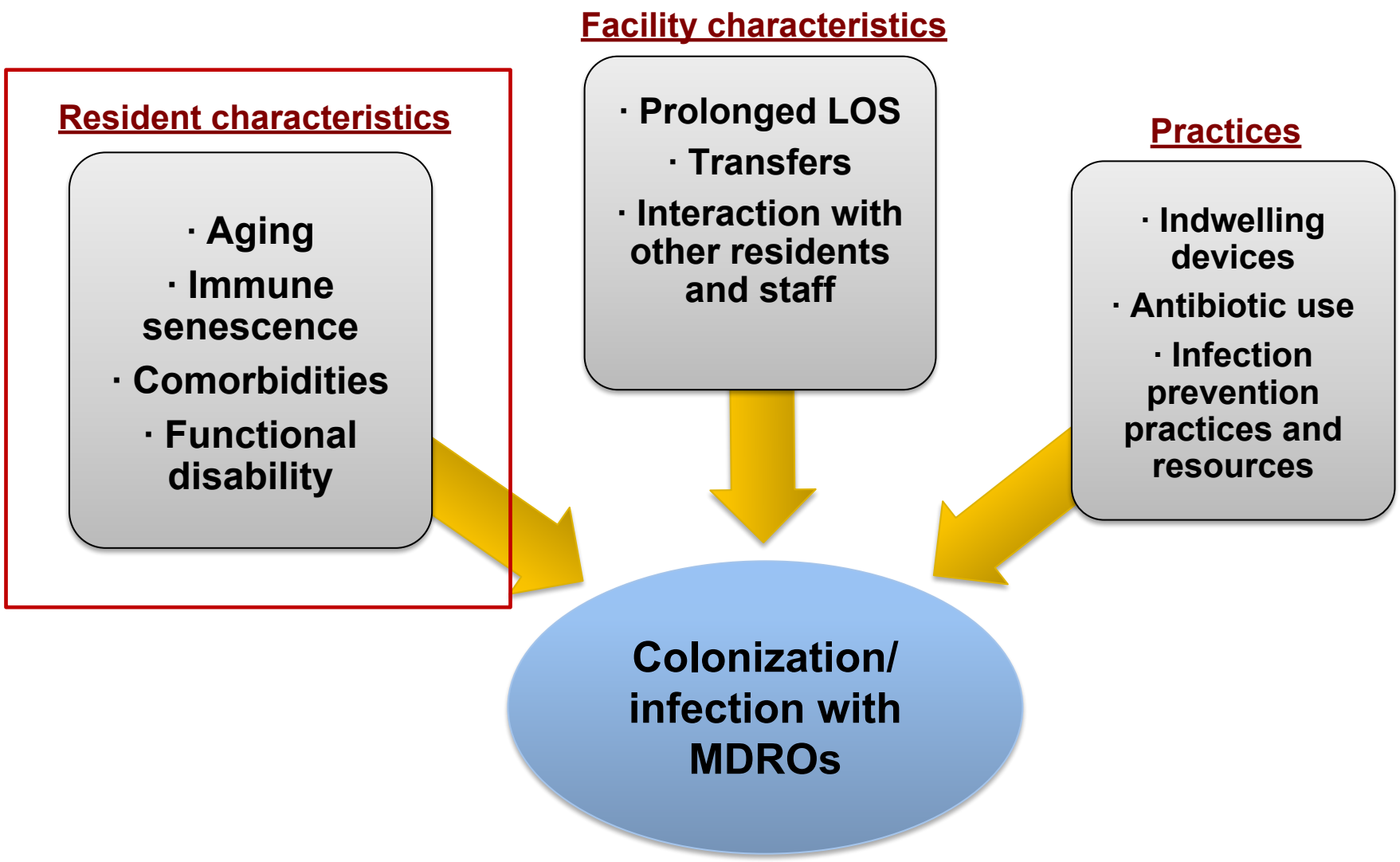
Note: Data for the years 2000 to 2050 are middle-series projections of the population.
Reference population: These data refer to the resident population.
Source: U.S. Census Bureau, Decennial Census Data and Population Projections.

What is a long-term care facility?

- **Residential setting for individuals with functional disabilities**
  - Nursing homes, skilled nursing facilities (SNFs), VA Community Living Centers (CLCs)
- **~70% of people ≥ 65 years will require some long-term care services**



Antibiotic resistance in nursing homes

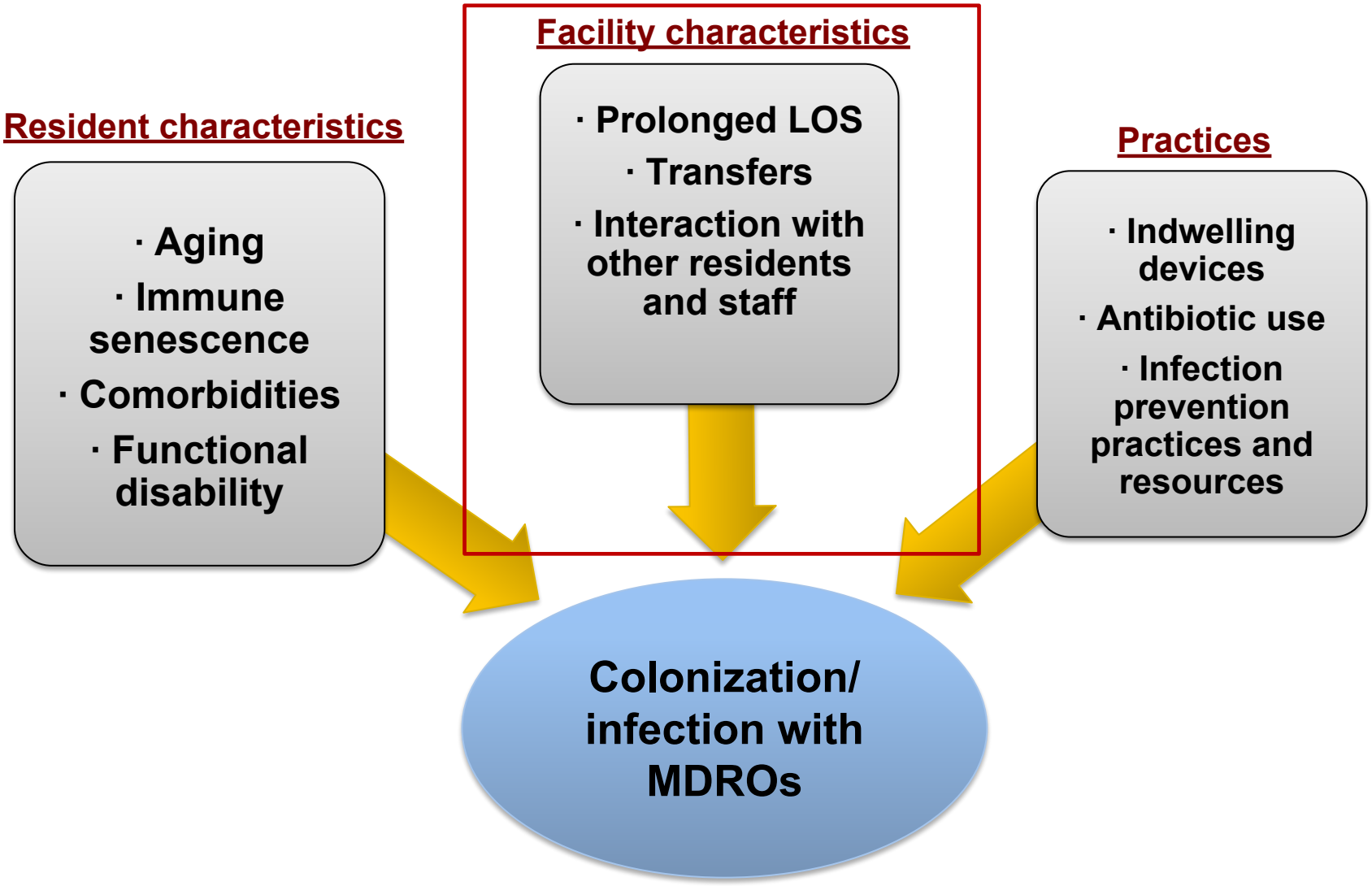


Mody L. Clin Infect Dis 2011;52.
Van Buul L. J Amer Med Dir Assoc 2012;568.

The nursing home population

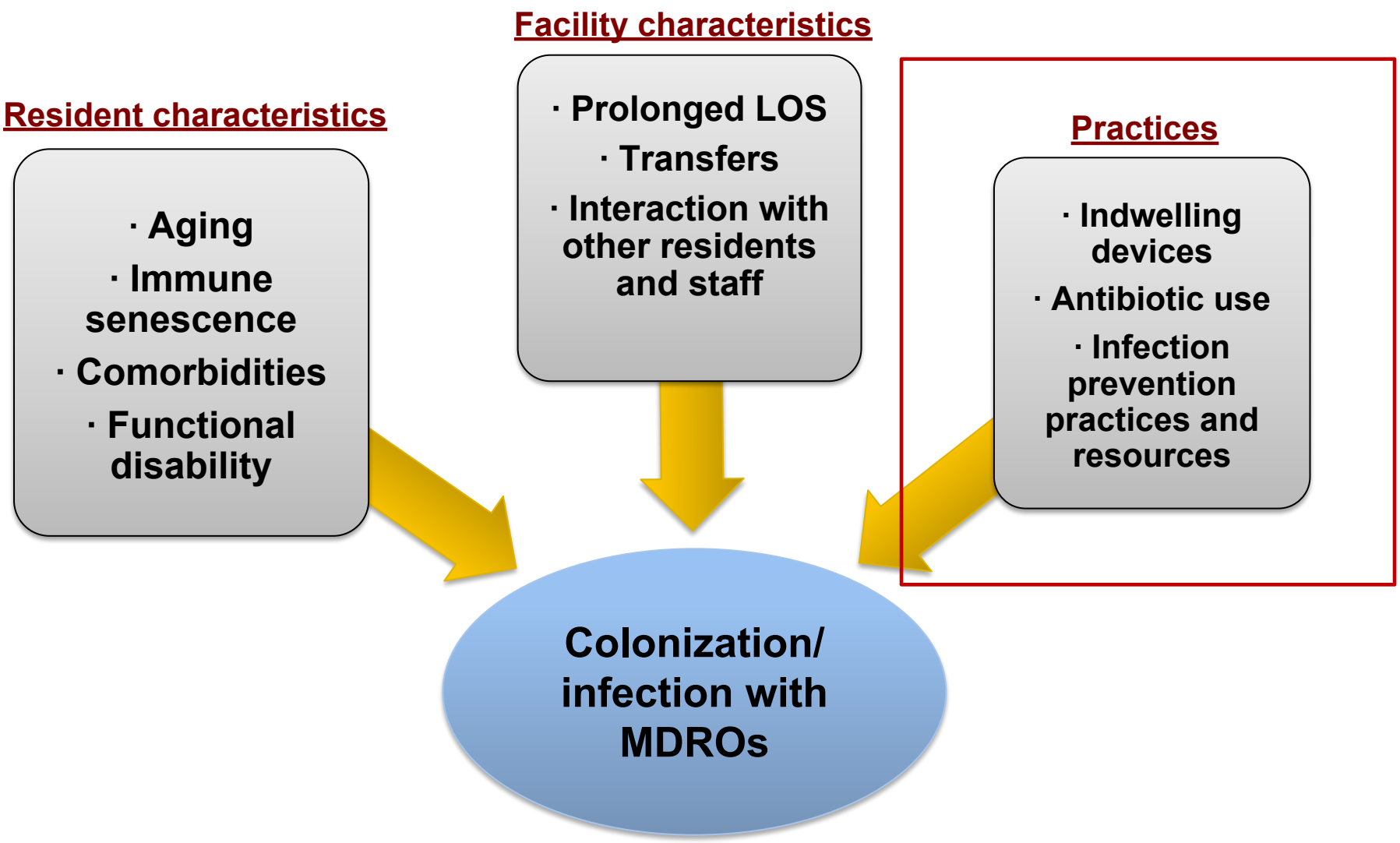
Characteristic	
Age ≥ 65 years	85%
Number of ADL impairments 4-5	62%
Cognitive impairment Moderate Severe	 26% 38%
Incontinence	36%
Stage ≥2 pressure ulcers	6%

Antibiotic resistance in nursing homes



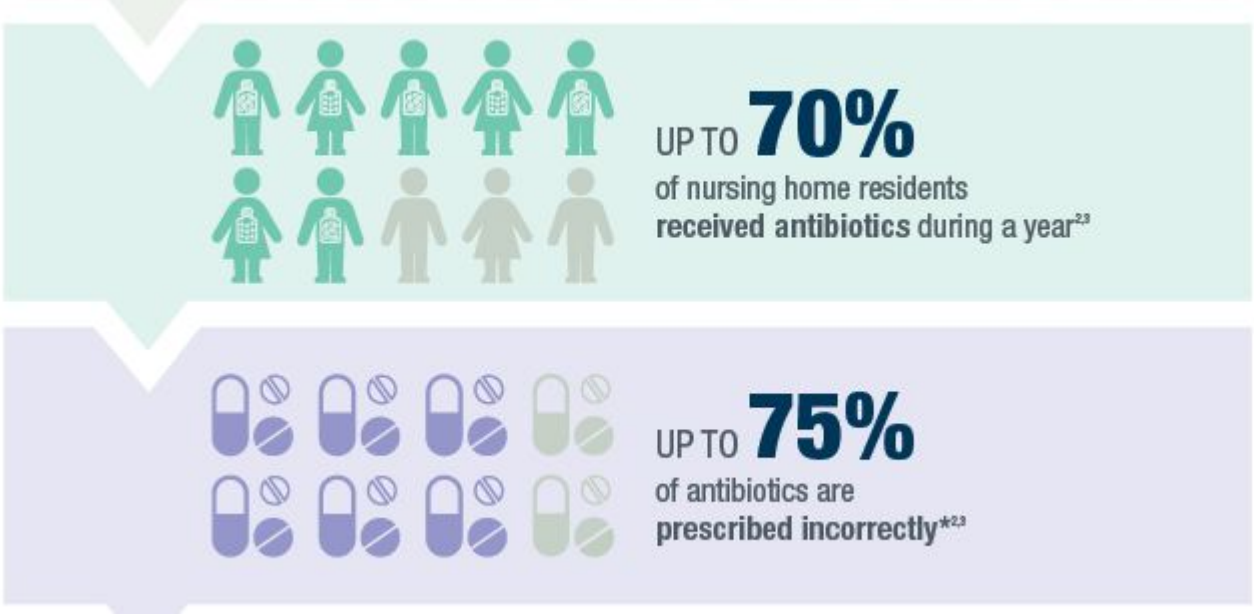
Mody L. Clin Infect Dis 2011;52.
Van Buul L. J Amer Med Dir Assoc 2012;568.

Antibiotic resistance in nursing homes



1. Mody L. CID 2011;52.
2. Van Buul L. JAMDA 2012;568.

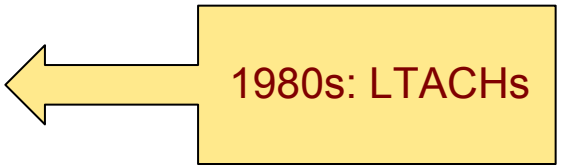
Antibiotic Stewardship in Nursing Homes



Centers for Disease Control and Prevention
National Center for Emerging and Zoonotic Infectious Diseases

What is an LTACH?

- **Hospital Length of Stay**
  - **1975 = 11.4 days**
  - **2004 = 6.5 days**
  - **2006 - 2011 = 4.8 days**

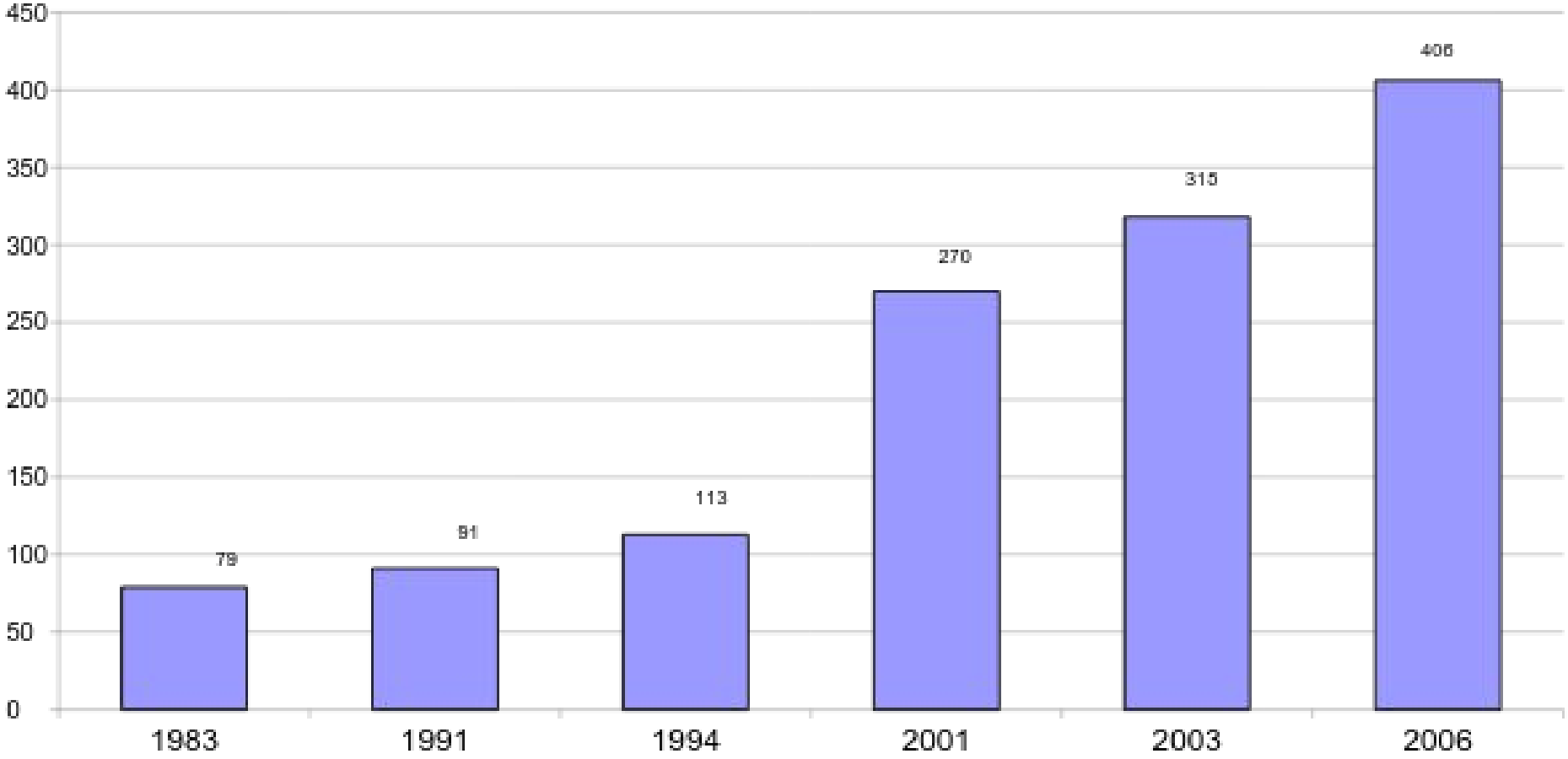


- **Require hospitalization for ≥ 25 days (CMS)**
- **Complex medical conditions → 90% had LOS in hospital of ≥14 days**
- **Acuity of care meets acute care hospital requirements**
  - Licensed and credentialed under same criteria as short-term acute care hospitals

National Center for Health Statistics. Summary Health Statistics for the US Population: National Health Interview Survey, 2008
Healthcare Cost and Utilization Project.

LTACH Growth

- Currently ~450 in the U.S.
- Moratorium expires September 2017



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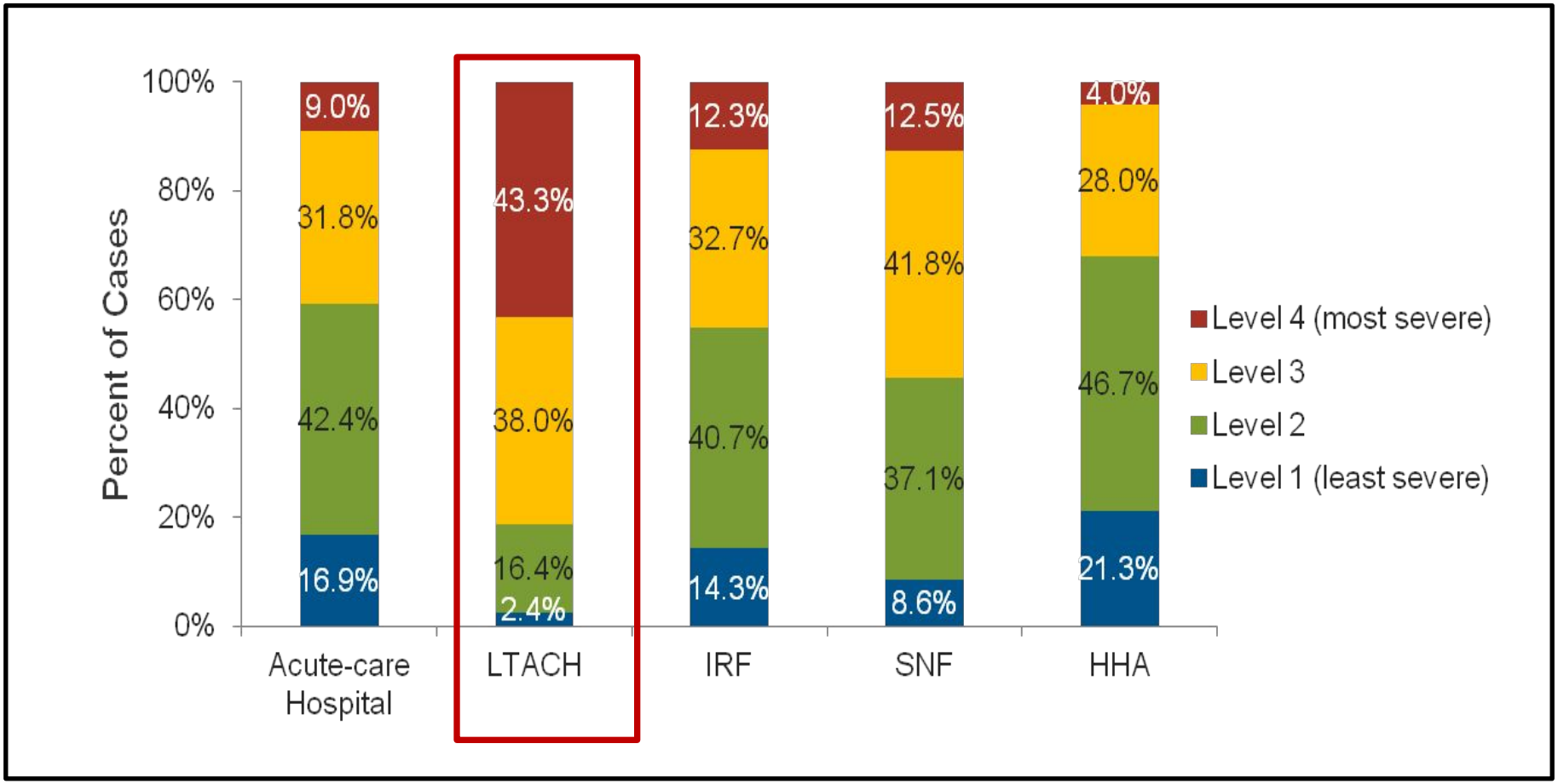
Centers for Medicare and Medicaid Services, 2008

Patient severity of illness varies by healthcare setting

- ~40% of discharges to LTACHs → chronic mechanical ventilation



Medicare Payment Advisory Commission. (2010). March Report to the Congress: Long-term Care Hospital Services. Washington, DC.
The Moran Company. Analysis of 2008 Medicare acute-care hospital data sorted by APR-DRG group.

LTACHs: the "Perfect Storm" for emergence of antibiotic resistance

- **Complex patient population with average LOS >25 days**
- **Device utilization high**
  - Up to ~75% central venous catheter use

- **Rate of antibiotic use high**
  - Use of broad-spectrum antibiotics higher than 50th-75th percentile of ICU use
- **Logistics of isolation and cohorting**

Gould, et al Infect Control Hosp Epidemiol 2006;27.
Furuno, et al. Am J Infect Control 2008;36.
Munoz-Price. Clin Infect Dis 2009;49.

CDC
CENTERS FOR DISEASE CONTROL AND PREVENTION

HAZARD LEVEL URGENT

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

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

HAZARD LEVEL SERIOUS

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

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

HAZARD LEVEL CONCERNING

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

Vancomycin-resistant *Staphylococcus aureus* (VRSA), Erythromycin-resistant *Streptococcus* Group A, Clindamycin-resistant *Streptococcus* Group B

CRE
C. difficile

"…require urgent public health attention to identify infections and to limit transmission."

MRSA

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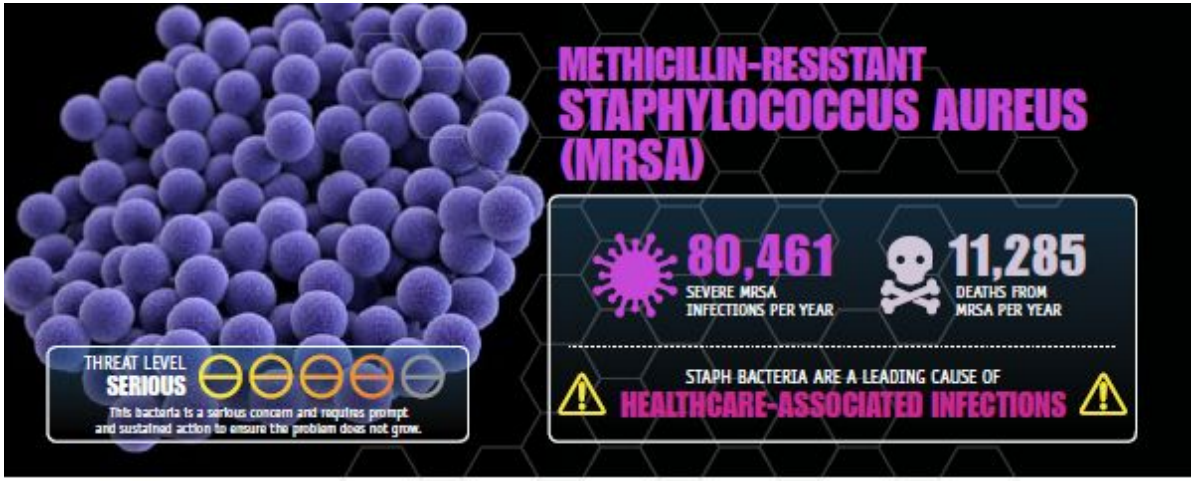
Epidemiology of MRSA in nursing homes

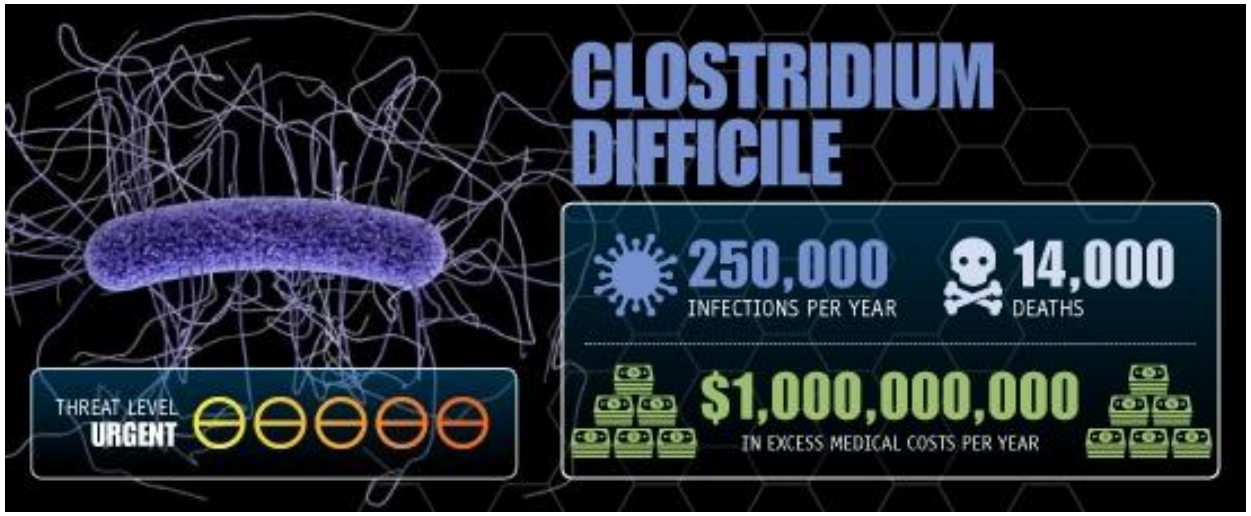


The epidemiology of MRSA in nursing homes

- **Burden in NHs significantly less well-studied than in acute care hospitals** → less standardized infection prevention policies
- **Prevalence of colonization: ~25-50%**
  - Residents with indwelling devices: ~75%
  - Acute care hospitals: 6-12%; ICUs: 7-24%
- **Highly dependent on local prevalence and importation pressure**
- **Risk factors for MRSA colonization**
  - Older age
  - Poor functional status
  - Prior antibiotic therapy
  - Indwelling devices
  - Low nursing : bed ratio
  - ↓ social engagement levels
  - Environmental contamination of common areas

Stone N. Infect Control Hosp Epidemiol 2008;29.
Mody L. Clin Infect Dis 2008;46.
Manzur A. Clin Microbiol Infect 2009;15(Suppl).
Reynolds C. Infect Control Hosp Epidemiol 2011;32
Murphy C. BMC Infect Dis 2012;12..

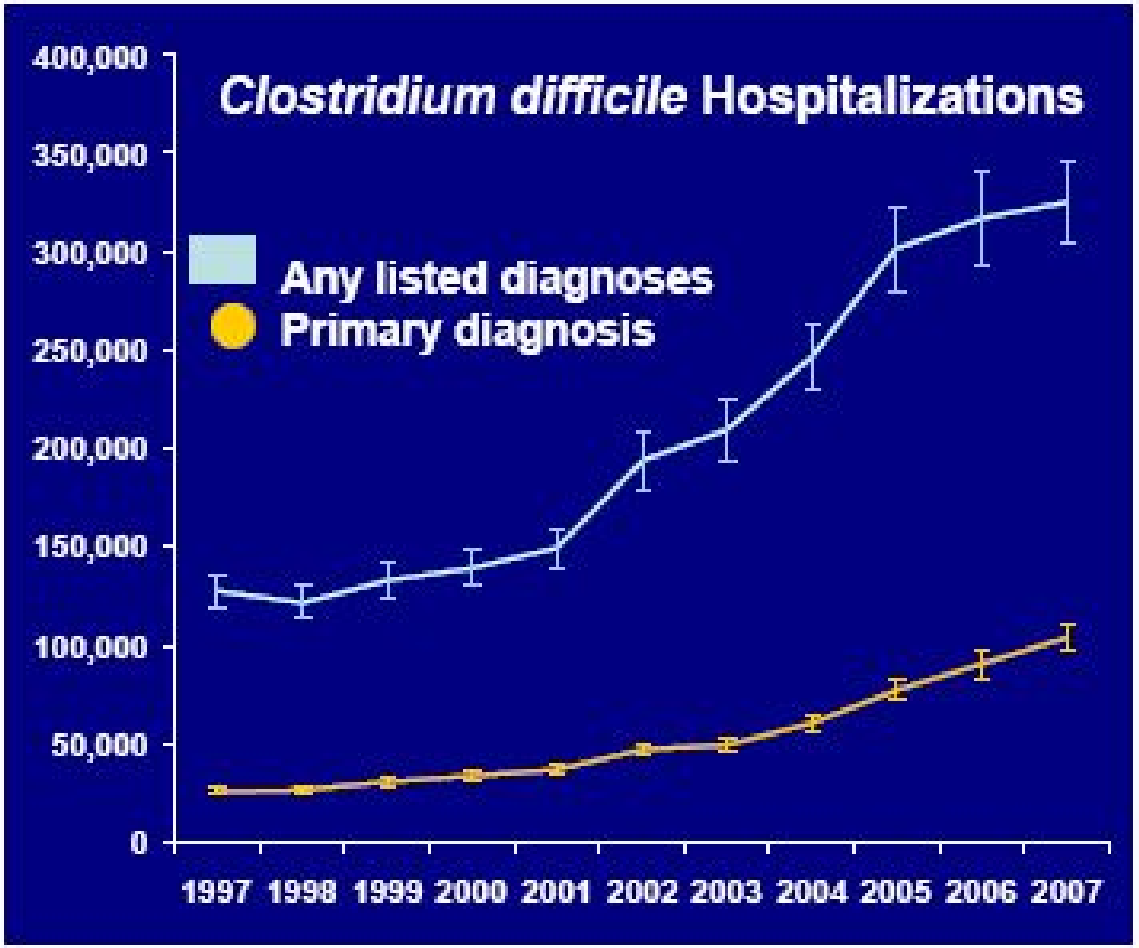
Clostridium difficile in nursing homes



C. diff no longer just a hospital superbug

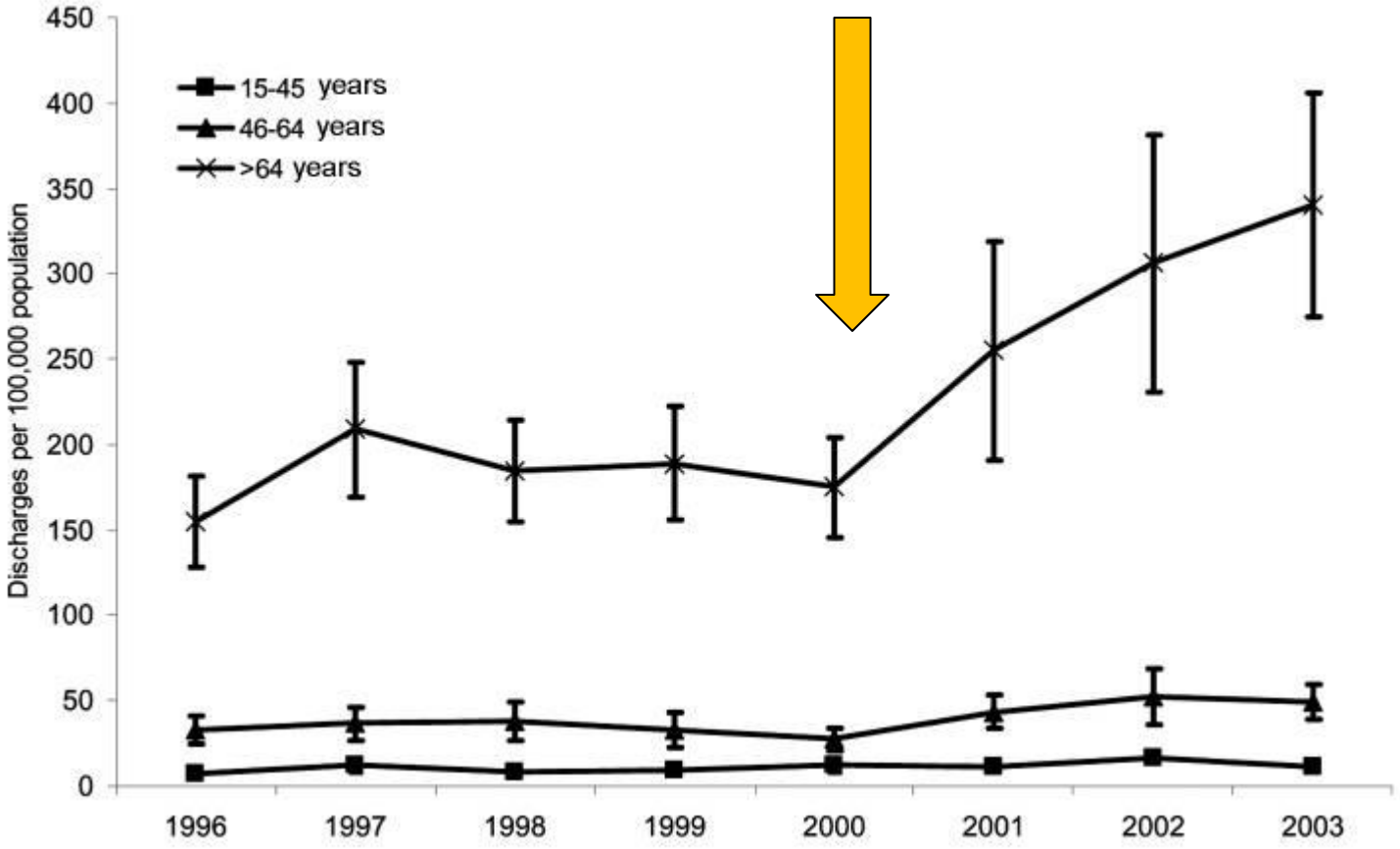
Newsday

National Estimates of U.S. Short-Stay Hospital Discharges with *C. difficile*



Campbell et al. Infect Control Hosp Epidemiol 2009:30.

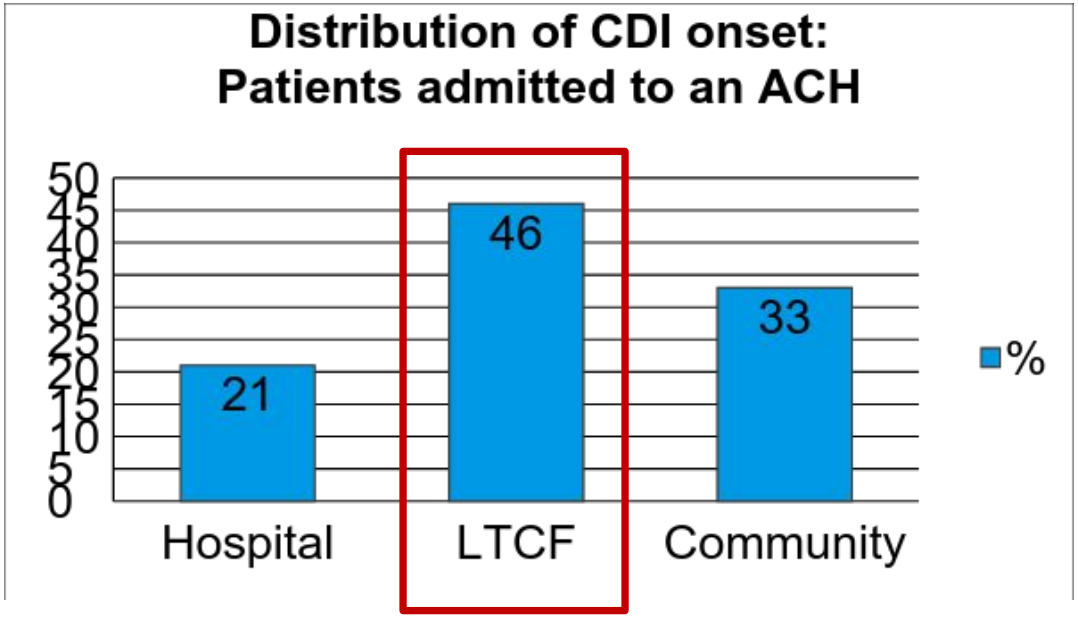
National Estimates of U.S. Short-Stay Hospital Discharges with *C. difficile* by Age



McDonald LC, et al. Emerg Infect Dis. 2006;12(3):409-15

Changing epidemiology of *C. difficile* in nursing homes

- 400 cases of CDI, 2005 - 2010



- **>300,000 cases/year**
- **$2.2 billion in excess costs**
- **16,500 deaths/year**

Garg S, et al. Dig Dis Sci 2013;58
Dubberke et al. Emerg Infect Dis. 2008;14.
Dubberke et al. Clin Infect Dis. 2008;46.
.

Carbapenem-resistant Enterobacteriaceae

WASHINGTONIAN

ocal Restaurants

WASHINGTONIAN COOLEST CAT CONTEST

ook 668

Outbreak at NIH

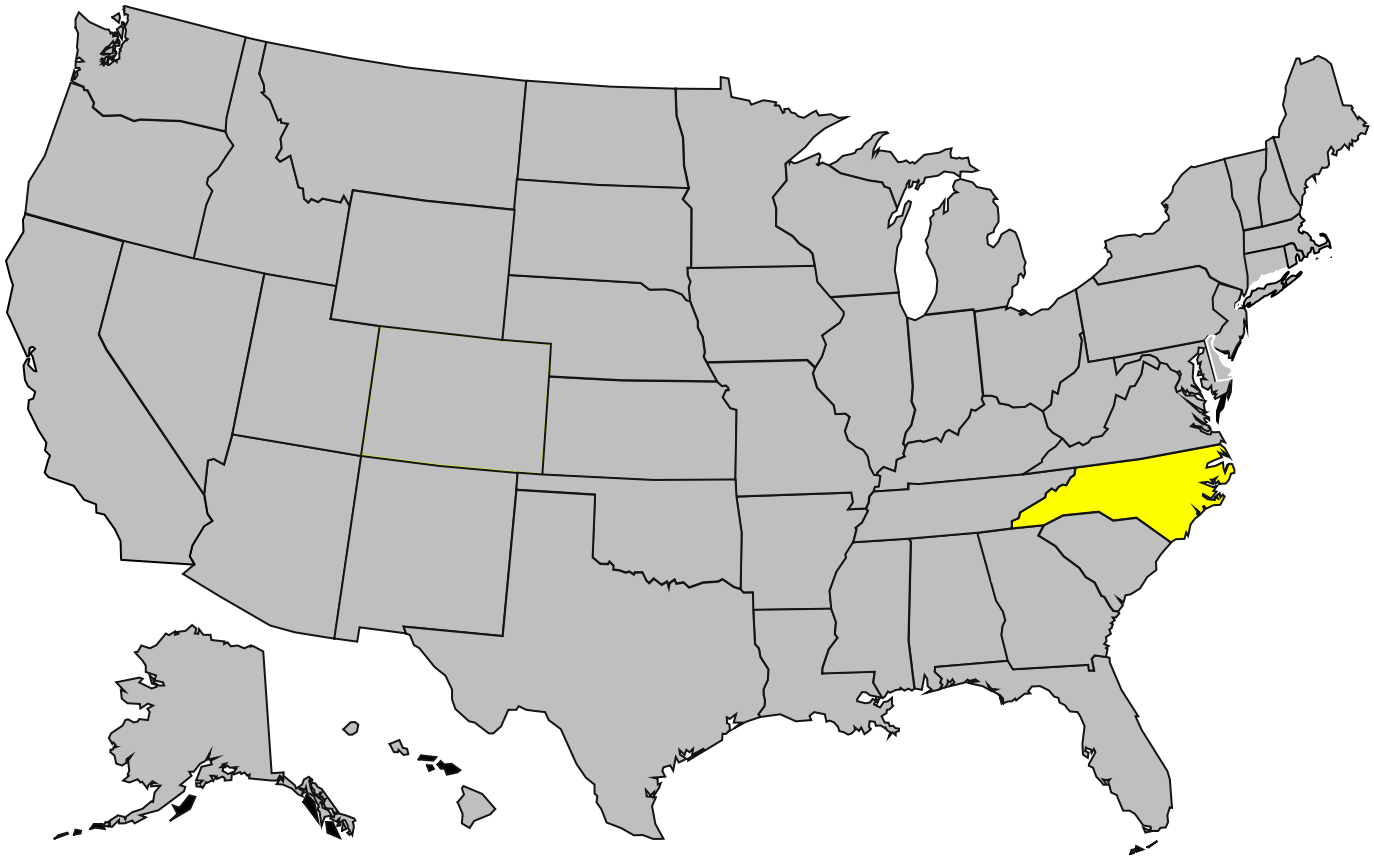
They tore out pipes, walled off a hallway, and sent in a robot. But staff at the National Institutes of Health seemed powerless to stop the spread of a drug-resistant superbug.

By John Buntin | June 4, 2013

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

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

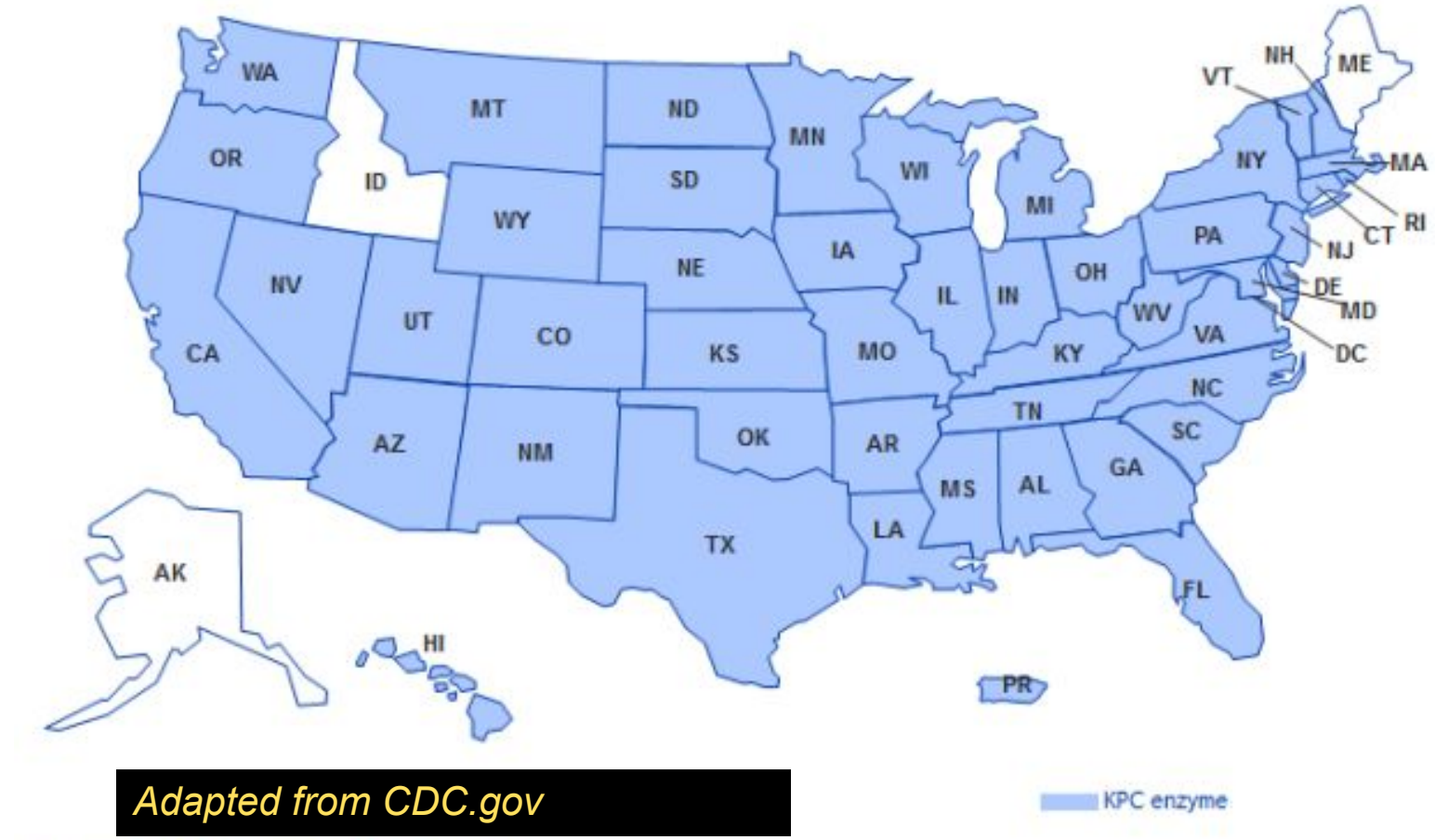
HESNA YIGIT,[1] ANNE MARIE QUEENAN,[2] GREGORY J. ANDERSON,[1]
ANTONIO DOMENECH-SANCHEZ,[3] JAMES W. BIDDLE,[1] CHRISTINE D. STEWARD,[1]
SEBASTIAN ALBERTI,[4] KAREN BUSH,[2] AND FRED C. TENOVER[1]*



Adapted from CDC.gov

Geographical Distribution of KPC-Producing Organisms

2014

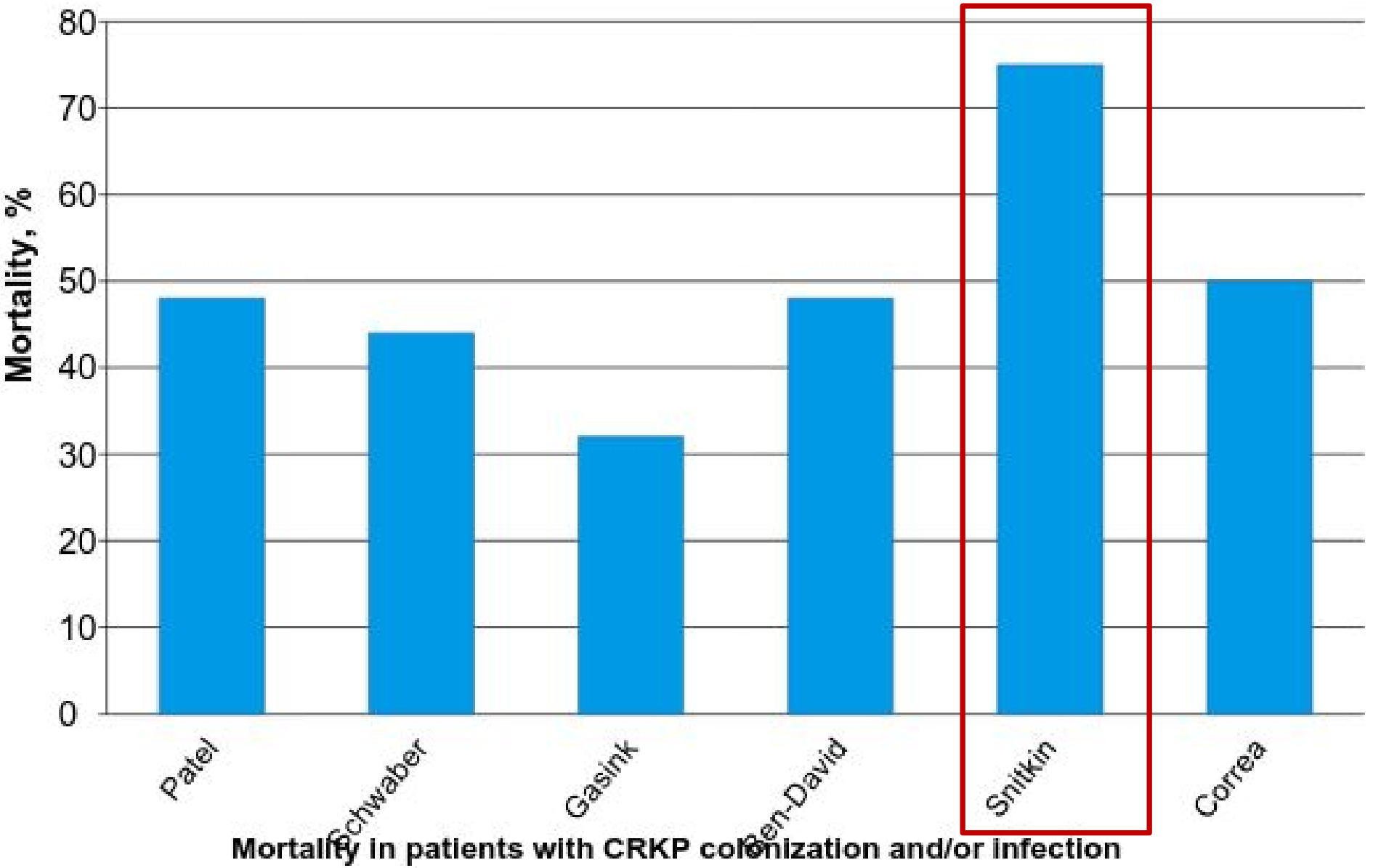


Adapted from CDC.gov

Carbapenem-Resistant Enterobacteriaceae (CRE)
a major therapeutic challenge

Antimicrobial agent	Interpretation	Antimicrobial agent	Interpretation
Amikacin	I	Ertapenem	R
Amox/clav	R	Gentamicin	R
Ampicillin	R	Imipenem	R
Aztreonam	R	Meropenem	R
Cefazolin	R	Gentamicin	R
Cefpodoxime	R	Tobramycin	R
Cefotaxime	R	TMP-SMX	R
Cetotetan	R		
Ceftriaxone	R		
Ceftazidime	R	Polymyxin B	≤ 2 µg/mL
Cefepime	R	Colistin	≤ 2 µg/mL
Ciprofloxacin	R	Tigecycline	≤ 2 µg/mL

Carbapenem resistant *K. pneumoniae* (CRKP): clinical outcomes in acute care hospitals



Prevalence of carbapenem-resistant Enterobacteriaceae in acute care hospitals versus LTACHs

- U.S. surveillance of healthcare-associated infections
- National Healthcare Safety Network (NHSN)

Facility type	Number of facilities with CRE from a CAUTI or CLABSI (2012)	Total facilities performing CAUTI or CLABSI surveillance (2012)	(%)
Acute care hospitals	145	3,716	(3.9)
LTACHs	36	202	(17.8)

CDC Vitalsigns™ March 2013

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Utah
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Missouri
United States
California
Kentucky
Oklahoma
Arkansas
Mississippi
Alabama
Georgia
Louisiana
Tennessee
North Carolina
South Carolina
Virginia
West Virginia
Pennsylvania
New York
Maine
Vermont
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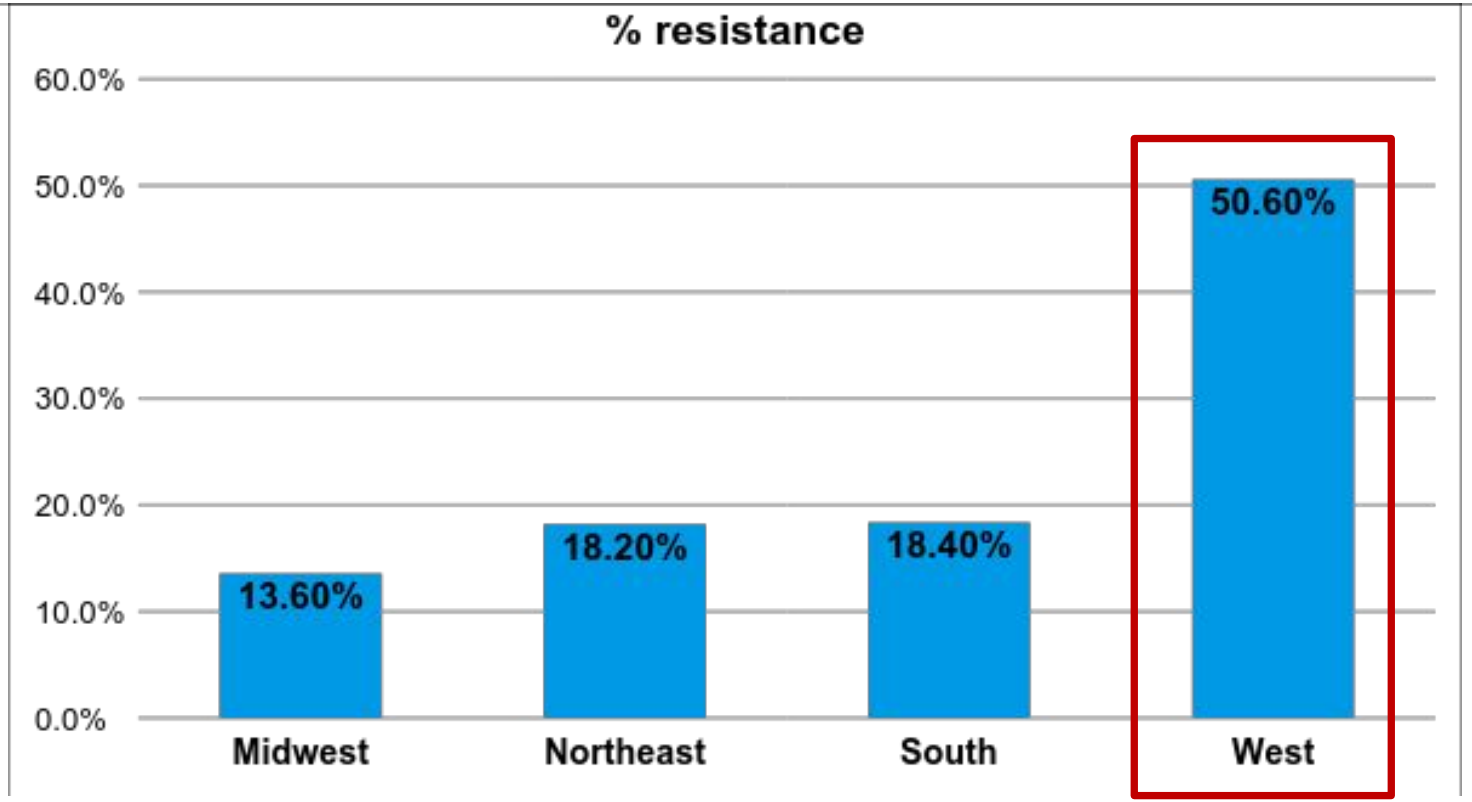
Massachusetts
Rhode Island
Connecticut
New Jersey
Delaware
Maryland
District of Columbia
New Brunswick
Nova Scotia
Montreal
Toronto
New Mexico
Phoenix
San Diego
Dallas
Houston
San Antonio
Monterrey
Mexico
Gulf of California
Gulf of Mexico
Havana

FY2013 snapshot



→ **LTACHs as a large, potentially unrecognized reservoir of CRE**

Interventions and future directions for prevention of MDROs in long-term care settings

- **Studies characterizing MDROs in nursing homes and LTACHs**
  - Systematic surveillance
  - Epidemiologic risk factors, outcomes
- **Infection prevention practices <u>targeted towards the nursing home setting</u>**
- **Antibiotic stewardship in long-term care**
- **Improved interfacility communication/collaboration**
  - Regional surveillance networks
  - Standardized communication on transfers

Nursing homes: infection prevention considerations

- **Residential setting**
- **Relative lack of private rooms**
- **No in-house reference laboratory**
- **Promotion of socialization**
  - Group activities: dining, recreation, PT/OT
- **Limited resources and personnel for IPC programs → 37% of NHs received an IPC-related deficiency citation**
  - CMS "Reform Requirements for Long-Term Care Facilities" → IPC program within quality assurance and performance improvement (QAPI) program
  - Requirement that facilities have a designated IPC officer for whom overseeing the IPC program is his or her major responsibility
  - Specialized training in infection prevention

Cohen C, et al. Infect Control Hosp Epidemiol 2015.

Nursing home IPC: contact precautions?

MRSA colonization as prime example

- **Potential significant contamination of gowns**

(up to 24%) and gloves (37%) with typical activities

- **Precautions for infection versus colonization?**
- **↓ HCW contact, ↑ depression, falls, delirium**
- "I've been through some very, very serious life and death situations…I have a lot of chronic problems that are difficult to treat. Like my osteomyelitis, it almost killed me, it really did. I am a walking, talking survivor. I am concerned about MRSA, and despite being in and out of facilities for 15 years…I have remained MRSA-free and I want to stay that way. Because I don't need that [MRSA] on top of all the other things I have going on."
- "This is my home and it scares me to see people wearing these yellow coverings and gloves. I feel like a pariah sometimes, and people don't want to be associated with me. It makes me worry about my friends and getting on with my social activities."

Roghmann MC, et al. Infect Control Hosp Epidemiol 2015;36
Morgan D, et al. Am J Infect Control 2009;37.

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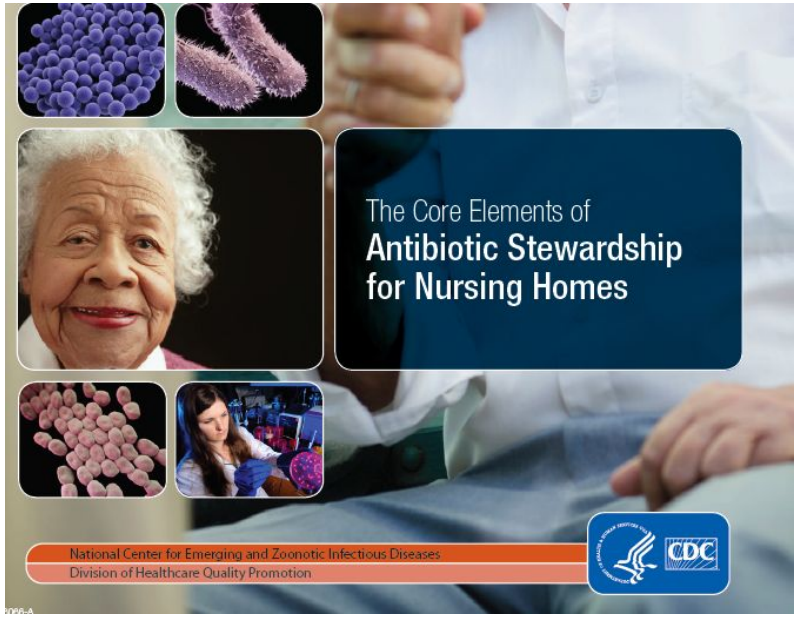
Antibiotic stewardship in nursing homes



- Leadership commitment
- Accountability
- Drug expertise
- Action to implement policies/practices
- Tracking measures
- Reporting data
- Education

- Considerations: staffing, expertise, data collection
- CMS finalized proposal → requirement for NHs to have antibiotic stewardship program
- <u>2014 survey of 175 PA LTCFs – only ~37% had an antibiotic stewardship program in place</u>

Pennsylvania Patient Safety Authority, LTCF and acute care hospital survey, 2014.

Interventions and future directions for prevention of MDROs in long-term care settings

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eXtensively
Drug
Resistant
Organism
Registry

XDRO registry

Mandatory reporting began November 1, 2013

https://www.xdro.org/img/MEMO_XDRO%20Registry_090413_Final.pdf

www.xdro.org

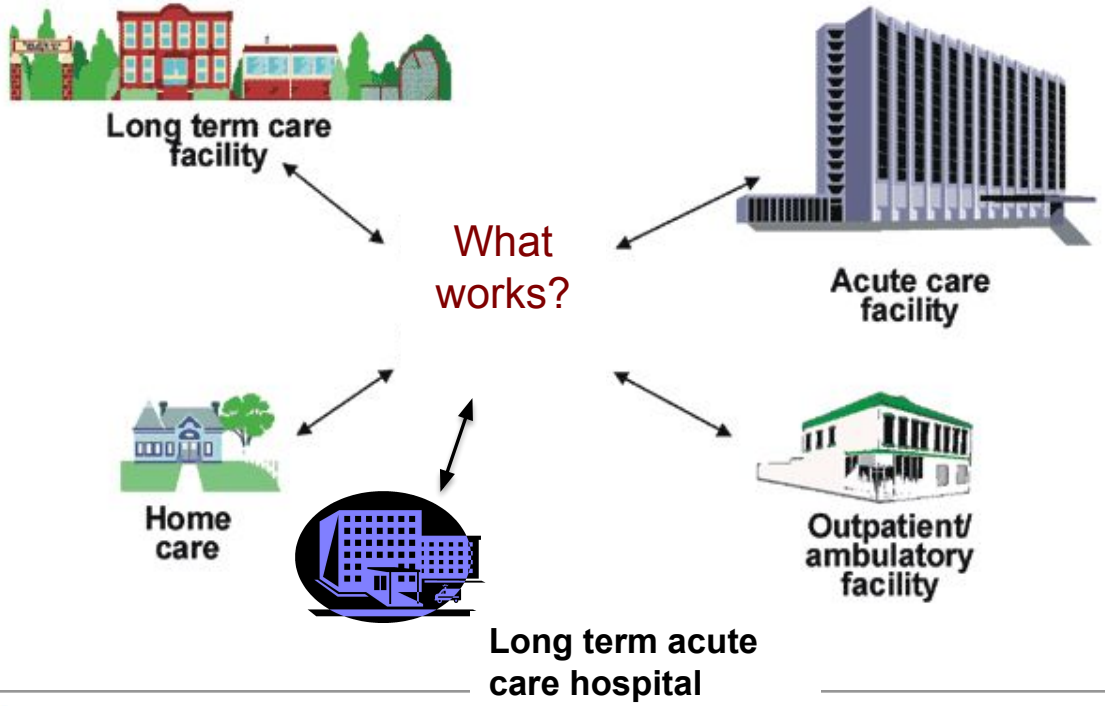
1st year: **1,557 CRE reports**

→ 115 acute care hospitals
→ 5 LTACHs
→ 46 long-term care facilities

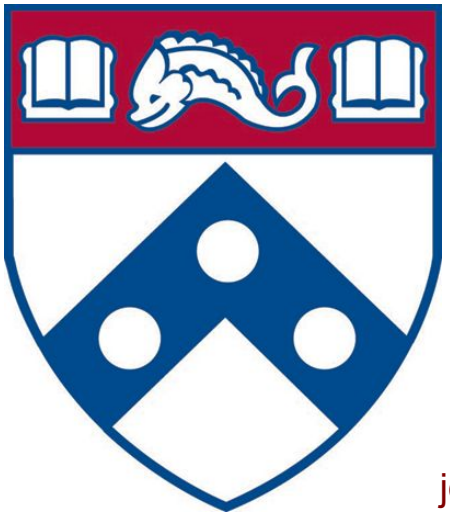
Infection Prevention Symposium: Antimicrobial Stewardship and Carbapenem-Resistant Enterobacteriaceae (CRE)

Summary

- **Increasing importance of post-acute care facilities in healthcare delivery**
- **These facilities can serve as reservoirs of major MDROs**
  - MRSA, *C. difficile*, CRE
- **Interventions and future research needed on ↓emergence of MDROs adapted to these settings**



Thank you!



jennifer.han@uphs.upenn.edu