



Beatrice the Biologist

Multi-drug Resistant Organisms – Prevention and Response

November 16, 2017
NC SHARPPS

Objectives

- Describe the SHARPPS program
- Discuss multi-drug resistant organisms and the public health significance of these organisms across the continuum of care
- Describe the role of public health in investigating cases and outbreaks in healthcare facilities

SHARPPS

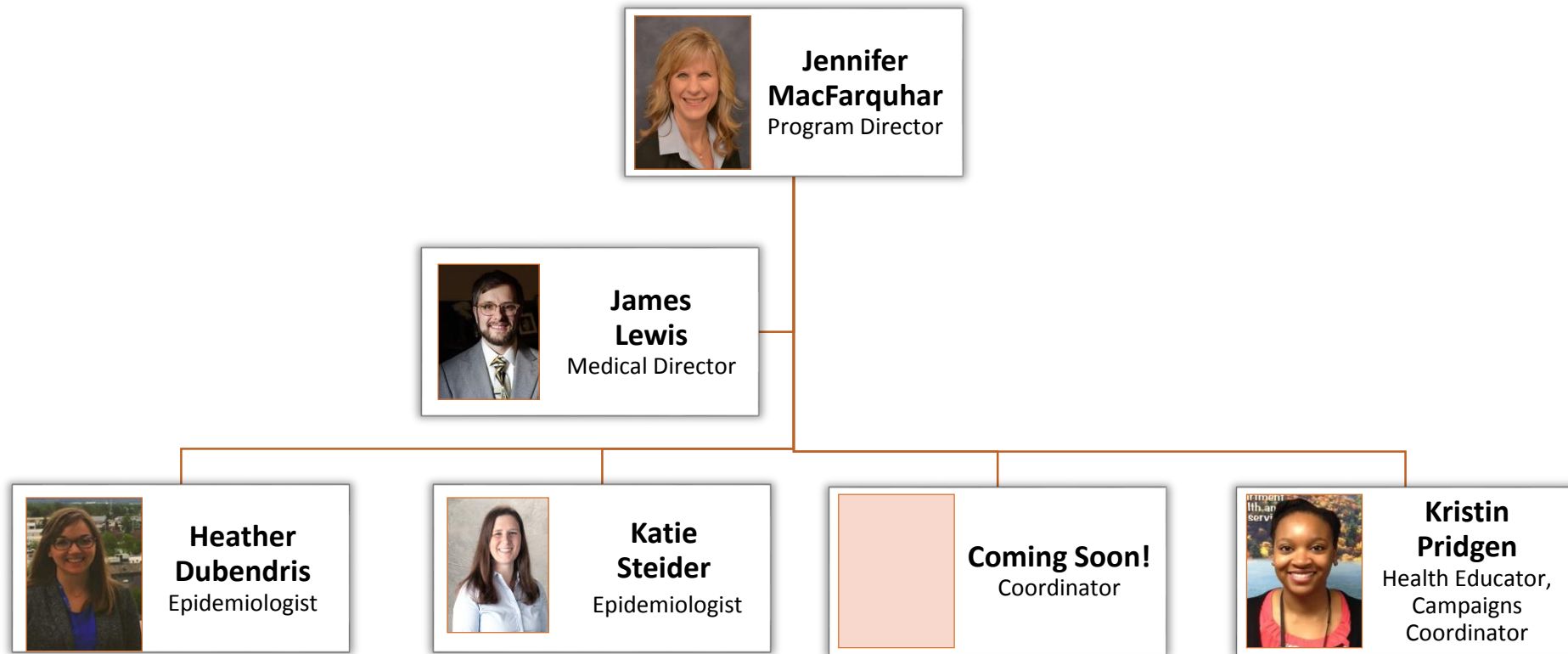
*Surveillance for Healthcare Associated & Resistant
Pathogens Patient Safety Program*

Mission

To work in partnerships to prevent, detect, and respond to events and outbreaks of healthcare-associated and antimicrobial resistant infections in North Carolina.

SHARPPS

Surveillance for Healthcare Associated & Resistant Pathogens Patient Safety Program



SHARPPS

Surveillance for Healthcare Associated & Resistant Pathogens Patient Safety Program

Surveillance, Investigation & Response

HAI reporting to
NHSN

CRE surveillance

DHSR Infection
Prevention Breach
reporting

Outbreak &
Exposure
management

Prevention, Education & Training

Campaigns: One &
Only, Get Smart

Drug Diversion

Antimicrobial
resistance &
stewardship

Infection Control,
Assessment &
Response (ICAR)

Partnerships

Monitoring & Evaluation

Data validation

TAP reports

Identification,
evaluation of
aberrant data
(CLABSI, CDI)

Communication

HAI data reports

Newsletters

Monthly webinar
updates

Drug Diversion
tabletop

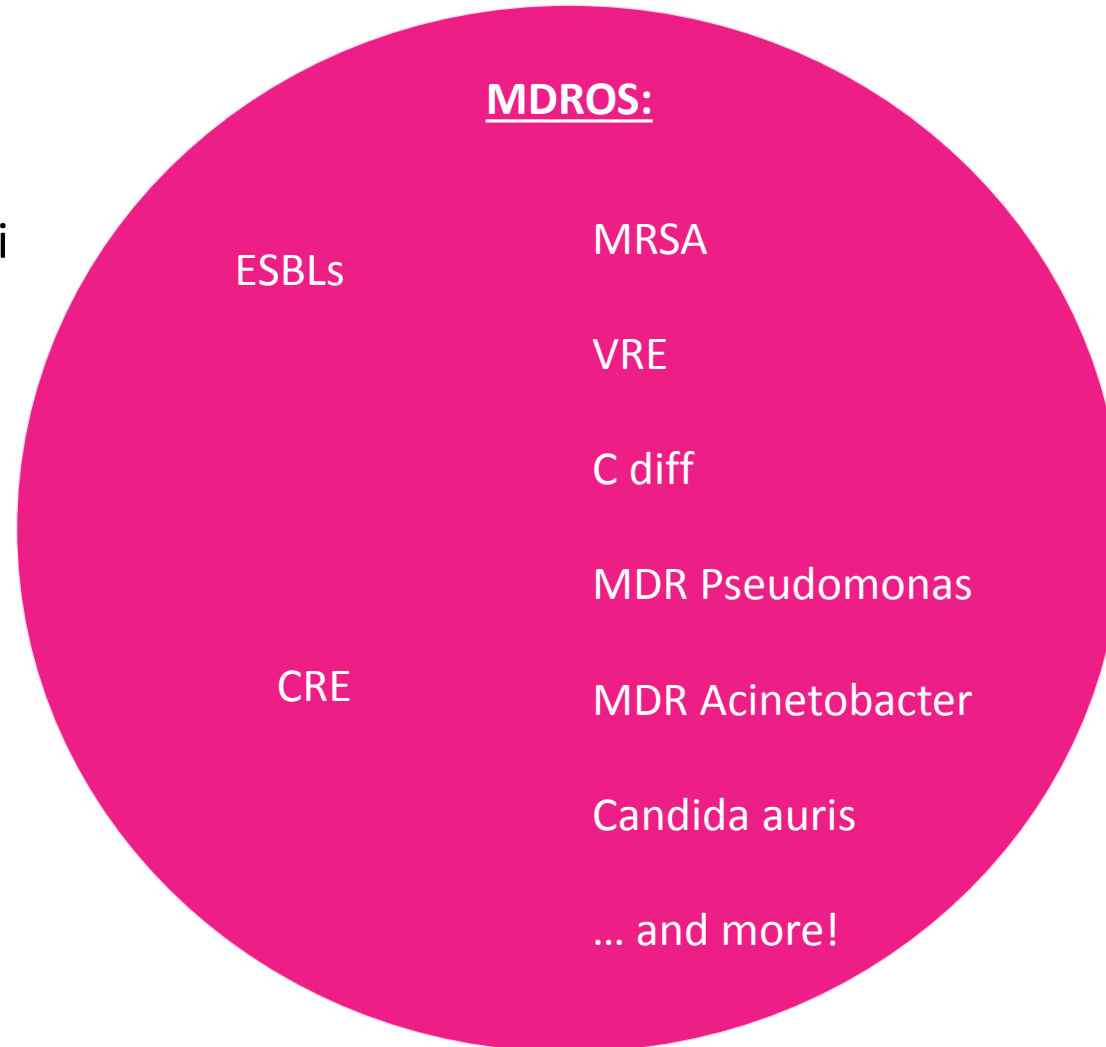
Defining MDROs

Multidrug-Resistant Organisms (MDROs)



Multidrug resistant organisms (MDROs)- Organisms that have become resistant to multiple types of antimicrobials. Many organisms can become drug resistant, some common examples are in the figure below:

- **CRE** - Carbapenem-Resistant Enterobacteriaceae
- **VRE** - Vancomycin-Resistant Enterococci
- **C Diff** - *Clostridium difficile*
- **ESBLs**- Extended Spectrum Beta-Lactamase Producers
- **MRSA** - Methicillin-resistant *Staphylococcus aureus*
- **MDR Acinetobacter** - Multi-drug resistant *Acinetobacter*
- **MDR Pseudomonas** - Multi-drug resistant *Pseudomonas*



Extended-Spectrum Beta-Lactamases (ESBLs)

- Enzyme → Produced by Gram-negative bacteria
- Difficult to treat
- Endemic in United States
 - Can be community acquired
- Spread via direct and indirect contact with colonized/infected patients and contaminated environmental surfaces.
- **Improper treatment → organisms may produce another enzyme called carbapenemase**



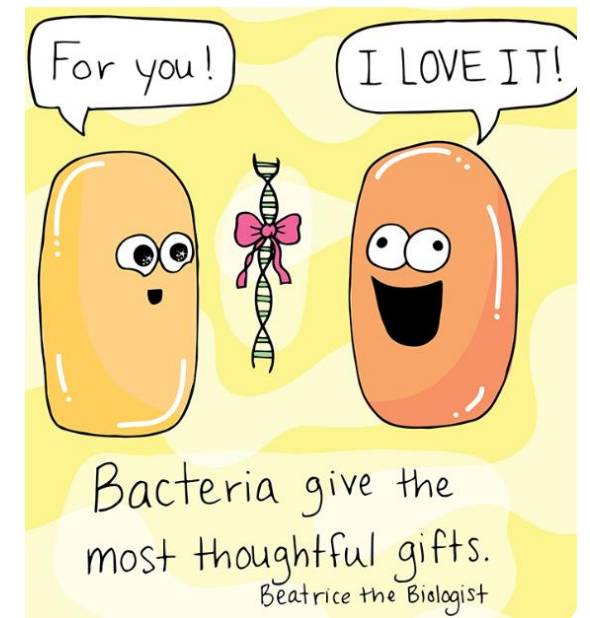
Carbapenem-Resistant Enterobacteriaceae (CRE)

- First recognized in US in 2001
- Enterobacteriaceae = gut bacteria
 - *Klebsiella spp.*
 - *E. Coli*
 - *Enterobacter spp.*
- Resistant to nearly all antibiotics
- Many ways to be resistant
 - Carbapenemase producing CRE (CP CRE)
 - Klebsiella pneumoniae carbapenemase (KPC),
 - New Delhi metallo- β -lactamase (NDM),
 - Verona integron encoded metallo- β -lactamase (VIM),
 - Imipenemase metallo- β -lactamase (IMP)
 - Oxacillinase-48 (OXA-48)

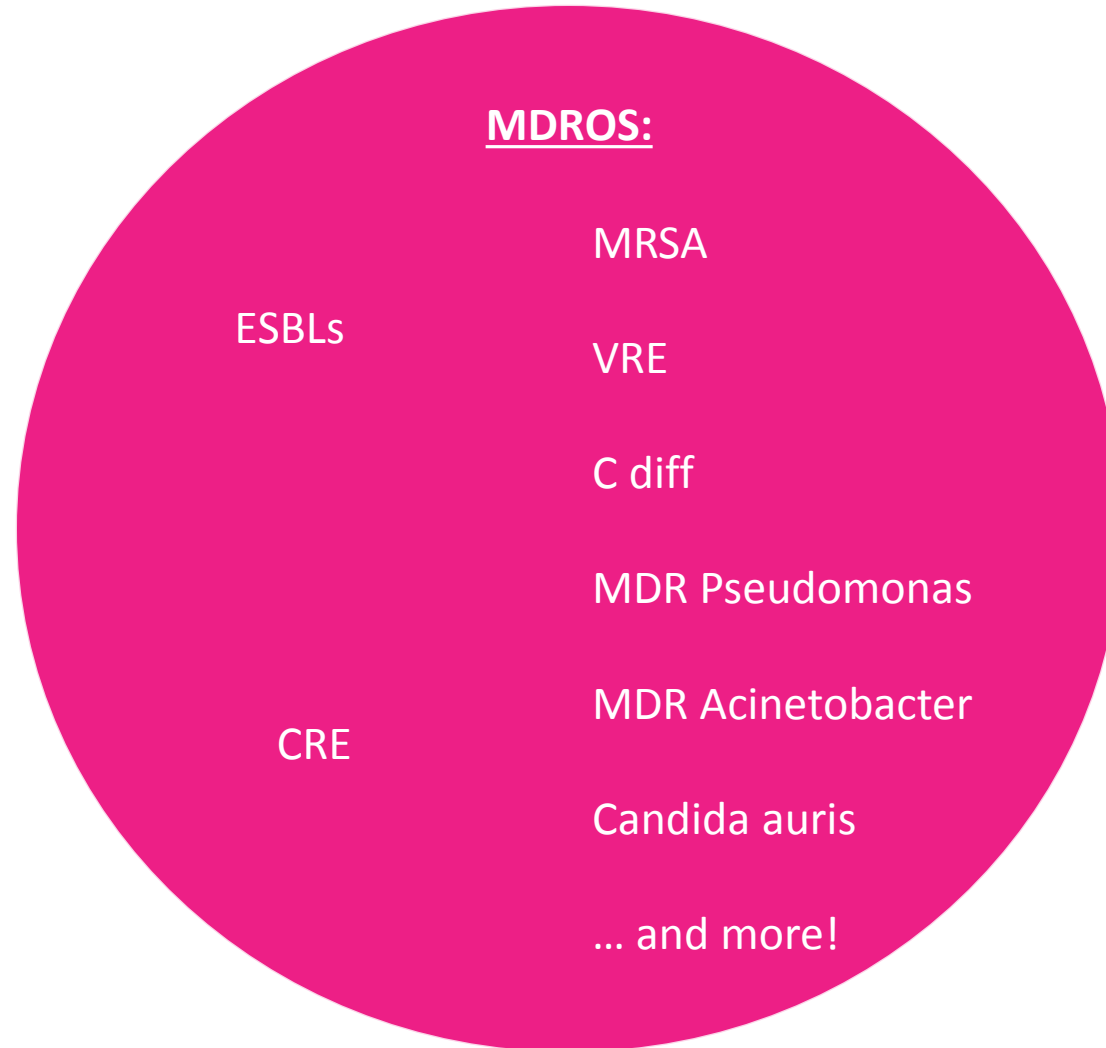


Public Health Significance of Carbapenemase Producing CRE

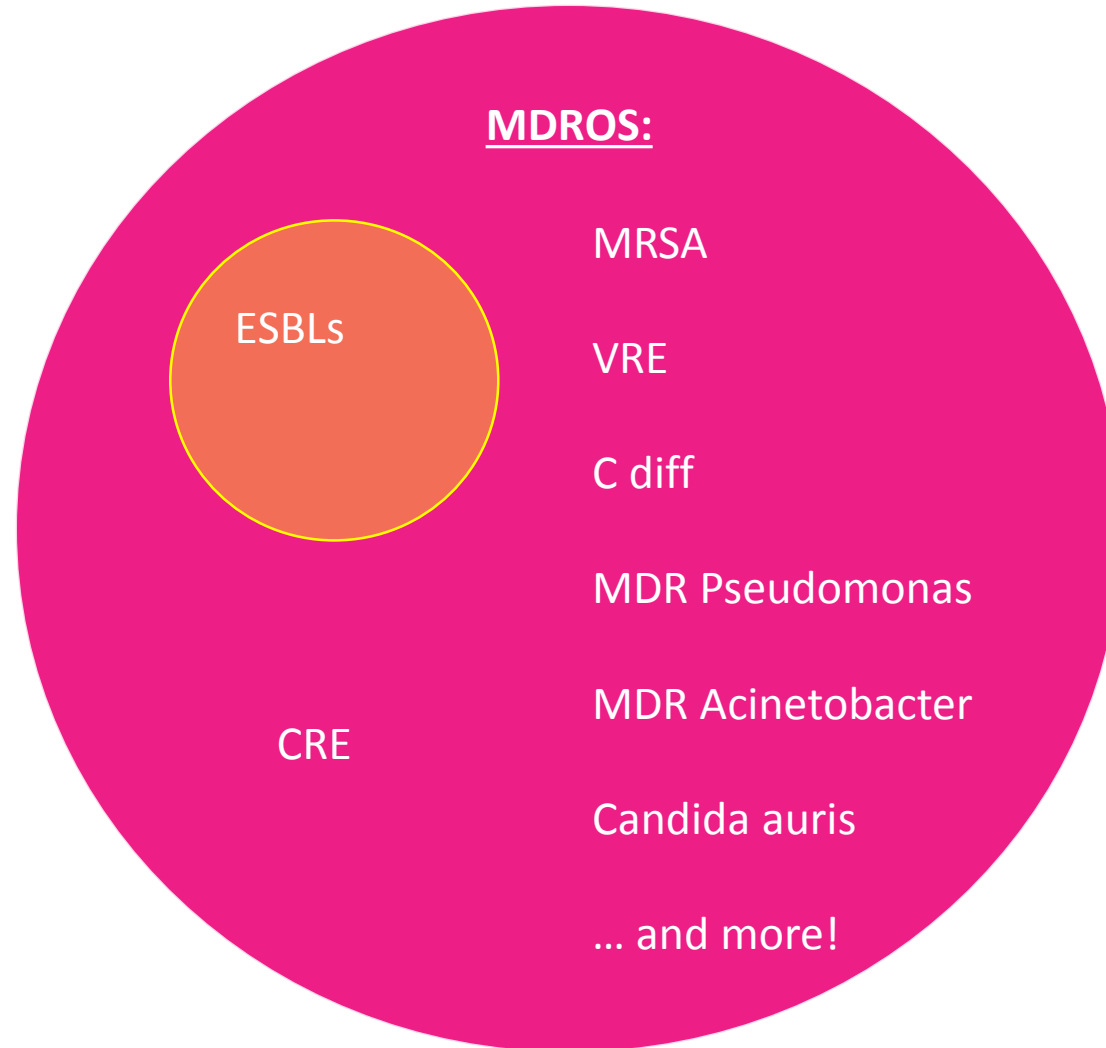
- “Urgent public health threat” - CDC
- Highly resistant
- Mobile resistance elements
- >9,000 healthcare-associated infections each year
- Up to 50% mortality



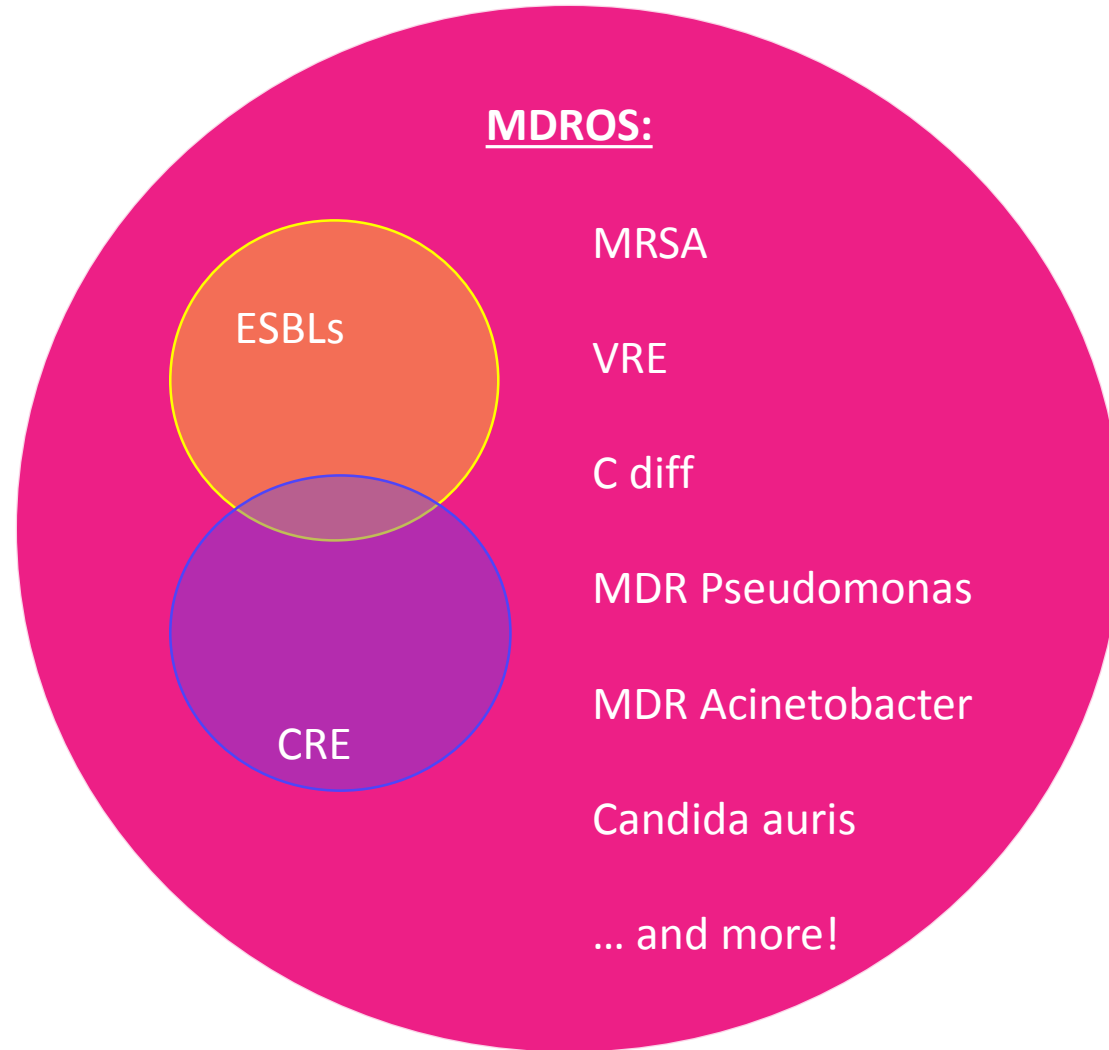
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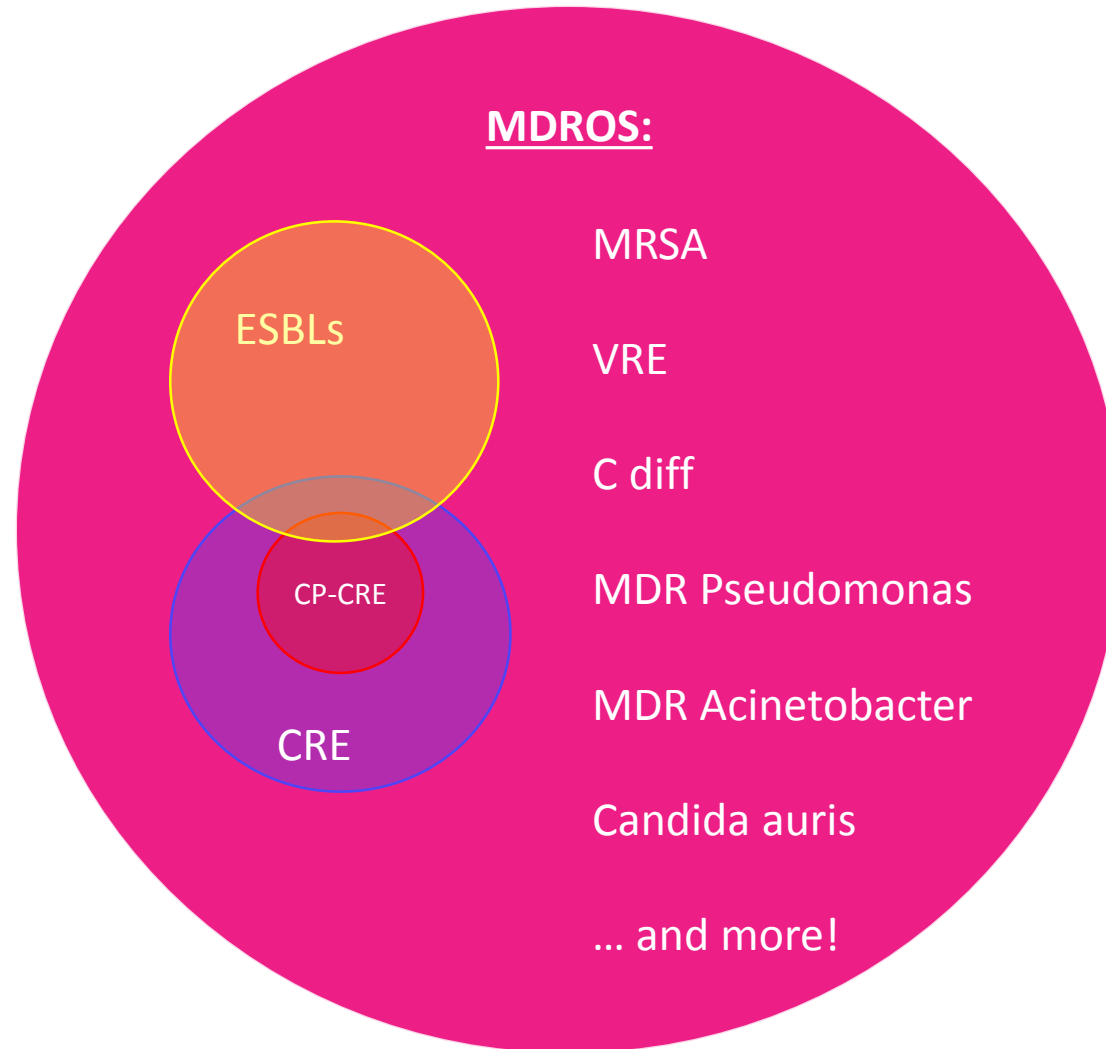
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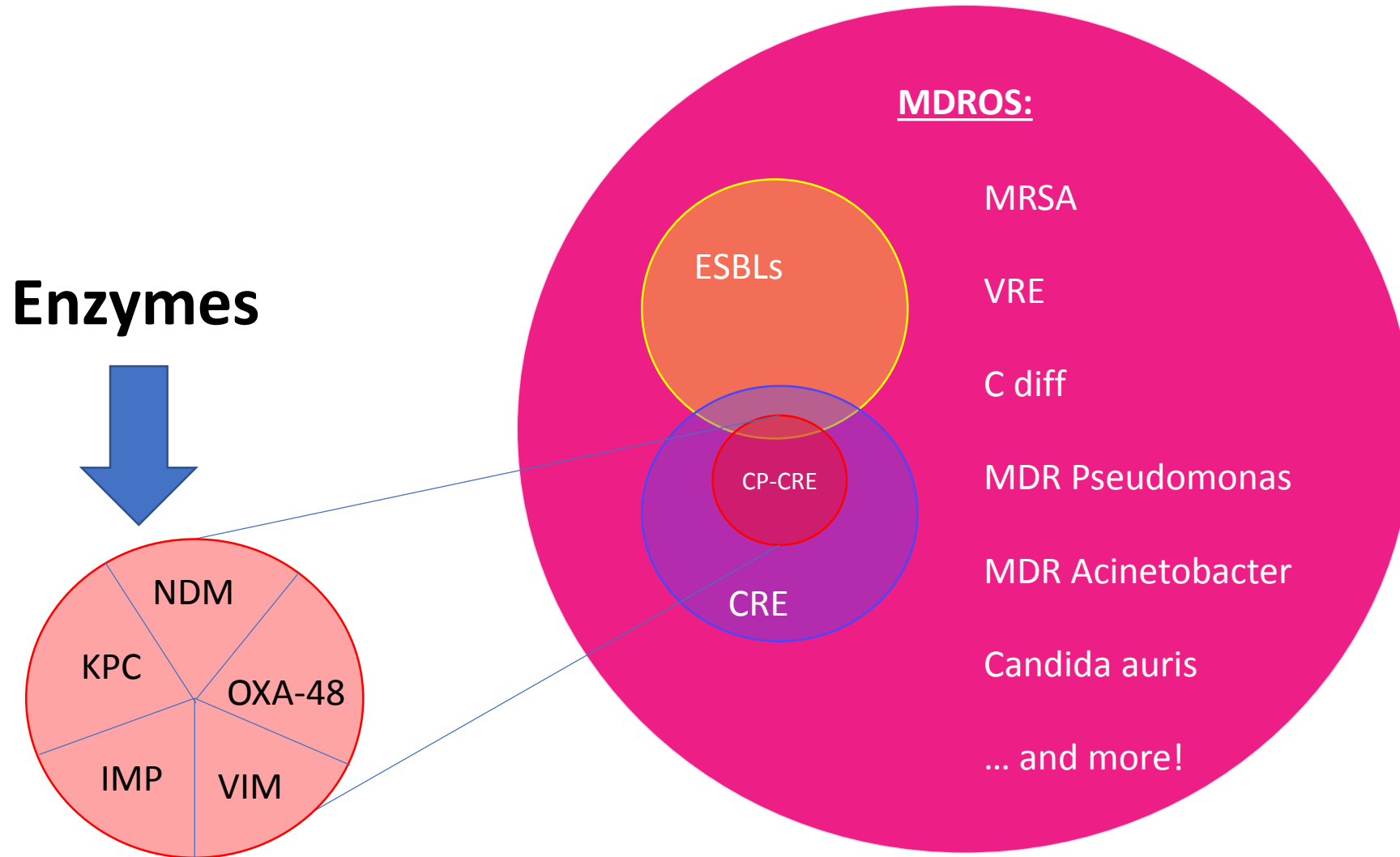
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Multidrug resistant organisms (MDROs)- Organisms that have become resistant to multiple types of antimicrobials. Many organisms can become drug resistant, some common examples are in the figure below:



CRE - Carbapenem-Resistant Enterobacteriaceae; CP-CRE- Carbapenemase producing CRE; VRE- Vancomycin-Resistant Enterococci; C Diff - *Clostridium difficile*; ESBLs- Extended Spectrum Beta-Lactamase Producers; MRSA - Methicillin-resistant *Staphylococcus aureus*; MDR Acinetobacter- Multi-drug resistant *Acinetobacter*; MDR Pseudomonas- Multi-drug resistant *Pseudomonas*

Responding to MDROs

What is a healthcare facility?

- Long-term care
- Skilled-nursing
- Hospital
- Dental office
- Dialysis
- Outpatient

Why are investigations in healthcare facilities different?

- Vulnerable population
 - Increased Incidence
 - Higher mortality
- Common source
- Communal living
- Can be initiated or propagated by activities, staff, or other characteristics of the facility

We investigate to prevent, or stop, an outbreak



CRE Case Investigation: Goals

- Identify if transmission/dissemination is occurring
- Identify affected patients
- Ensure appropriate control measures are promptly implemented
- Characterize the organism

CRE Case Investigation: Components

- Initial investigation
 - Healthcare/community exposures
- Infection control considerations
- Contact Investigation
 - Healthcare
 - Healthcare personnel
 - Household
- Prospective laboratory surveillance (clinical cultures)

10 Steps of an Outbreak Investigation

1. Identify investigation team and resources
2. Establish existence of an outbreak
3. Verify the diagnosis
4. Construct case definition
5. Case finding: Find cases systematically / develop line list
6. Perform descriptive epidemiology / develop hypotheses
7. Evaluate hypotheses / perform additional studies (as necessary)
8. Implement control measures
9. Communicate findings
10. Maintain surveillance

Verify the diagnosis

Confirm that a case meets the case definition by reviewing the isolate's susceptibility information

What am I looking for?

- Organism identification
 - May use a culture or “NAAT” (“nucleic acid amplification test”)
- Antimicrobial susceptibility results
 - Also called “MICs” (“minimum inhibitory concentration”) with “interps” (“interpretation”)

CRE

CDC case definition: Enterobacteriaceae resistant to imipenem, meropenem, doripenem, or ertapenem OR documentation that the isolate possesses a carbapenemase

<https://www.cdc.gov/hai/organisms/cre/definition.html>

CRE

CDC case definition: **Enterobacteriaceae resistant to imipenem, meropenem, doripenem, or ertapenem OR documentation that the isolate possesses a carbapenemase**

What do you think?

Order CULTURE, URINE [URC] (Order 308868132)

Ordering Provider

Authorizing
[REDACTED]

Acknowledgement Info

| | | | |
|-------------------|------------------|----------------------------|------------------------------------|
| For Placing Order | At 05/17/17 1927 | Acknowledged By [REDACTED] | Acknowledged On 05/17/17 1957 |
| Task Unit Sec Ack | | Completed by [REDACTED] | Date/Time Wed May 17, 2017 7:29 PM |

Order Info

| | | |
|----------------|----------------------|---|
| Priority: STAT | Start: 05/17/17 1927 | Process Instructions: ** Minimum Specimen Requirements: 25 ML Urine ** **Submit urine in a container with NO preservative** **Use Orange Screw-capped urine cup, White Screw-caped urine tube or Red top tubes** |
|----------------|----------------------|---|

Order Frequency

| Antibiotic | | Organism | Organism |
|--------------------------|-----|--------------------------------------|----------|
| | | >100,000 cfu/ml enterobacter cloacae | |
| AMP/SULBACTAM | MIC | RESISTANT | Final |
| AMPICILLIN | MIC | RESISTANT | Final |
| AUGMENTIN | MIC | RESISTANT | Final |
| CIPROFLOXACIN | MIC | RESISTANT | Final |
| ERTAPENEM | MIC | RESISTANT | Final |
| GENTAMICIN | MIC | SUSCEPTIBLE | Final |
| NITROFURANTOIN | MIC | SUSCEPTIBLE | Final |
| PIPERACILLIN/TAZOBACTAM | MIC | RESISTANT | Final |
| TRIMETH-SULFAMETHOXAZOLE | MIC | SUSCEPTIBLE | Final |

Lab and Collection

CULTURE, URINE on 6/3/2017

Result History

CULTURE, URINE on 6/6/2017

Reviewed by List

[REDACTED]

View SmartLink Info

Culture,Urine (Order #308868172) on 6/3/17

Ordering Provider NPI ID:

What do you think?

- Organism
- Susceptibility

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- Susceptibility

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| Reviewed by List | | | |
| [REDACTED] | | | |
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What do you think?

- CRE
 - Organism = *Enterobacter cloacae*
 - Resistant to ertapenem

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Microbiology Report

VIDANT DUPLIN HOSPITAL

401 North Main Street
Kenansville, NC 28349

| Name | Specimen | SWAB | Status | Final |
|---------------|-------------|-------------|-------------|-----------|
| Patient ID | Source | RECTAL SWAB | Status Date | 7/27/2017 |
| Date of Birth | Ward of leo | | Collected | |
| Attd. Phys | | | Req Phys | |

| | | | | |
|---|------------------------------|--|---------------|-----------|
| 1 | Klebsiella oxytoca | | Status: Final | 7/24/2017 |
| 2 | Escherichia coli | | Status: Final | 7/27/2017 |
| 3 | Escherichia coli ESBL | | Status: Final | 7/27/2017 |

| 1 K. oxytoca | | | 2 E. coli | | |
|------------------|-----------------|----------|------------------|-----------------|----------|
| Drug | MIC | Interp | Drug | MIC | Interp |
| Amp/Sulbactam | <=8/4 | S | Amp/Sulbactam | 16/8 | I |
| Ampicillin | >16 | R | Ampicillin | >16 | R |
| Cefazolin | 16 | I | Cefazolin | 4 | S |
| Cefepime | <=2 | S | Cefepime | <=2 | S |
| Cefotaxime | <=2 | S | Cefotaxime | <=2 | S |
| Cefotaxime-ESBL | <=1 | S | Cefotaxime-ESBL | <=1 | S |
| Ceftriaxone | <=1 | S | Ceftriaxone | <=1 | S |
| Ciprofloxacin | <=1 | S | Ciprofloxacin | <=1 | S |
| Ertapenem | <=0.5 | S | Ertapenem | <=0.5 | S |
| Gentamicin | <=4 | S | Gentamicin | <=4 | S |
| Meropenem | <=1 | S | Meropenem | <=1 | S |
| Pip/Tazo | <=16 | S | Pip/Tazo | <=16 | S |
| Trimeth/Sulfa | <=2/38 | S | Trimeth/Sulfa | <=2/38 | S |

| β E. coli ESBL | | |
|------------------|-----------------|----------|
| Drug | MIC | Interp |
| Amikacin | <=8 | S |
| Amp/Sulbactam | >16/8 | R |
| Ampicillin | >16 | R* |
| Cefazolin | >16 | R* |
| Cefepime | >16 | R* |
| Cefotaxime | >32 | ESBL |
| Cefotaxime-ESBL | >1 | ESBL |
| Ceftriaxone | >32 | ESBL |
| Ciprofloxacin | >2 | R |
| Ertapenem | <=0.5 | S |
| Gentamicin | >8 | R |
| Meropenem | <=1 | S |
| Pip/Tazo | <=16 | S |
| Tobramycin | >8 | R |
| Trimeth/Sulfa | >2/38 | R |

S = Susceptible NR = Not Reported Blank = Data not available, or drug not advisable or tested
 I = Intermediate -- = Not Tested ESBL = Extended spectrum beta-lactamase
 R = Resistant POS = Positive Sfo = Beta-lactamase positive
 MIC = mcg/ml (µg/L) NEG = Negative TFG = Thymidine-dependent strain

S* = Predicted susceptible interpretation
 R* = Predicted resistant interpretation
 ESBL = Suspected ESBL. Confirmatory tests needed to differentiate ESBL from other beta-lactamase
 IB = Inducible beta-lactamase. Appears in place of "Susceptible" with species known to possess inducible beta-lactamase; potentially they may become resistant to all beta-lactam drugs. Monitoring of patients during/after therapy is recommended. Avoid other/combined beta-lactam drugs.

* = Reported interpretation changed

For blood and CSF isolates, a beta-lactamase test is recommended for Enterococcus species.
 RUO: Un-validated results are not intended for clinical use.

| Name | Specimen | SWAB | Status | Final |
|---------------|----------|-------------|-------------|-----------|
| Patient ID | Source | RECTAL SWAB | Status Date | 7/27/2017 |
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Next:

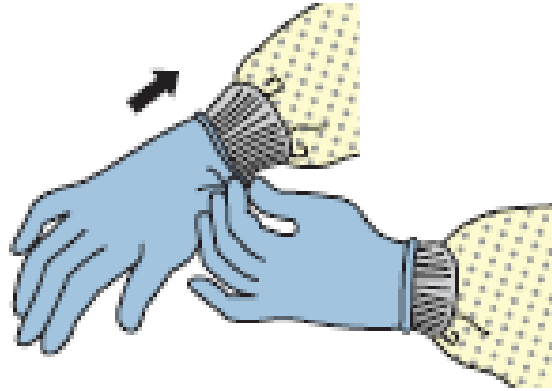


- Notify patient and healthcare facilities as appropriate

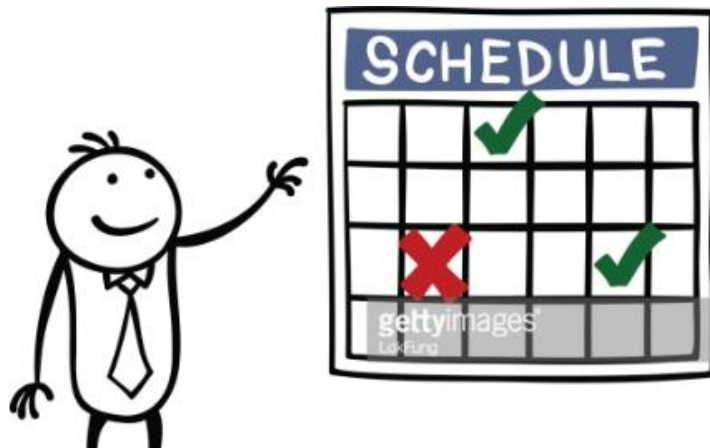


Ensure implementation of control measures

Initial control measures



Gown and gloves



Prevent opportunities for transmission



Hand hygiene



Site Visit



- Investigate to stop transmission & prevent future outbreaks

Major Findings from recent investigations



- **Hand hygiene:** inconsistent ✘
- **Wound care:** reusing scissors, interruptions in flow from clean to dirty ✘
- **OT/PT:** contact precautions not adequately maintained, lack of dedicated equipment ✘
- **Contact precautions:** implemented to varying degrees ✘
- **Lack of inter-facility notification** ✘
- **Outdated policies** ✘

Additional Control Measures

1. Staff Education
2. Laboratory notification
3. Cohort infected residents
4. Contact precautions
5. Hand Hygiene
6. Environmental cleaning
7. Communicate CRE status to transferring and receiving facilities
8. Review infection prevention policies and procedures
9. Antimicrobial Stewardship

Review the patient's risk factor information

- Demographics & clinical presentation of infection
- Travel
- Healthcare
 - Complex medical devices (e.g., duodenoscopes)
 - Long term care facility stay
 - Other healthcare exposures
 - Medical devices (catheters, foley, trach, etc) in place within 2 calendar days prior to culture
 - Antibiotics

Contact investigation

- Screening may be recommended for high risk contacts
- Coordinated through the antimicrobial resistant laboratory network (ARLN)
- In consultation with DPH and CDC

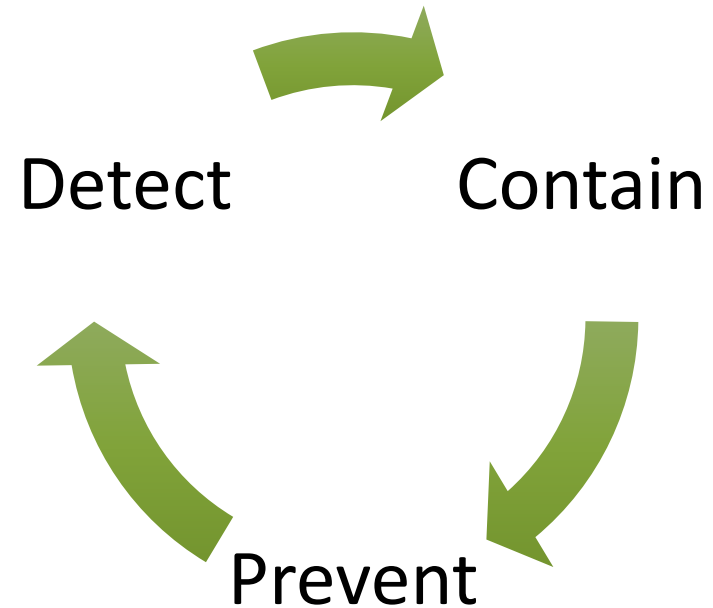


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Surveillance - CP-CRE Nationally Notifiable

- Improved detection
- Track trends and spread over time
- Rapid response and containment
- Prevention and control



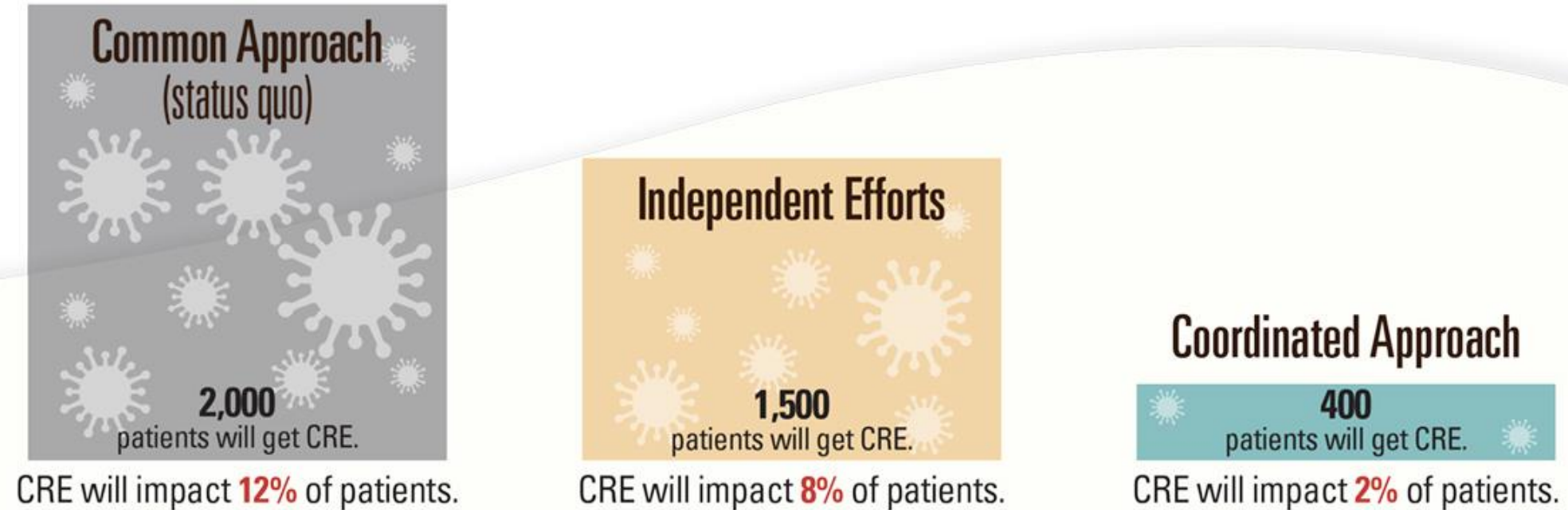
CRE activities in NC

- Outbreak response
- Sentinel event investigations
- Education
- Mechanism testing
- Colonization screening
- Special projects
 - Targeted surveillance
 - Non-big three surveillance



More patients get infections when facilities do not work together.

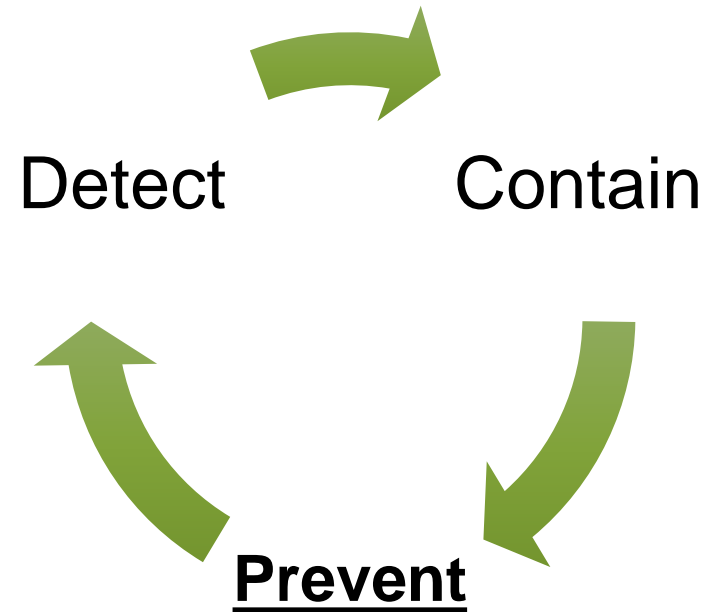
(Example: 5 years after CRE enters 10 facilities in an area sharing patients)



SOURCE: CDC Vital Signs, August 2015.

Responding to MDROs

- Detect MDROs
 - Increased awareness and testing
 - ARLN
- Ensure rapid response & containment
 - Prevent transmission
 - Inter-facility communication
- Stewardship efforts
 - Antimicrobial resistance subcommittee
 - Get Smart Campaign
- Education
 - Collaborative effort (SPICE, DPH, LHD)



Resources

- **MDROs**

- Management of Multidrug Resistant Organisms in Healthcare Settings, 2006

https://www.cdc.gov/hicpac/mdro/mdro_toc.html

- Interim Guidance for a Public Health Response to Contain Novel or Targeted Multidrug-resistant Organisms (MDROs)

<https://www.cdc.gov/hai/outbreaks/docs/Health-Response-Contain-MDRO.pdf>

- NC DPH CRE information for Long-Term Care Facilities

<http://epi.publichealth.nc.gov/cd/hai/docs/CREinfoLTCfacilities.pdf>

- **Antimicrobial Stewardship**

- <http://epi.publichealth.nc.gov/cd/antibiotics/campaign.html>

- **NCHAI@DHHS.NC.GOV**



Questions?

