

# Battling Superbugs: Infection Control and Multi-drug Resistant Organisms (MDROs) in Long-term Care

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for the  
Drug-Resistant Organism Prevention and Coordinated Regional Epidemiology  
(DROP-CRE) Network

# Learning Objectives

- Be familiar with the basic concepts of antibiotic resistance and infection control
- Be aware of the emerging problem of carbapenem-resistant Enterobacteriaceae (CRE) and how it relates to long-term care
- Be aware of the new DROP-CRE Network to support MDRO response in Oregon

# General Principles of Antibiotic Resistance

# Antibiotic resistance

- Genetic mutation
- Decreased susceptibility to antibiotics
- Inherent or acquired

# Why do we care about antibiotic resistance?

- Patients with resistant infections tend to have worse outcomes than patients with susceptible or no infections
  - Morbidity
  - Mortality
  - Costs

# Why the increased risk?

- Treatment failure
- Resistant bacteria are more virulent
- Fewer treatment options
  - Inappropriate antibiotic therapy
- Confounding by severity illness

# Spread of Antibiotic Resistance

- Patient-to-Patient Transmission
- Antibiotic Pressure

# Patient-to-Patient Transmission

- Direct (rare)
- Indirect
  - Healthcare workers hands or clothing
  - Fomites (e.g. environmental surfaces)

# Antibiotic selective pressure

- People are colonized with both susceptible and resistant bacteria
- Antibiotics kill antibiotic-susceptible bacteria
- Antibiotic-resistant bacteria are not killed
- Fill the void left by killed susceptible bacteria

# Infections and Antibiotic Resistance in Older People

# Older people at increased risk of acquisition and development of infections

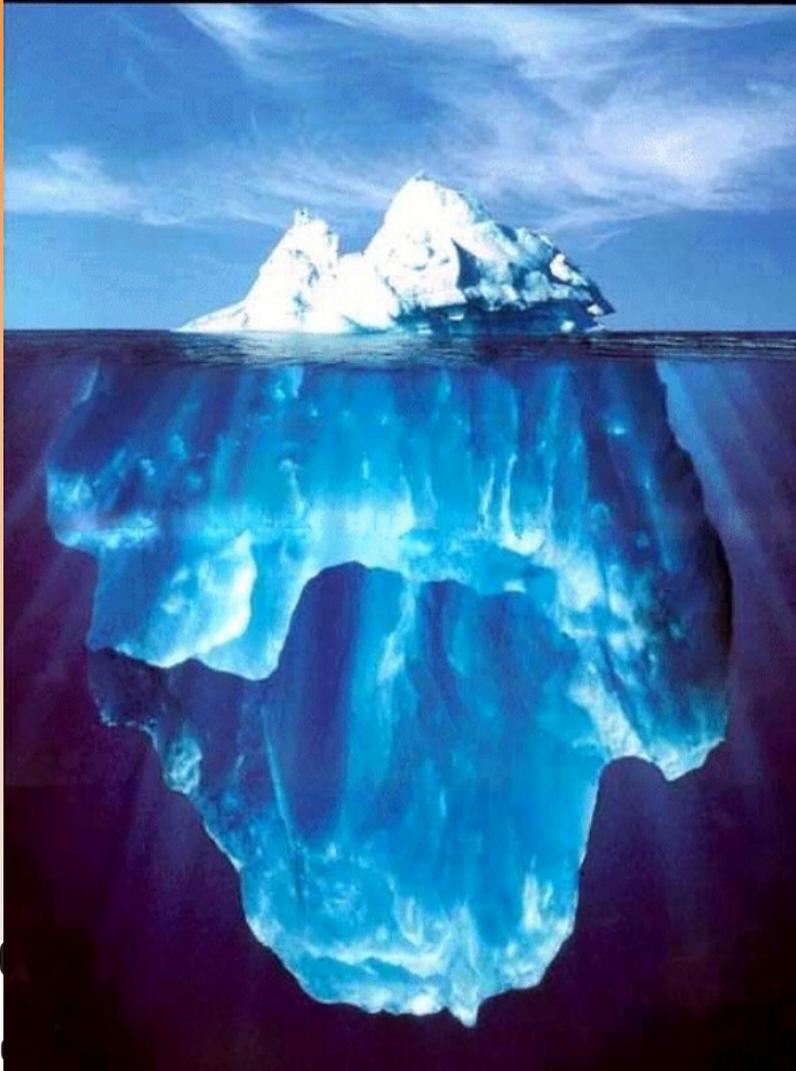
- Decreased immunity
- Increased exposure to healthcare settings
- Increased usage of broad spectrum empiric antibiotic therapy

# Other issues

- Decreased immune response and cognitive ability often mask symptoms
- Positive cultures in older people may not represent infection (e.g. urine cx)
- Certain drugs are favored because of better bioavailability (e.g. quinolones)

# General Principles of Infection Control

# Colonization and Infection



Infected patients

Colonized patients

# Types of Infection Control Interventions

- Education
- Active surveillance
- Passive surveillance
- Standard and/or Contact Precautions
- Decolonization
- Environmental Decontamination
- Antimicrobial Stewardship

# Active vs. Passive Surveillance

- Active surveillance relies on culturing patients to assess colonization and not infection
- Depending on patient population, ratio of colonized to infected will vary
- Colonized patients placed on contact isolation precautions

# 8 key elements of Standard Precautions

1. Hand hygiene
2. Personal Protective Equipment (PPE)
3. Respiratory Hygiene/Cough Etiquette
4. Safe injection practices
5. Environmental controls
6. Safe laundry practices
7. Resident placement (private/cohort)
8. Waste management

# Standard Precautions: When should hand hygiene be performed?

- 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 procedures
- Before handling sterile or clean supplies
- 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\*

# Standard Precautions: When should PPE be used?

## Gloves:

- Before any possible contact with blood or body fluids, mucous membranes (eyes, nose, mouth) or potentially infectious materials such as contaminated medical equipment or waste

## Face masks or shields

- To protect eyes during situations where blood or body fluids may spray or splatter

## Gowns

- To protect skin and clothing during situations where blood or body fluids may spray or splatter or care of resident could result in contamination of skin/clothing

# Contact Precautions

- Hand Hygiene
  - Before/after PPE use
  - During resident care as appropriate (e.g. if gloves changed)
- Use of gown and gloves for direct resident care
  - i.e. not just for potential contact with body fluids
  - Don prior to room entry
  - Remove prior to room exit
- Dedicating non-essential items for resident care
  - May help decrease transmission due to contamination
  - Blood pressure cuffs; Stethoscopes; IV poles and pumps
- Private rooms or cohorting residents if possible

# Challenges with Contact Precautions in LTC

- Lack of private rooms / limited ability to move residents
  - Moving people 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 MDRO carriage
  - Underestimating the sources of potential transmission

# Strategic placement of residents based on risk factors

- New roommate assignments on resident characteristics and history of MDRO carriage
  - Try to avoid placing two high risk residents together
  - May be safer to cohort low-risk and high-risk residents
- Don't necessarily change stable room assignments just because of a new culture result unless it now 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)

# Resident Characteristics to Consider: “5 C’s”

- Cognitive function (understands directions)
- Cooperative (willing and able to follow directions)
- Continent (of urine or stool)
- Contained (secretions, excretions or wounds)
- Cleanliness (capacity for personal hygiene)

# Consider contact precautions during direct 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

# Consider contact precautions and restricted movement within NH

- Active symptoms of a contagious infection
  - Nausea/vomiting
  - New or worsening diarrhea
  - New or worsening respiratory symptoms
  - New, undiagnosed fever
- Precautions and restrictions can be time-limited
  - Only until diagnosis made (e.g. infection excluded) and/or symptoms resolve

# Discontinuing Contact Precautions

- There is no single ‘best’ strategy for discontinuation of contact precautions for MDRO carriers (in any setting)
- Typically, would resume standard precautions once high-risk exposures or active symptoms have discontinued
- Communication to care-givers and clear documentation of rationale is key

# Practical Tips

- Maintain an ongoing database of residents with a history of prior MDRO carriage
- Incorporate assessment of risk factors for MDRO carriage or acquisition into resident care planning
- Outline protocols for implementation and discontinuation of contact precautions
- Regularly assess staff knowledge of MDRO transmission and steps for prevention
- Hand hygiene, hand hygiene, hand hygiene...

# Carbapenem-resistant Enterobacteriaceae (CRE)

# Enterobacteriaceae

- Normal human gut flora & environmental organisms
- More than 70 species
  - *E. coli*
  - *Klebsiella*
- Range of human infections: UTI, wound infections, pneumonia, bacteremia

# Carbapenem-resistant Enterobacteriaceae

- Carbapenems
  - Doripenem
  - Meropenem
  - Imipenem
  - Ertapenem
- Major Genetic Mutations
  - KPC (*Klebsiella pneumoniae* carbapenamase)
  - NDM (New Delhi metallo-beta-lactamase)



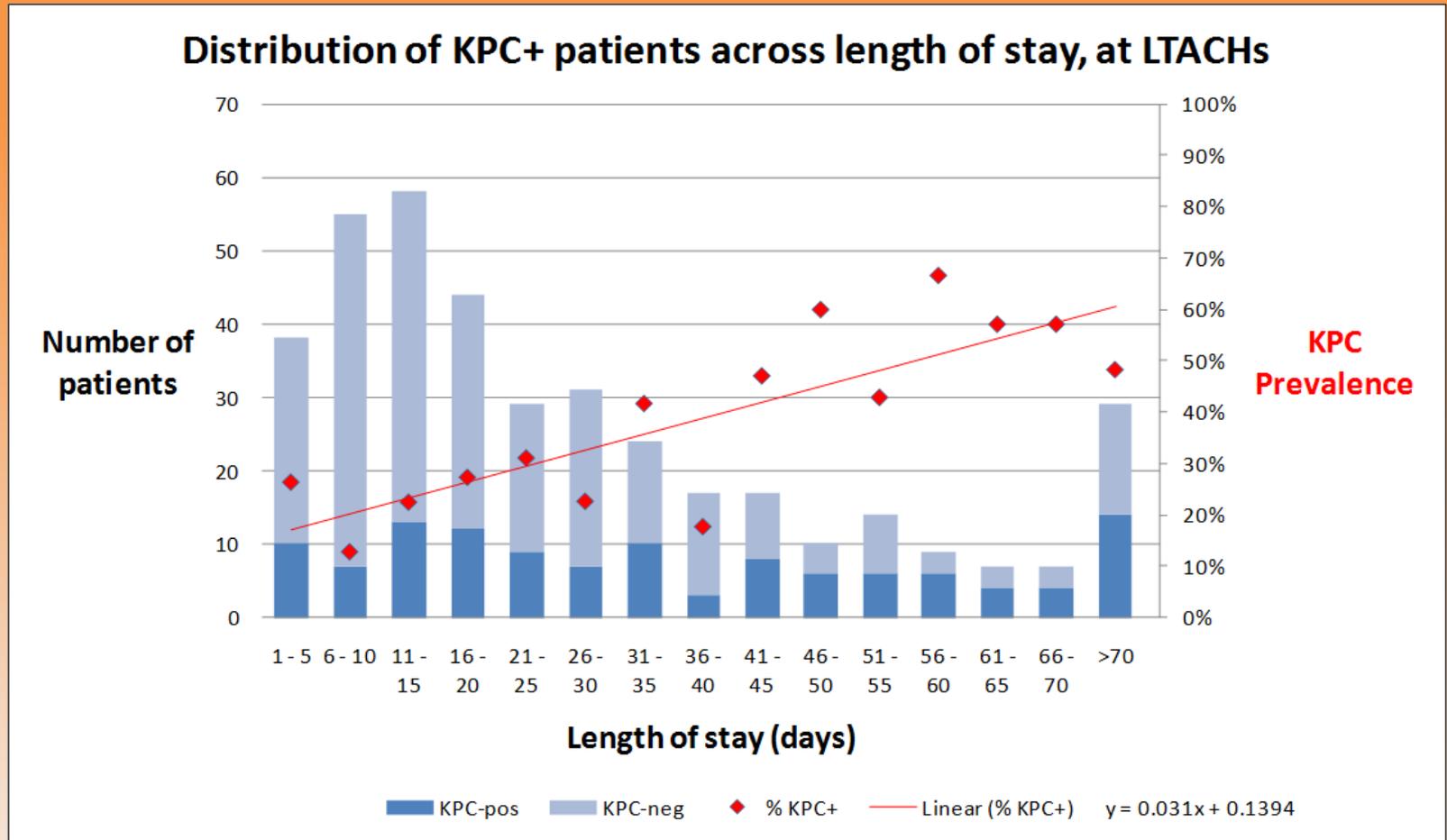




# KPC Point Prevalence Survey - Chicago

- Hospitals with >10 ICUs and 7 LTACHs
- Two point prevalence surveys (2010 and 2011)
- Results
  - All LTACHs and 15/24 hospitals had at least one patient with KPC
  - In acute care, 3.3% of patients colonized (30/909)
  - In LTACH, 30.4% of patients colonized (119/391)

# KPC Point Prevalence Survey - Chicago

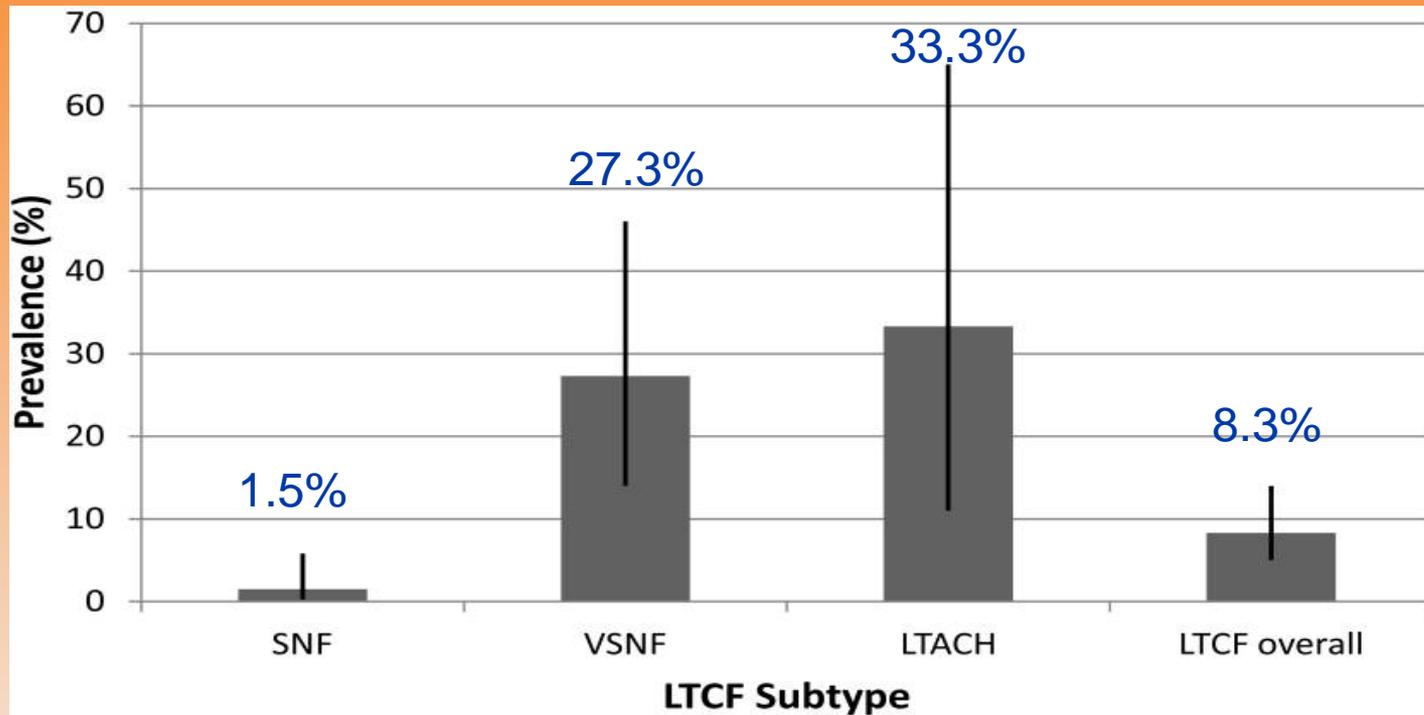


# Prevalence of CRE Colonization following transfer from LTCFs to Acute Care

- **Patients transferred to 4 acute-care hospitals**
  - 180 patients transferred from LTCFs
  - 180 patients admitted from the community (matched age, clinical service, date)
- **Rectal swabs (<3 days) to assess KPC prevalence**
- **No community patients colonized**
- **8.3% of LTCF patients were colonized**

# CRE Prevalence in LTCF: By Type

Prevalence of CRE Carriage at admission to 4 acute-care hospitals

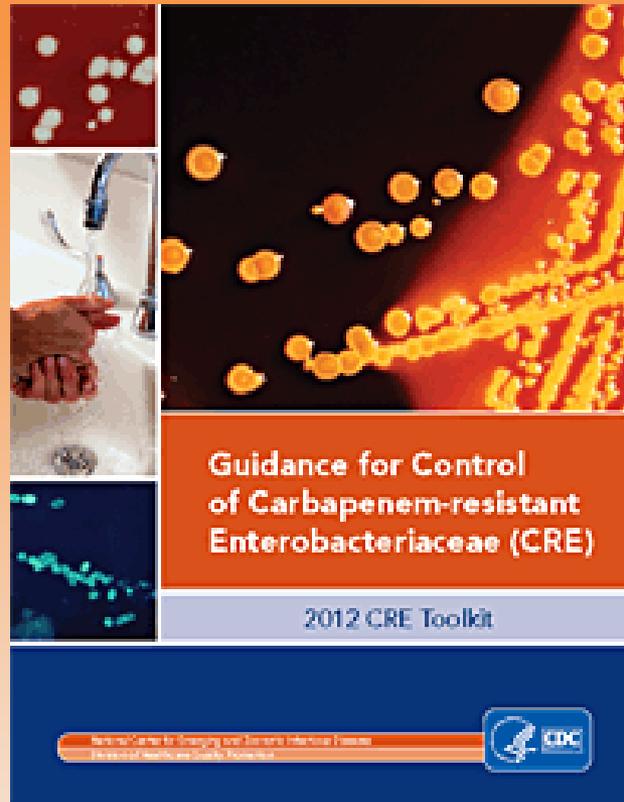


0% from those admitted to the community

# Why are CRE Clinically and Epidemiologically Important?

- Infections are associated with high mortality rates
- Resistance is highly transmissible
  - Between organisms (plasmids)
  - Between patients
- Treatment options are limited
  - Pan-resistant strains have been identified
  - Few new agents in the antibiotic pipeline
- Potential for spread into the community
  - *E. coli* common cause of community infection

# Prevention



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

# Types of Infection Control Interventions

- Education
- Active surveillance
- Passive surveillance
- Standard and/or Contact Precautions
- Decolonization
- Environmental Decontamination
- Antimicrobial Stewardship

# Surveillance and Definitions

- Facilities/Regions should have an awareness of the prevalence of CRE in their facility/region
- Should concentrate on *Klebsiella* and *E. coli*
- Definition\* (based on 2012 CLSI definitions):
  - Non-susceptible to one of the carbapenems (doripenem, meropenem, imipenem)
  - Resistant to ANY 3<sup>rd</sup> generation cephalosporins tested
  - PCR-positive or phenotypic (Modified Hodge Test) for carbapenemase

# Active Surveillance for CRE

- Used to identify unrecognized CRE colonization among contacts of CRE patients
- Stool, rectal, peri-rectal
- Link to laboratory protocol  
[http://www.cdc.gov/ncidod/dhqp/pdf/ar/Klebsiella\\_or\\_E.coli.pdf](http://www.cdc.gov/ncidod/dhqp/pdf/ar/Klebsiella_or_E.coli.pdf)
- Applicable to both acute and long-term care settings
- Description of types
  - Point prevalence survey
    - Rapid assessment of CRE Prevalence on particular wards/units
    - Might be useful if lab review identifies one or more previously unrecognized CRE patient on a particular unit
  - Screening of epidemiologically linked patients
    - Roommates
    - Patients who shared primary HCP

# Surveillance Sites

- Rectal appears to be most sensitive (68% to 97%)
- Skin (axillae/inguinal) can also be colonized with CRE and can add to sensitivity if sampled

# Sensitivity of Sites for Surveillance Culturing

TABLE 2. Sensitivity of Culture of Different Anatomic Sites for *Klebsiella pneumoniae* Carbapenemase–Producing Enterobacteriaceae

	No. of positive cultures ( <i>N</i> = 24)	Sensitivity, % (95% CI)
Skin sites		
Inguinal	19	79 (58–93)
Axillary	18	75 (53–90)
Upper back	6	25 (10–47)
Antecubital fossae	6	25 (10–47)
Nonskin sites		
Rectal <sup>a</sup>	21	88 (68–97)
Urine ( <i>N</i> = 19) <sup>b</sup>	10	53 (29–76)
Oropharyngeal/tracheal secretions	10	42 (22–63)
Combined sites		
Rectal and inguinal	24	100 (86–100)
Rectal and axillary	23	96 (79–100)
Axillary and inguinal	22	92 (73–99)

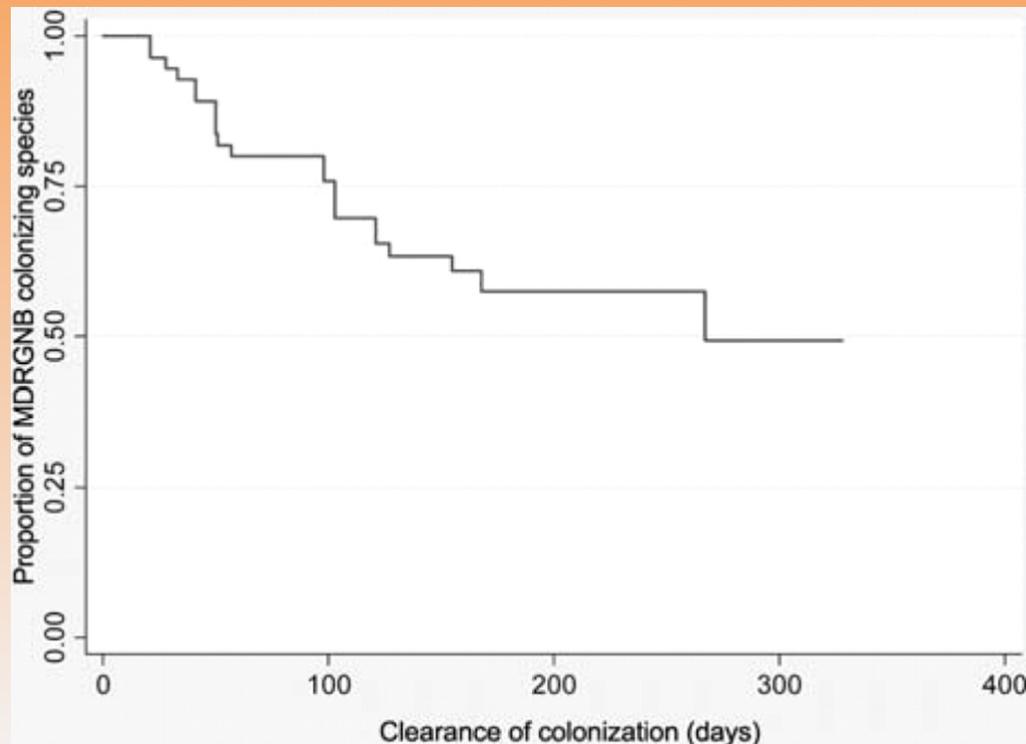
NOTE. CI, confidence interval.

<sup>a</sup> Three patients had negative rectal swab cultures but positive cultures of inguinal skin.

<sup>b</sup> Five patients were anuric, so urine was not collected for culture.

# Duration of Contact Precautions

- **33 LTCF patients colonized with MDR GNB followed for 1 year with serial (q 3 to 4 week rectal swabs)**
  - Clearance of MDR GNB in 3/33 (9%)
  - Median duration of colonization 144 days



# Chlorhexidine Bathing

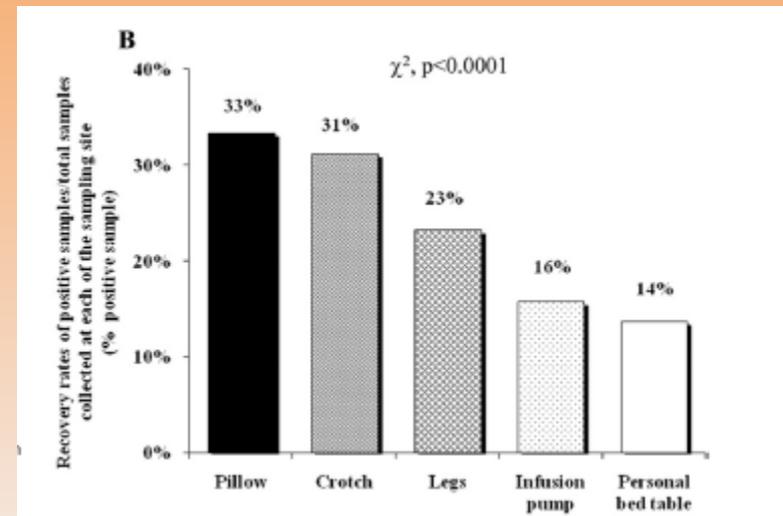
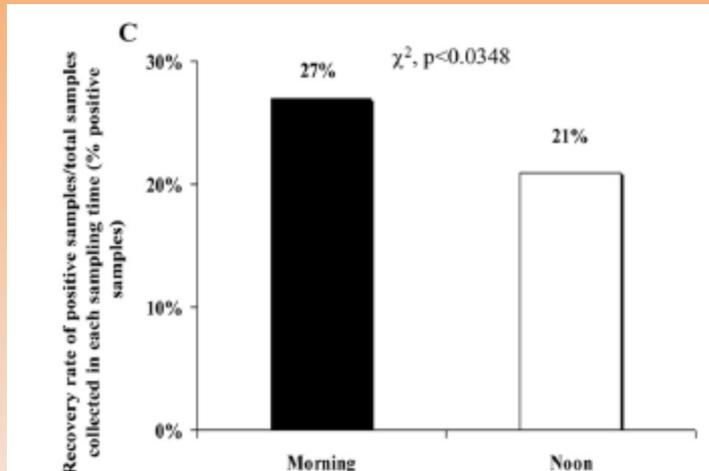
- **Limited evidence for CRE**
  - Used effectively in outbreak in LTAC as part of a package of interventions
- **Applied to all patients regardless of CRE colonization status**
- **Has shown decrease transmission of MRSA and VRE**

# Environment as Source for CRE Transmission

- **Anecdotal associations in outbreaks**
  - Equipment from physical therapy room
- **One study in 6 LTACHs included 371 environmental samples**
  - 2 (0.5%) positive for CRE
  - Bed rail and call button
  - Of note, 57 grew other CR Gram-negative bacilli (primarily *Acinetobacter baumannii*)

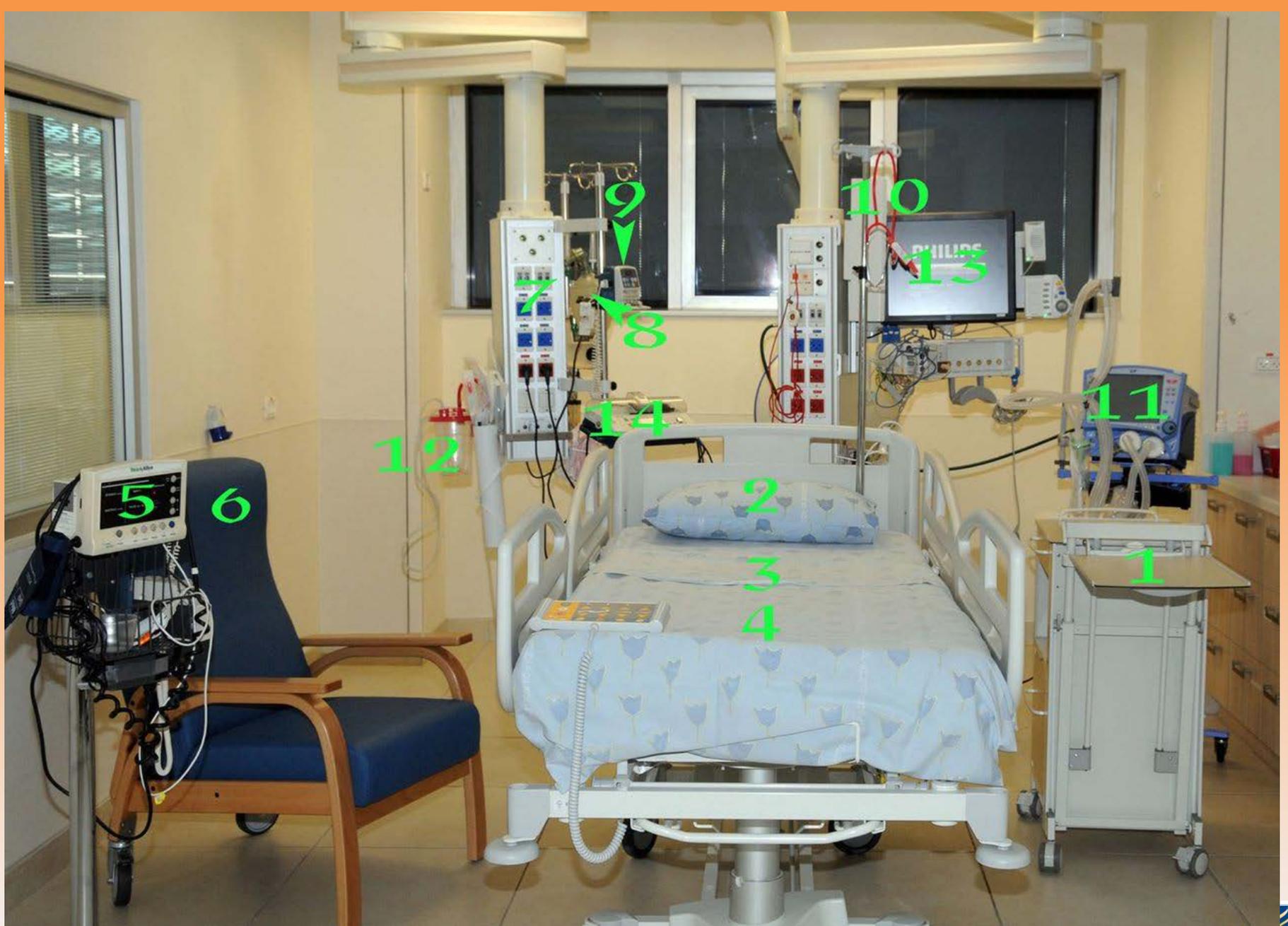
# Environment as Source for CRE Transmission

- Cultures of environmental samples from rooms of CRE carriers
- Sampled pillow, groin, legs, bedside table and infusion pump on 2 wards
  - 18% to 29% positive for CRE
- Proximity to patient and prior to cleaning predictive of



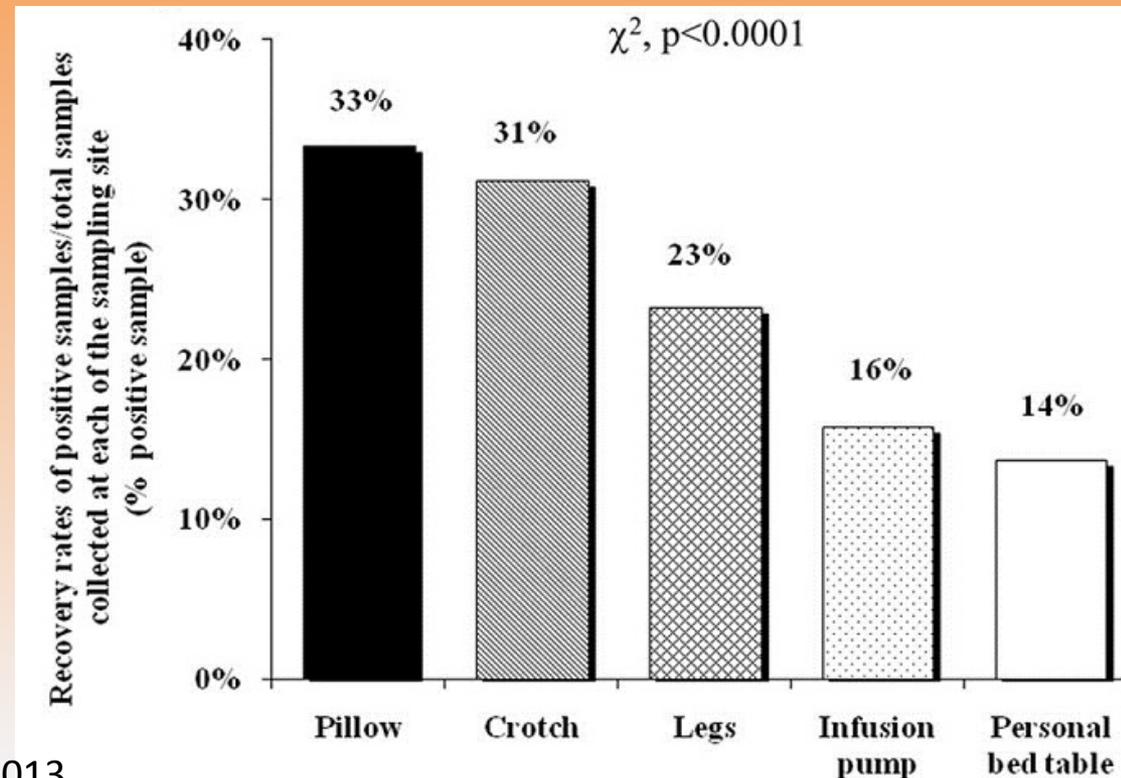
# CRE Environmental Contamination

- Acute care hospital in Israel
- Cultures of environmental sites in rooms of CRE colonized patients
- 14 sites were cultured 6 times
  - bed linen around the head (pillow), crotch, and legs
  - personal bedside table;
  - infusion pump; personal chair
  - dedicated stethoscope
  - electrical outlet line
  - suction machine; respirator
  - cardiovascular monitor screen
  - pulse oximeter
  - manual respirator bag
  - enteral feeding pump

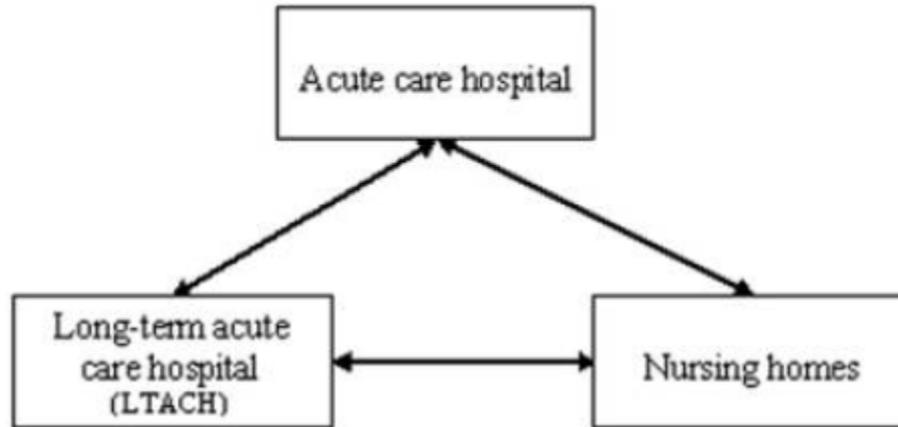


# CRE Environmental Contamination

- 5/14 sites were contaminated
- Contamination decreased with distance from the patient



# Inter-Facility Transmission of MDROs (Including CRE)



**Figure 3.** Patient flow among regional health care facilities. Outbreaks of infection with multidrug-resistant organisms have been found to follow the flow of colonized patients across institutions.

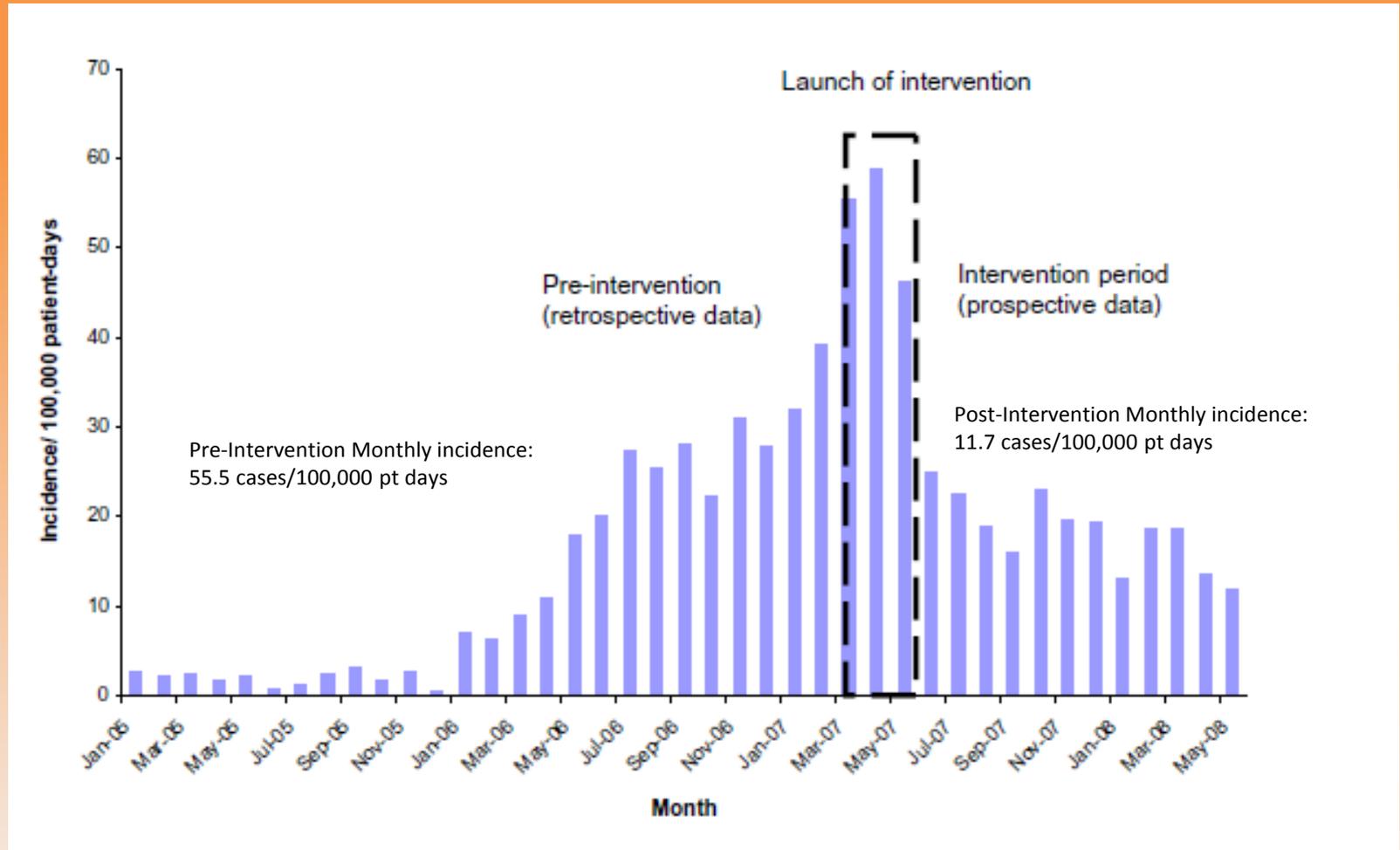
# Regional Approach to MDRO Prevention is Essential

- Successful regional coordination by public health
  - VRE control in Siouland region
  - CRE containment in Israel
- Public health well placed to facilitate/support regional prevention efforts
  - Situational awareness
  - Technical and laboratory support

# Israel Experience in CRE Containment

- KPCs likely originally from U.S. were identified in Israel beginning in late 2005
- By early 2006, an increase in cases was observed
- Initiated National effort to control CRE
  - Mandatory reporting of patients with CRE
  - Mandatory isolation (CP) of CRE patients
    - Staff and patient cohorting
  - Task Force developed with authority to collect data and intervene

# Israel Experience



# Drug-Resistant Organism Prevention and Coordinated Regional Epidemiology (DROP-CRE) Network

# DROP-CRE Network

- Initiated Sept, 2012
- **Primary Objective:** establish a statewide network to detect, control, and prevent multidrug-resistant organisms (MDROs) with an initial focus on carbapenem-resistant *Enterobacteriaceae* (CRE).
- **Spearheaded by OHA**
  - Collaboration with PVAMC/OHSU/OSU/CDC

# DROP-CRE Advisory Committee

- Primary Functions
  - Help guide Oregon’s strategy for CRE
  - Promote the DROP-CRE Network
- Our recruitment strategy: broad membership from groups potentially impacted
  - ID physicians/Hospital Epidemiologists
  - Infection Preventionists
  - Microbiologists
  - Include representatives from Long Term Care Facilities (LTCFs), OPSC, Acumentra Health, and CDC

# DROP-CRE Network Personnel

- Zintars Beldavs, MS (OHA)
- Genevieve Buser, MD (OHA)
- Margaret Cunningham, MPH (OHA)
- Tasha Poissant, MPH (OHA)
- Ann Thomas, MD, MPH (OHA)
- JJ Furuno, PhD (OSU College of Pharmacy)
- Chris Pfeiffer, MD, MHS (PVAMC, OHSU)
- John Townes, MD (OHSU)

# Advisory Committee Members

- Dianna Appelgate, MS, MPH, CIC (Sacred Heart, Springfield)
- Avanthi Doppalapudi, MD (Providence, Medford)
- Ronald Dworkin, MD (Providence, Portland)
- Kendra Gohl, RN, BSN, CIC (Columbia, Astoria)
- Alex Kallen, MD, MPH (CDC)
- Margret Oethinger, MD, PhD (Providence, Portland)
- Robert Pelz, MD, PhD (PeaceHealth, Springfield)
- Kathy Phipps, RN, BSN, CPUR (Acumentra, Portland)
- Mary Post, RN, MS, CNS, CIC (OPSC, Portland)
- Pat Preston, MS (Geriatric Infection Control)
- Sheryl Ritz, RN, BSN (Vibra, Portland)
- Susan Sharpe, PhD, DABMM, FAAM (Kaiser, Portland)
- Sarah Slaughter, MD (Providence, Portland)
- Cathy Stone, MT, CIC (Good Samaritan, Corvallis)

# DROP-CRE Network: 2012-13

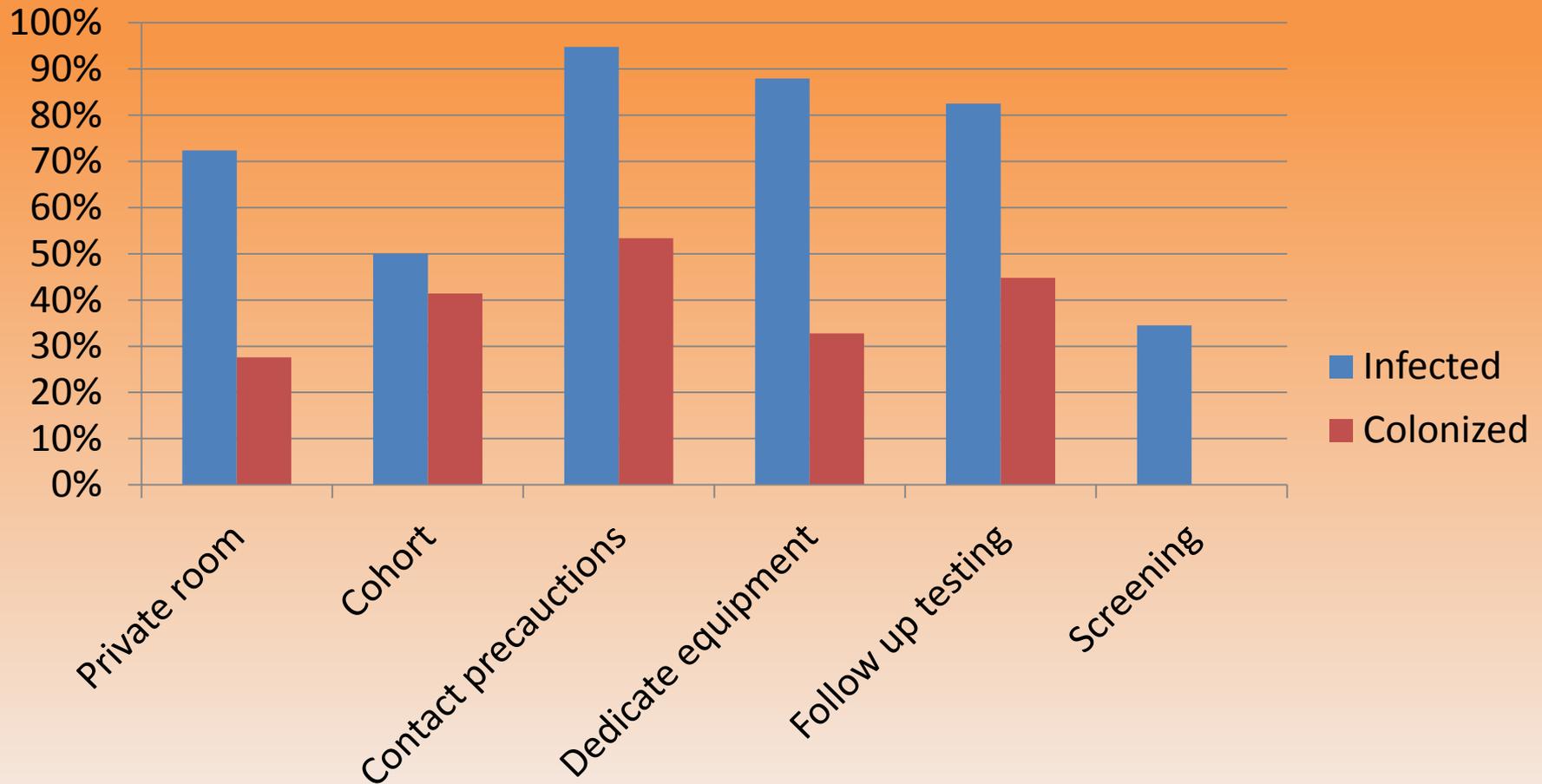
## Goals/Accomplishments

1. Assess statewide needs and capabilities for MDRO/CRE response in acute care hospitals, microbiology laboratories, and LTCFs. **(completed)**
2. Coordinate statewide CRE education.
3. Develop capacity for rapid CRE identification.
4. Offer real-time epidemiologic outbreak assistance to Oregon facilities with CRE.
5. Track CRE regionally between facilities.

# LTCF Needs Assessment: Facility Characteristics

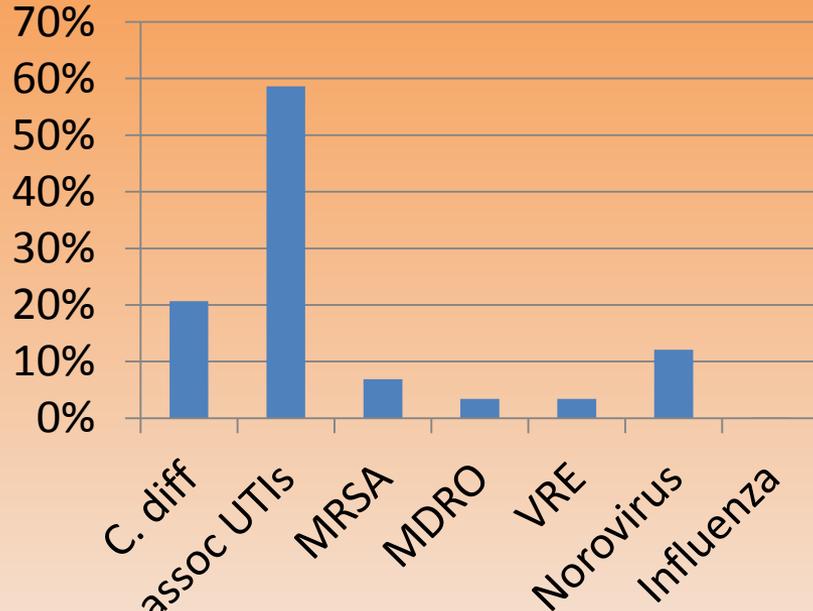
- We conducted a needs assessment of Oregon LTCFs
- 58/140 completed survey

# LTCF Needs Assessment: Infection Control Policies

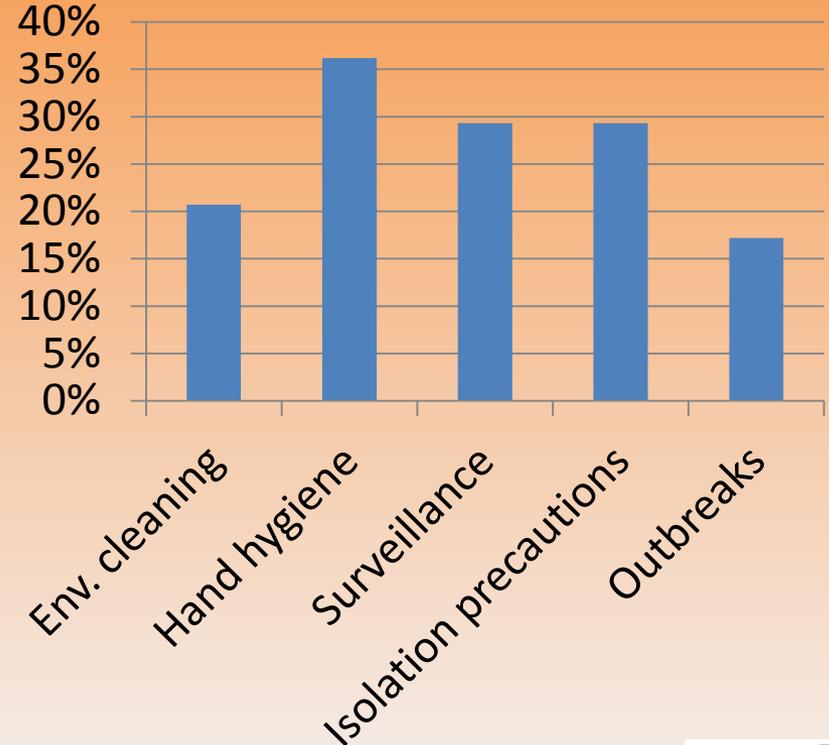


# LTCF Needs Assessment: Major Concerns

## Most difficult HAIs to prevent



## Most challenging aspect of infection control



# CRE Education

- Invited Speakers to Oregon
- Speaking engagements for DROP-CRE Network Personnel around Oregon
- Oregon CRE Toolkit (coming soon)
  - Patient education
  - Staff education
  - Specific long-term care section
- CD Summary (Spring 2013)
- Ideally: develop website with CRE slidesets for tailored education to groups impacted

# Rapid CRE Identification

- Worked with Oregon State Public Health Laboratory (Dr. Robert Vega) to develop real-time capacity to perform:
  - Modified Hodge Test
  - PCR (coming soon)
- Considering other collaborations for more detailed molecular testing

# Real-time Outbreak Assistance

- When CRE is reported, our objectives are:
  - Support the local facility as needed via phone or on-site consultation
  - Ensure a standardized statewide approach to infection prevention and control response
- Hence, we created the “Oregon CRE Toolkit”

# Oregon CRE Toolkit (Available April 2013)

1. Overview of the Toolkit
- 2. Definition(s)**
3. Prevention and Control in Acute Care
4. Prevention and Control in Long Term Care
5. Microbiology Laboratories: Detection/Reporting
6. References
7. Appendices (Lab Protocols, CRE FAQ, inter-facility transfer form)

# Real-time Outbreak Assistance

- In December, we assisted with:
  - One CRE case (LTCF → acute care facility → LTCF)
  - One other MDRO cluster
- Additional point prevalence studies are planned

# Regional tracking of CRE

- We developed a statewide database for improved central tracking of CRE
- We developed a relatively simple Inter-Facility Transfer Form for use in CRE cases
- We have discussed potential expansion to a larger regional collaboration (i.e. West Coast)

# Regional tracking of CRE

- Statewide CRE database
- Inter-Facility Transfer form
- Collaboration with neighboring state health departments

# Summary

- MDROs and infection control are/will continue to be a constant battle
- Carbapenem resistance among Enterobacteriaceae appears to be increasing
- A regional approach to MDRO prevention is required
  - Public health well-positioned to facilitate and support regional prevention efforts
- Resources and assistance are available in Oregon to assist with this prevention

# Acknowledgements\*

- Alex Kallen, MD, MPH
- Chris Pfeiffer, MD, MHS
- Nimale Stone, MD, MPH

\*people who let me use their slides