

MULTIDRUG RESISTANCE ORGANISMS AND UNDERSTANDING ENHANCED BARRIER PRECAUTIONS

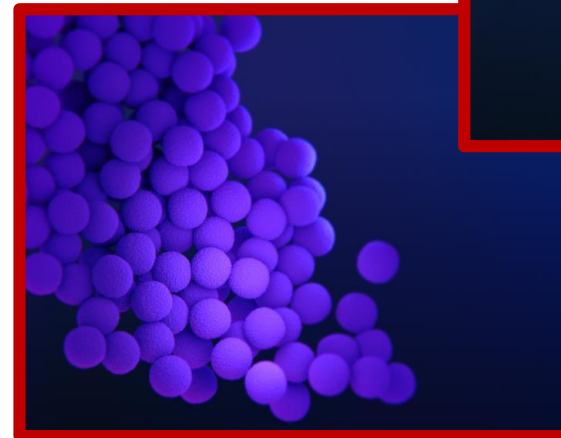
Ashley Jackson, BSMT, MPH, CIC
Clinical Infection Prevention Consultant
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OVERVIEW

- ▶ Discuss the burden of multidrug resistance organisms in healthcare settings
- ▶ Discuss the clinical importance of MDROs in long term and congregate care settings.
- ▶ Discuss how antibiotic resistance occurs in bacteria and how they are identified
- ▶ Identify common multidrug resistance organisms
- ▶ Discuss infection prevention measures to prevent MDROs
- ▶ Overview of Enhanced Barrier precautions

MULTIDRUG RESISTANT ORGANISMS

- ▶ MDRO- Organisms that develop resistance to one or more classes of antibiotics. This may result in typical antibiotic regimens not working or becoming less effective.
- ▶ Cause infections and/or colonization
- ▶ Infections caused by MDROs are:
 - ▶ More difficult to treat
 - ▶ Require more toxic antibiotics to treat
 - ▶ Often have poor patient outcomes
 - ▶ Are easily transmitted in healthcare settings



CLASSES OF ANTIBIOTICS

Antibiotic Table

GROUP I – Beta Lactams				GROUP II	GROUP III	GROUP IV	GROUP V	GROUP VI
Class I Penicillins	Class II Cephalosporins	Class III Carbapenems	Class IV Monobactams	Class V Aminoglycosides	Class VI Quinolones*	Class VII Antimetabolites	Class VIII Glycyclines	Class IX Tetracyclines
Penicillin Amoxicillin Ampicillin Oxacillin Piperacillin Piperacillin-taxobactam Ticarcillin-clavulanate Ampicillin-sulbactam	Cefazolin Cefalexin Cefalexin Cefoxitin Cefotaxime Ceftriaxone Ceftazidime Cefepime	Imipenem Meropenem Doripenem Ertapenem	Aztreonam	Gentamicin Tobramycin Amikacin Netilmycin	Ciprofloxacin Levofloxacin Moxifloxacin	Trimethoprim-Sulfamethoxazole	Tigecycline	Minocycline Tetracycline Doxycycline

* Resistance to one agent implies resistance to all agents

Other Classes include:

Glycopeptides: Vancomycin

Lincosamides: Clindamycin, Lincomycin

Lipopeptides: Daptomycin

Macrolides: Azithromycin, Erythromycin

Polypeptides: Bacitracin, Colistin

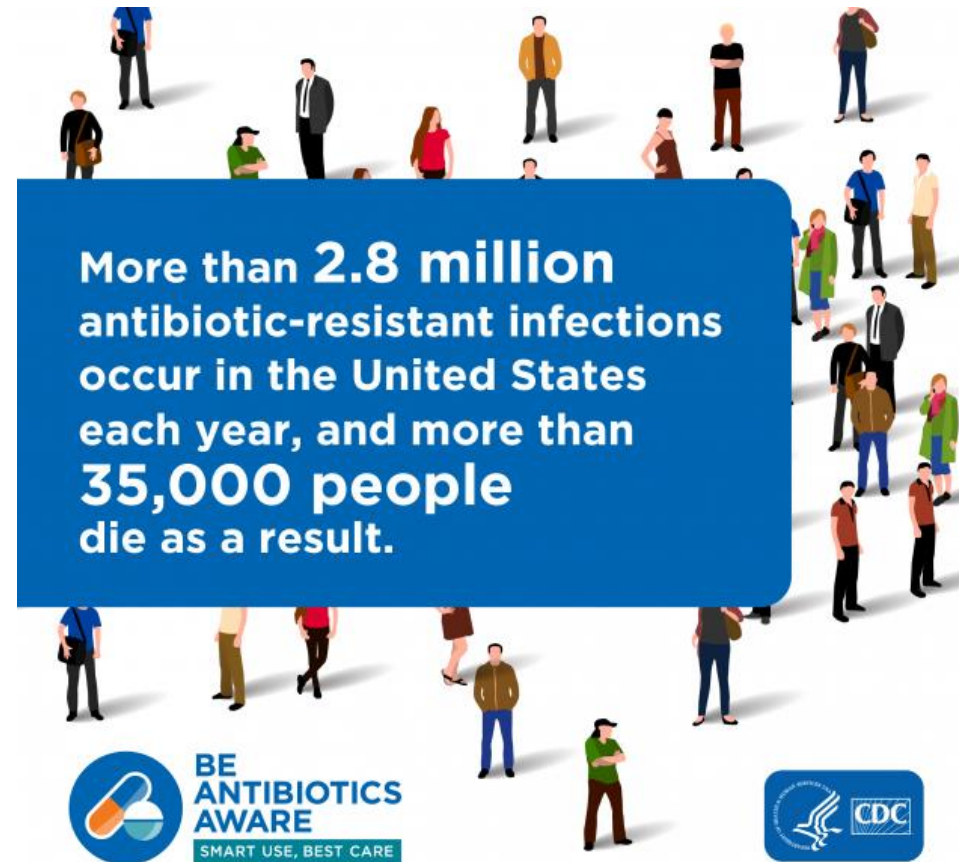
Linezolid (Zyvox)

Metronidazole (Flagyl)

Mupirocin (Bactroban)

THE BURDEN OF MULTIDRUG RESISTANCE IN HEALTHCARE

- ▶ MDROs cause an increase of mortality, healthcare costs, and length of stays in our healthcare systems.
- ▶ Estimates of economic costs vary but they ranged as high as 20 BILLION dollars in direct healthcare costs.



<https://www.cdc.gov/antibiotic-use/community/about/antibiotic-resistance-faqs.html>

RISK FACTORS FOR DEVELOPING A MDRO

- ▶ Duration of hospitalization
- ▶ High rates of transfer in and between hospitals
- ▶ Local institution risk factors
- ▶ **Long term care facilities**
- ▶ Intensive care units
- ▶ High rate of device utilization
- ▶ Colonization
- ▶ Prior antibiotic use

*“Age, comorbid illnesses, invasive medical devices, frequent antibiotic exposure, and dependence on healthcare workers, in the setting of communal living, all serve to increase the risk of nursing home residents becoming colonized or infected with healthcare-acquired bacterial pathogens.”
(Dumyati, et. Al., 2017)*

MULTIDRUG RESISTANT ORGANISMS

▶ Cause infections

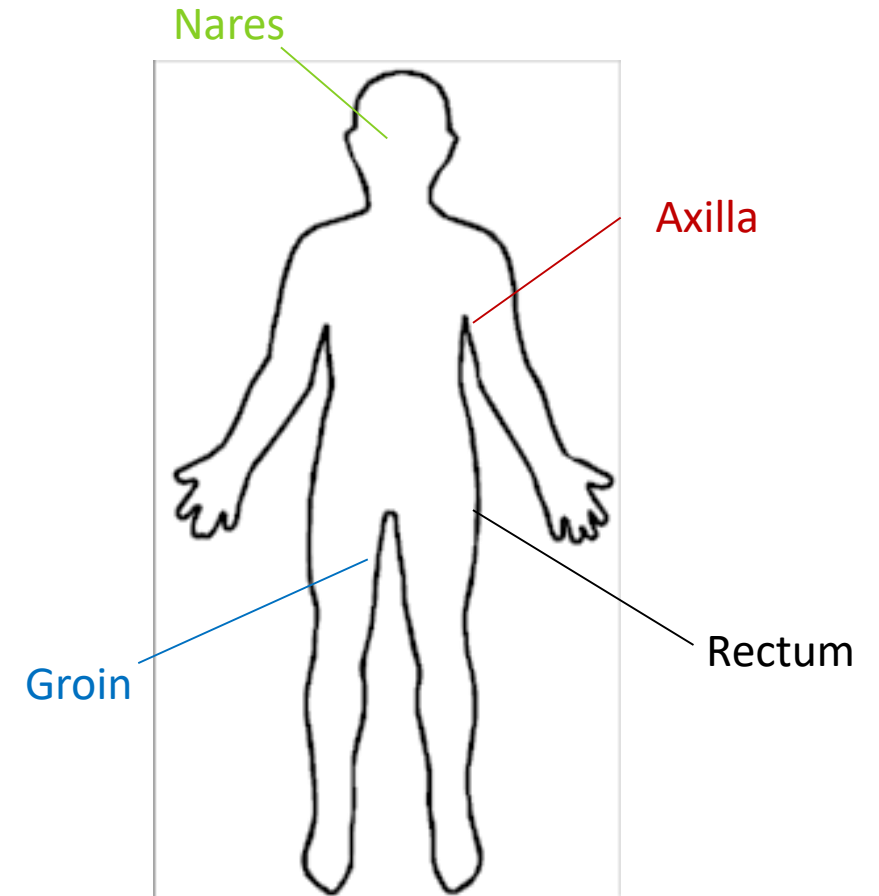
- ▶ More difficult to treat
- ▶ Require more toxic antibiotics to treat
- ▶ Often have poor patient outcomes
- ▶ Are easily transmitted in healthcare settings

▶ Colonization

- ▶ Colonization means organisms live on or in the body without having an active infection.
- ▶ CDC notes up to 50% of nursing home residents are colonized with MDROs.
- ▶ MDRO colonization can increase the individual's risk for developing an infection.
- ▶ ** MDRO-colonized residents serve as a source of transmission to others ***

COLONIZATION VS INFECTION

- ▶ MDRO colonization can persist for long periods of time (e.g., months) and result in silent transmission.
- ▶ Common colonization sites for MDROs include:
 - ▶ Nares
 - ▶ Axilla
 - ▶ Groin
 - ▶ Rectum

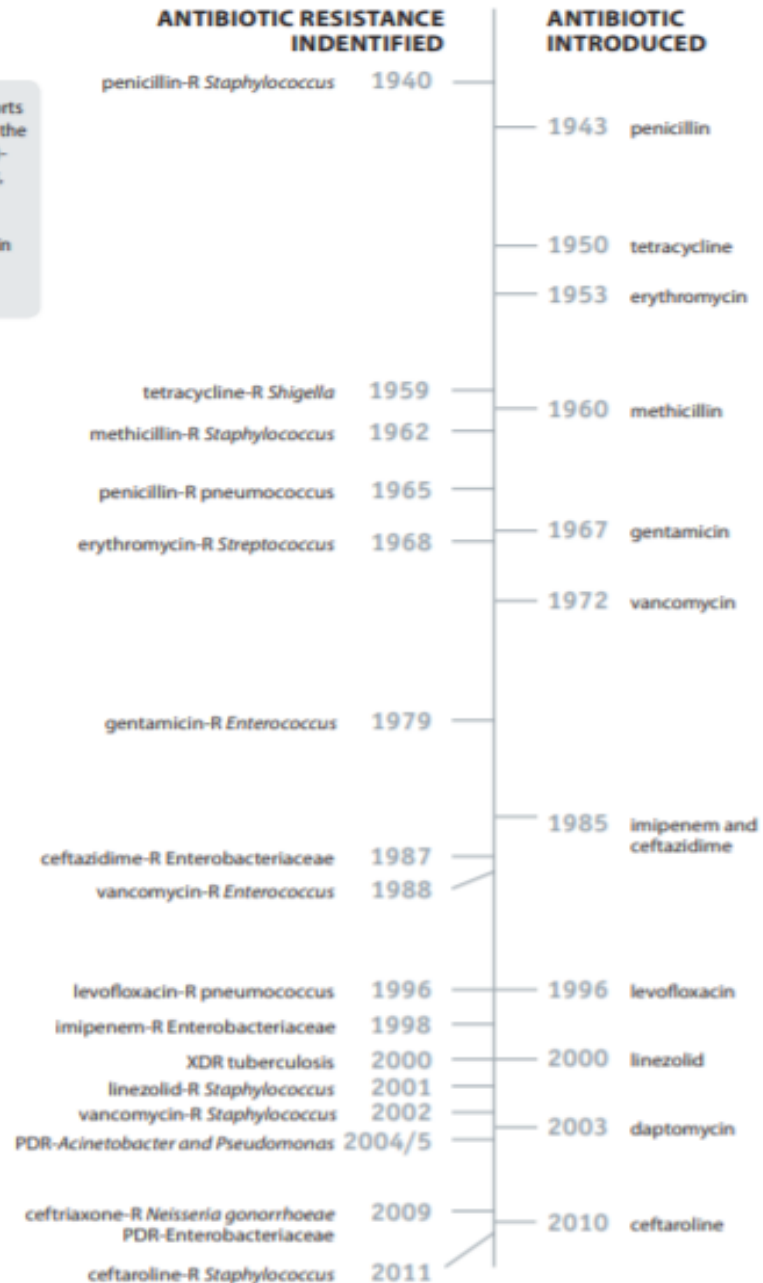


HOW DOES ANTIBIOTIC RESISTANCE OCCUR?

Developing Resistance

Timeline of Key Antibiotic Resistance Events

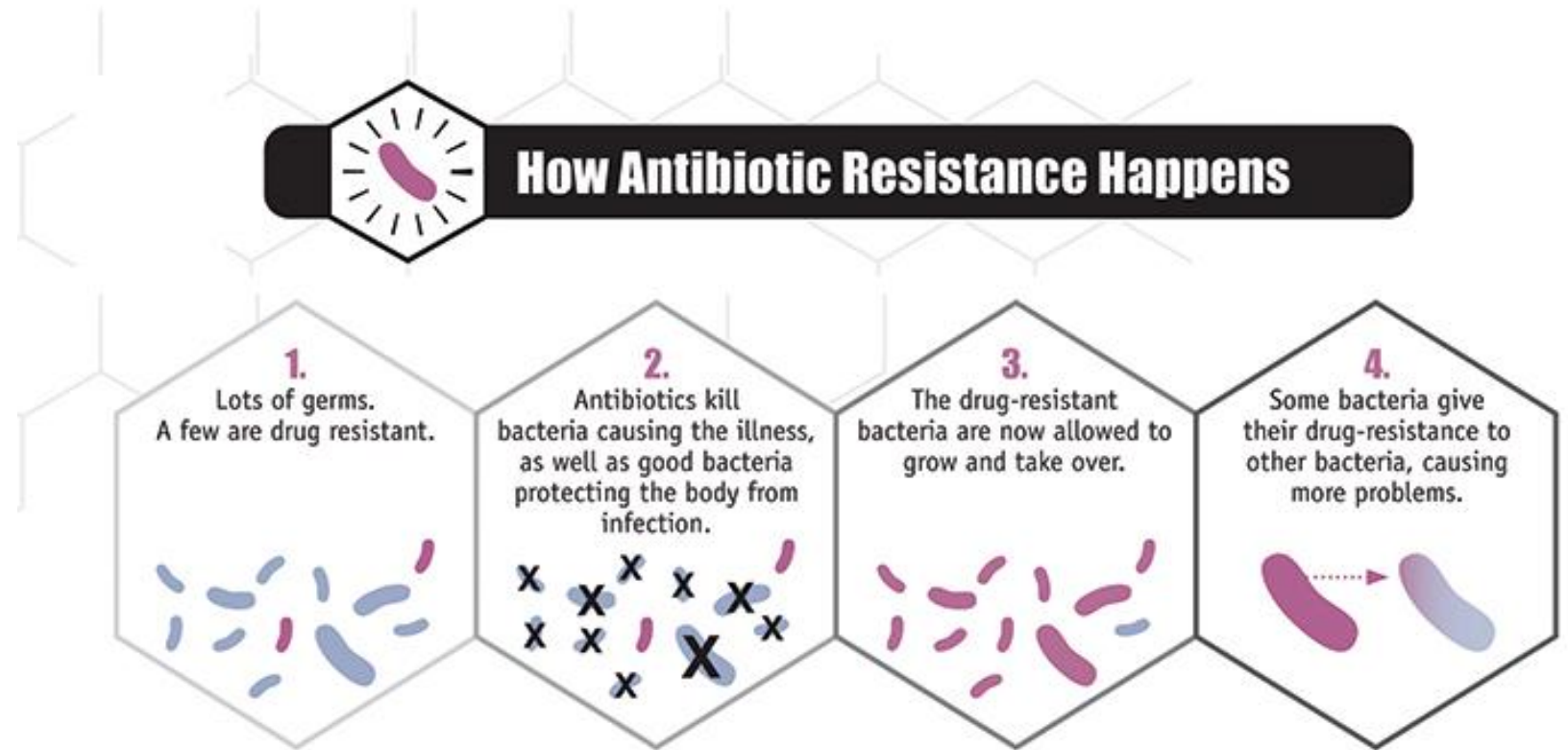
Dates are based upon early reports of resistance in the literature. In the case of pan drug-resistant (PDR)-*Acinetobacter* and *Pseudomonas*, the date is based upon reports of healthcare transmission or outbreaks. Note: penicillin was in limited use prior to widespread population usage in 1943.



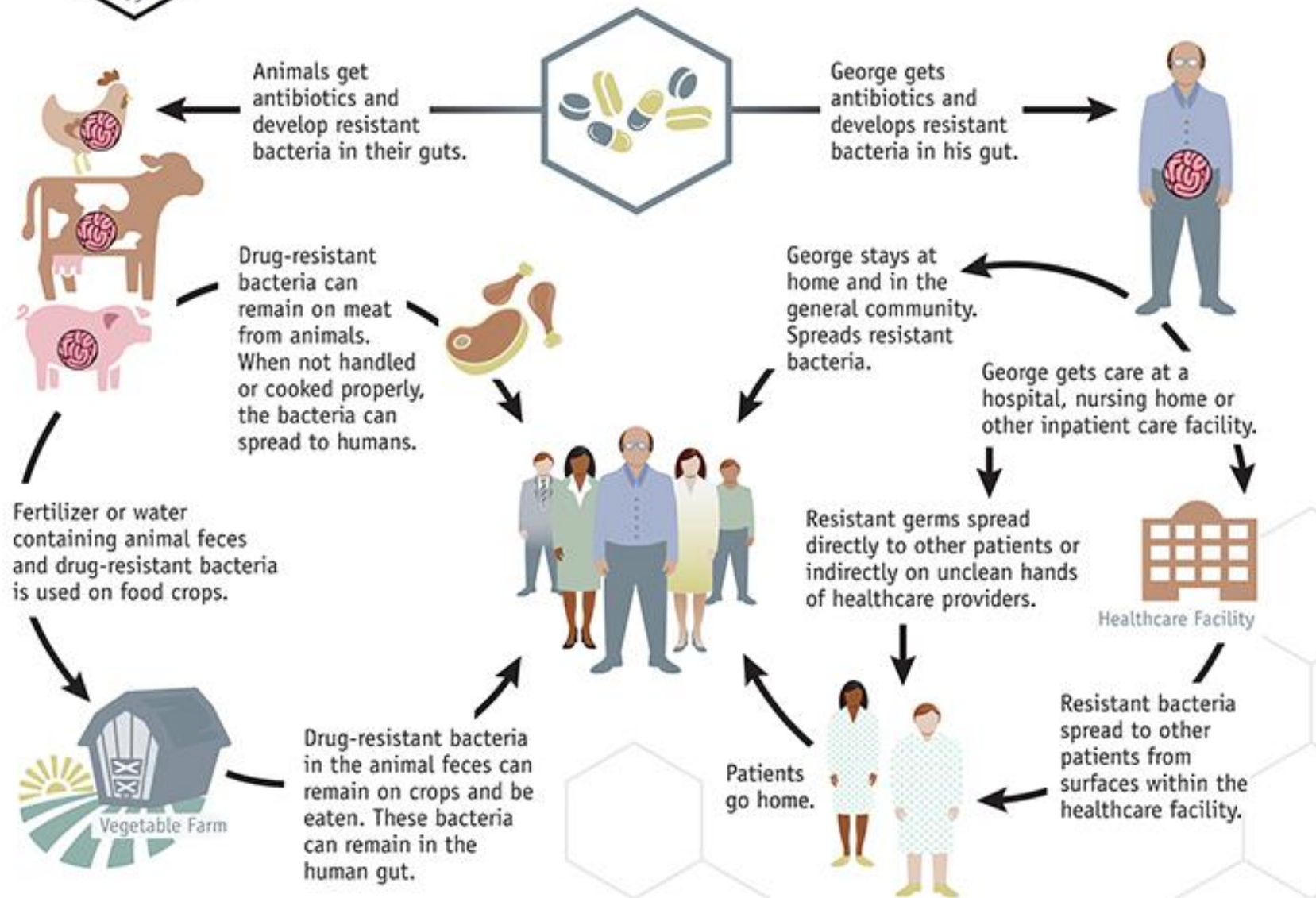
<https://www.cdc.gov/drugresistance/pdf/ar-threats-2013-508.pdf>

HOW ANTIBIOTIC RESISTANCE OCCURS

- Antibiotic resistance: the ability of bacteria to resist the killing effects of antibiotics.
- Resistant bacteria continue to multiply and can spread resistance to other bacteria.

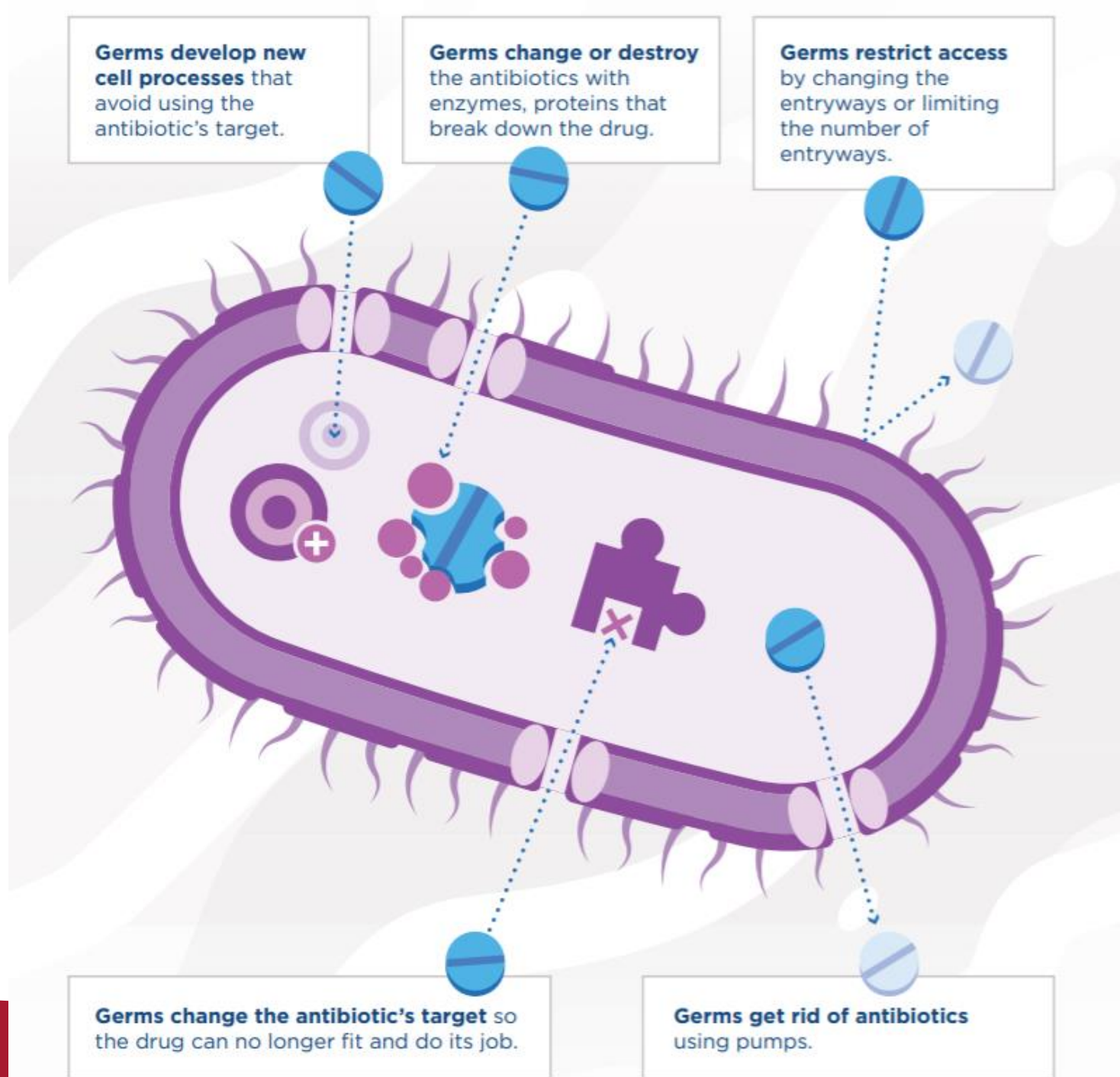


Examples of How Antibiotic Resistance Spreads



Simply using antibiotics creates resistance. These drugs should only be used to treat infections.

MECHANISMS OF RESISTANCE



<https://www.cdc.gov/drugresistance/pdf/threats-report/2019-ar-threats-report-508.pdf>

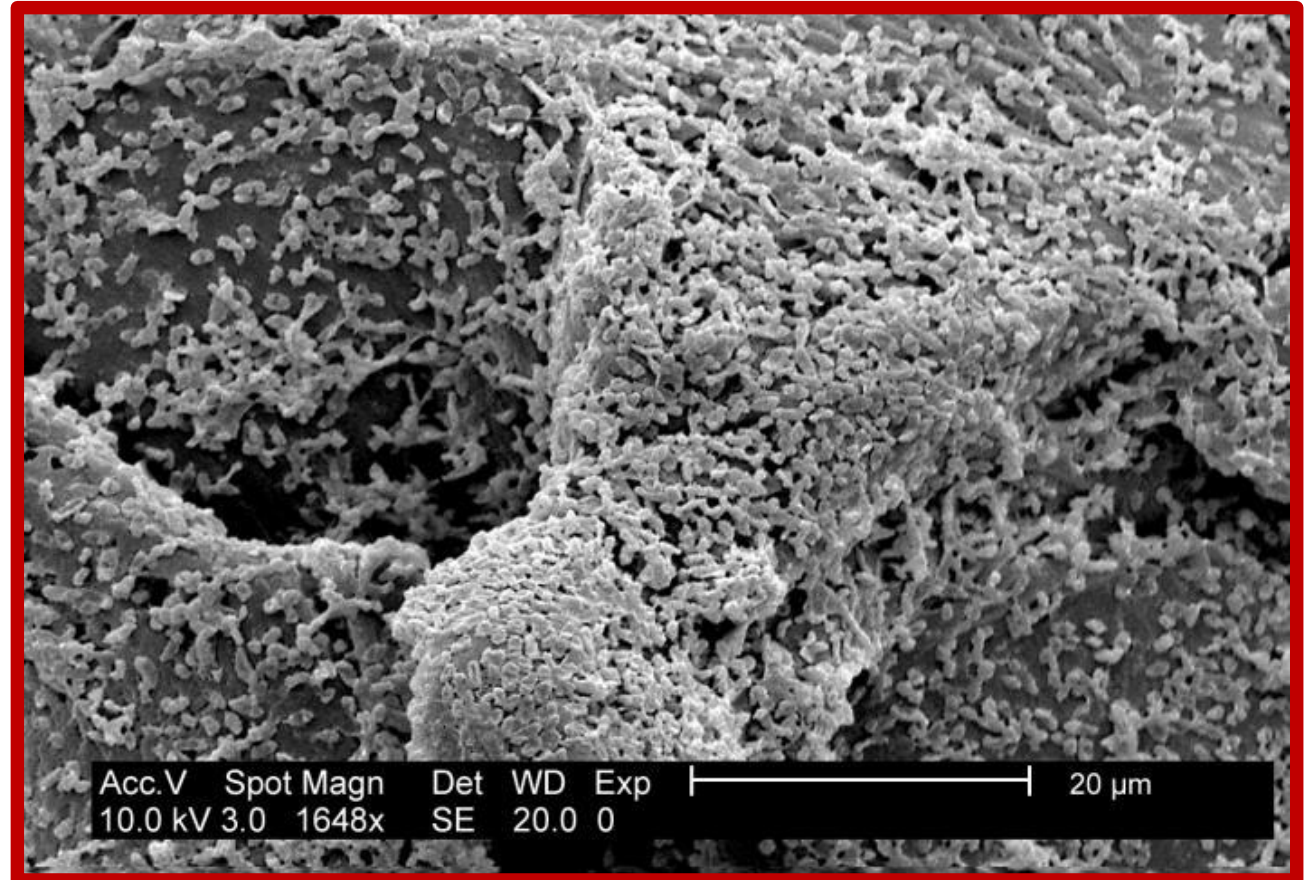
TYPES OF MDROS

▶ How do Antimicrobial-resistant Pathogens Emerge?

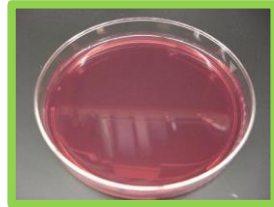
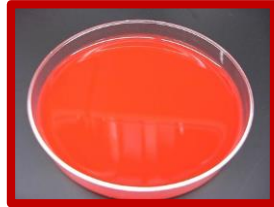
- ▶ Antimicrobial use
- ▶ Failure to properly implement infection control practices

▶ Biofilm

- ▶ Antibiotics have difficulties penetrating biofilm

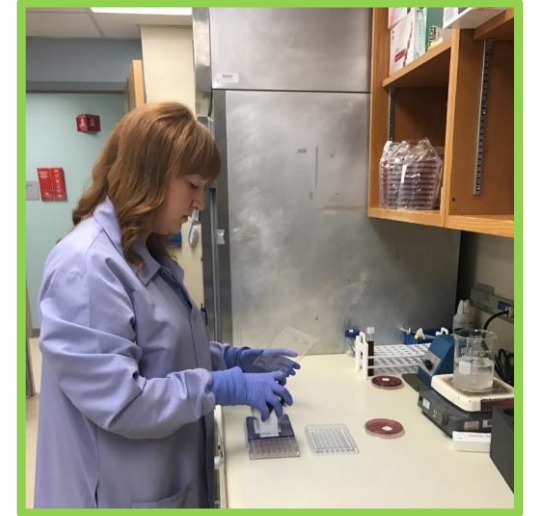


HOW MDROS ARE IDENTIFIED

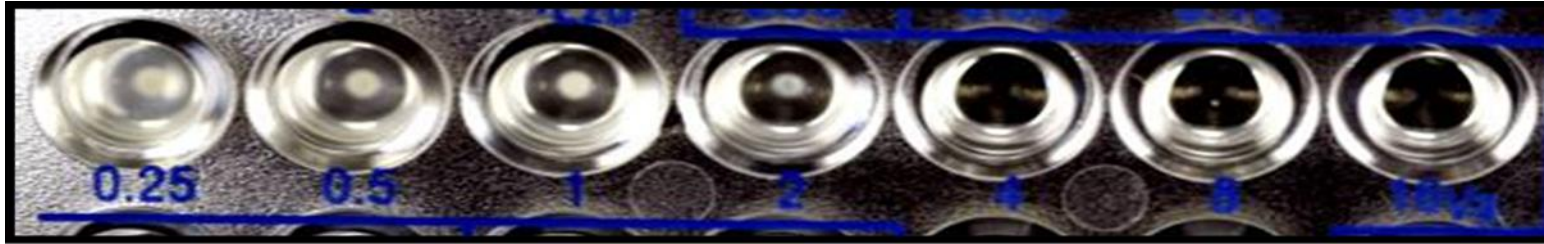


- ▶ When a specimen (urine, wound, etc.) gets collected, it is sent to the lab to be plated and then incubated so organisms can grow.

- ▶ After it grows and a pathogen is determined, it is set up for antibiotic sensitivity testing which is mostly automated



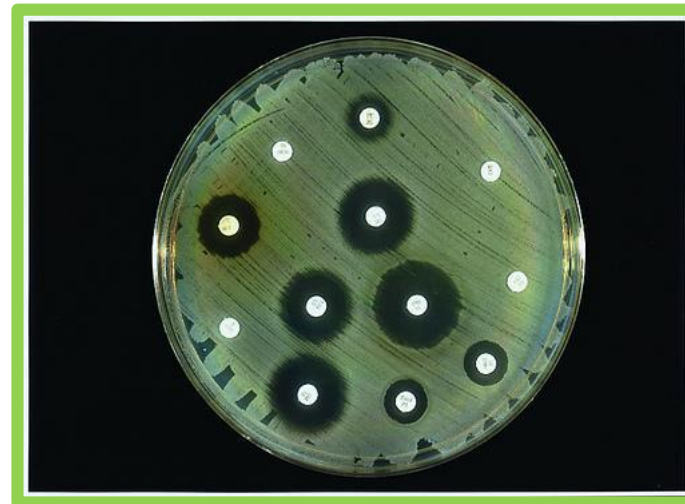
HOW MDROS ARE IDENTIFIED



VISA detected at CNMC

► Kirby Baur

- Antibiotic impregnated disc
- Zone of inhibition



Minimal inhibitory concentration (MIC) – lowest concentration of drug that still can inhibit microbial growth

The MIC will determine whether the bacteria is resistant to the tested antibiotic.

OVERVIEW OF MDROS

- ▶ Methicillin-resistant *Staphylococcus aureus* (MRSA)
- ▶ Vancomycin-resistant *Enterococcus* spp. (VRE)
- ▶ Extended spectrum Beta-lactamase producing *Enterobacteriaceae* (ESBL)
- ▶ Carbapenem Resistant *Acinetobacter*
- ▶ Carbapenem Resistant *Enterobacteriaceae* (CRE)
- ▶ *Clostridium difficile*
- ▶ *Candida auris*



TYPES OF MDROS- MRSA



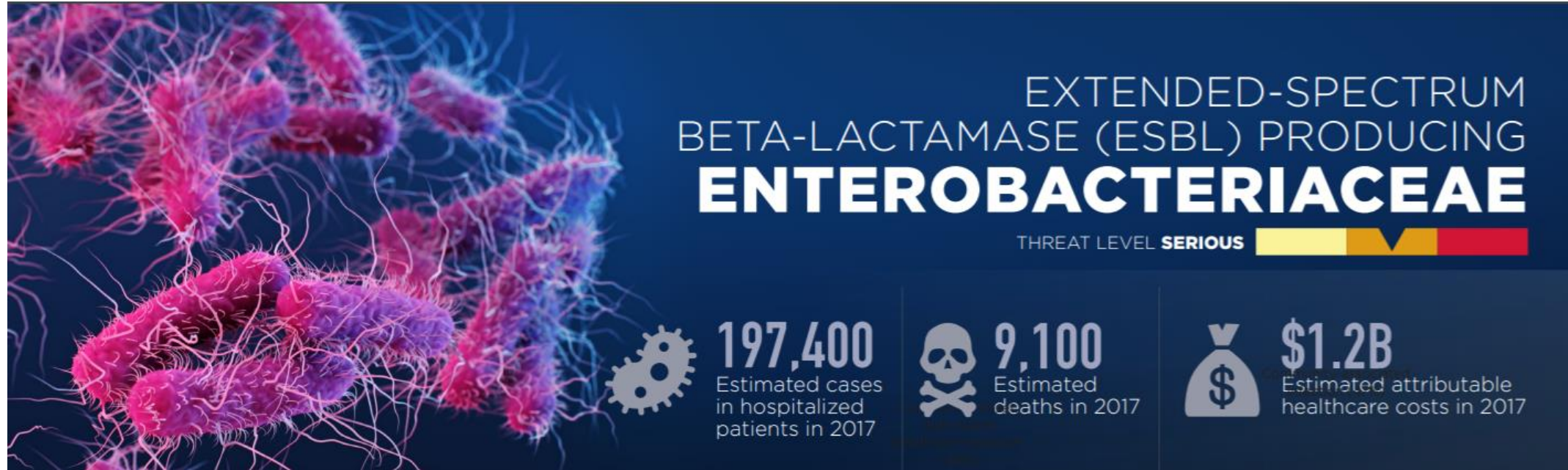
- ▶ Gram positive cocci -**resistant** to Oxacillin and beta-lactam antibiotics
- ▶ *Staphylococcus aureus* -commonly found on the skin or in the noses of healthy people
 - ▶ According to CDC:
 - ▶ 33% of people are colonized with *Staphylococcus*
 - ▶ Only about 2% colonized with MRSA
- ▶ MRSA can cause serious infections
 - ▶ Wound
 - ▶ Blood stream (sepsis)
 - ▶ Pneumonia

TYPES OF MDROS - VRE



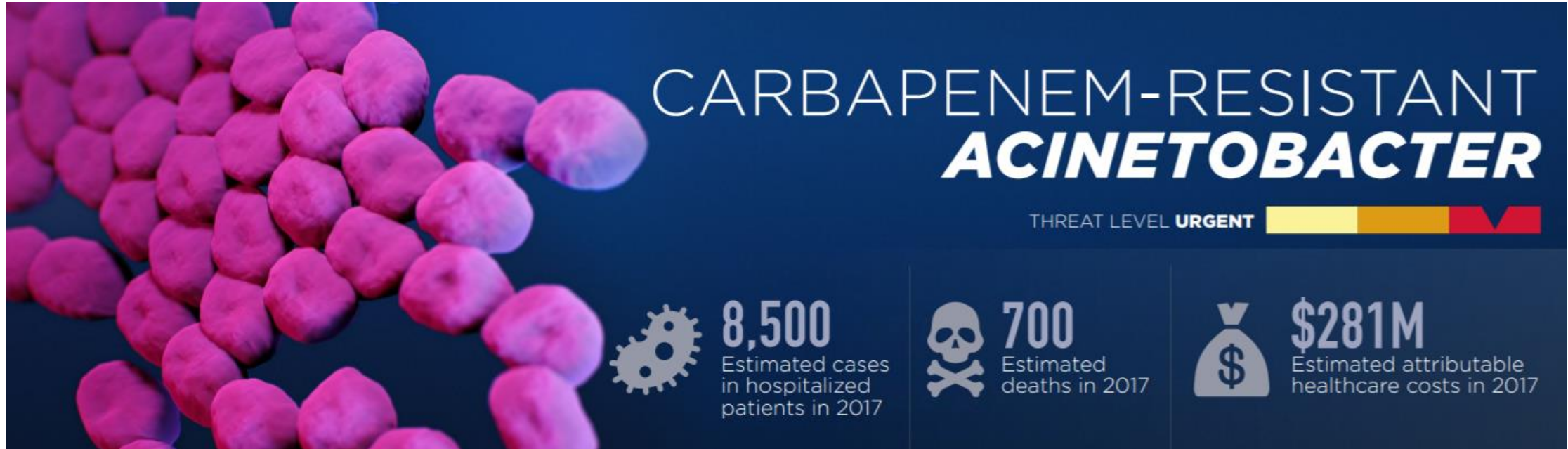
- ▶ Can cause blood, urine, and surgical site infections
- ▶ *Enterococcus faecalis*, *Enterococcus faecium*
- ▶ Nearly all VRE infections happen in patients with healthcare exposures
- ▶ Long term care residents are a risk

ESBL



- ▶ Extended Spectrum β -lactamase (ES β L) producing GNR
 - ▶ Enzyme conferring bacterial resistance to penicillins, first-, second, and third-generation cephalosporins, and aztreonam

CARBAPENEM RESISTANT ACINETOBACTER



- ▶ Acinetobacter is already a very resistance organism (intrinsically resistance). Resistance to carbapenems further reduces patient treatment options.
- ▶ Acinetobacter can contaminate healthcare facility surfaces and shared medical equipment. If not addressed through infection control measures, including rigorous cleaning and disinfection, outbreaks in hospitals and nursing homes can occur.

TYPES OF MDROS - CRE



- ▶ High mortality - 30-70%
- ▶ Double the mortality of MRSA
- ▶ Resistant to almost all antibiotics
- ▶ Colistin / Tigecycline can be used to treat but these can be toxic

ENTEROBACTERIACEAE

Table 1. Genera of Enterobacteriaceae

Common Genera of Enterobacteriaceae			
Escherichia	Klebsiella	Providencia	Serratia
Enterobacter	Proteus	Salmonella	Shigella
Other Genera of Enterobacteriaceae			
Alishewanella	Cedecea	Leminorella	Rahnella
Alterococcus	Citrobacter	Moellerella	Raoultella
Aquamonas	Cronobacter	Morganella	Samsonia
Aranicola	Dickeya	Obesumbacterium	Sodalis
Arsenophonus	Edwardsiella	Pantoea	Tatumella
Azotivirga	Erwinia	Pectobacterium	Trabulsiella
Blochmannia	Ewingella	Phlomobacter	Wigglesworthia
Brenneria	Grimontella	Photorhabdus	Xenorhabdus
Buchnera	Hafnia	Poodoomaamaana	Yersinia
Budvicia	Kluyvera	Plesiomonas	Yokenella
Buttiauxella	Leclercia	Pragia	

TYPES OF MDROS - CRE

CRE- Any Enterobacteriaceae resistant to imipenem, meropenem, doripenem, or ertapenem (last resort antibiotics)

OR by production of a carbapenemase (KPC, NDM, VIM, IMP, OXA-48)**
demonstrated using a recognized test (e.g. polymerase chain reaction, metallo- β -lactamase test, modified-Hodge test, Carba-NP).

Mechanisms of resistance

- ▶ Mediated by plasmids (mobile genetic element)
- ▶ Enzymes that inactivate carbapenems
 - ▶ *Klebsiella pneumoniae* carbapenemase (KPC)

REPORTING CRE

- ▶ Identification of CRE from a clinical specimen associated with either infection or colonization, including all susceptibility results and all phenotypic or molecular test results.
- ▶ For the purpose of reporting, CRE are defined as: (1) Enterobacter spp, E.coli or Klebsiella spp positive for a known carbapenemase resistance mechanism or positive on a phenotypic test for carbapenemase production; or (2) Enterobacter spp, E.coli or Klebsiella spp resistant to any carbapenem in the absence of carbapenemase resistance mechanism testing or phenotypic testing for carbapenemase production

CLOSTRIDIOIDES DIFFICILE



- ▶ More than half of C. difficile cases among long-term care facility residents happen in those who were recently hospitalized.
- ▶ From 2011 to 2015, CDC noted decreases in C. difficile cases in people 65 years or older in long-term care facilities.
- ▶ Although there's a decrease in healthcare associated C. diff, there hasn't been a decrease in community acquired C. diff.

CANDIDA AURIS



- ▶ Candida auris is an emerging multidrug-resistant yeast (a type of fungus).
- ▶ First discovered in 2009.
- ▶ It can cause severe infections and spreads easily between hospitalized patients and nursing home residents

PAN RESISTANCE

- ▶ Pan-resistant organisms:
**Resistant to all current
antibacterial agents**



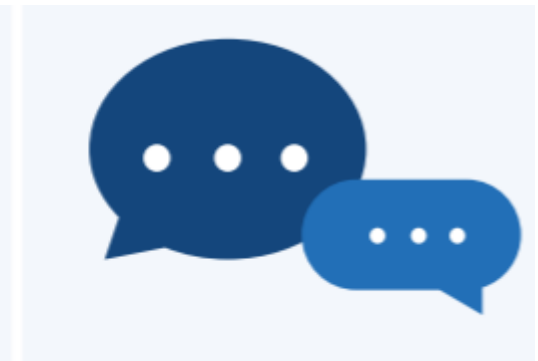
- ▶ *Acinetobacter*
- ▶ *Klebsiella pneumonia*
- ▶ *Pseudomonas aeruginosa*



INFECTION PREVENTION MEASURES

▶ All MDROs

- ▶ Staff education
- ▶ Risk assessment to identify high risk patients
- ▶ Laboratory notifications/ communication with outside facilities.
- ▶ Hand hygiene
- ▶ **Barrier precautions (Contact or Enhanced barrier precautions)**
- ▶ Antibiotic stewardship
- ▶ Environmental cleaning
- ▶ Cohort residents if necessary



UNDERSTANDING CONTACT AND ENHANCED BARRIER PRECAUTIONS

- ▶ CDC implemented Enhanced Barrier precautions for long term care.
- ▶ Enhanced barrier precautions does not replace existing guidance regarding use of Contact Precautions for other pathogens (e.g., *Clostridioides difficile*, norovirus) in nursing homes.
- ▶ **WHY CHANGE?**
 - ▶ “Focusing only on residents with active infection fails to address the continued risk of transmission from residents with MDRO colonization, which can persist for long periods of time (e.g., months), and result in the silent spread of MDROs”.
 - ▶ “With the need for an effective response to the detection of serious antibiotic resistance threats, there is growing evidence that current implementation of Contact precautions in nursing homes is not adequate for prevention of MDRO transmission”.

CONTACT ISOLATION

- ▶ Contact Precautions:
- ▶ All residents with an MDRO when there is acute diarrhea, draining wounds or other sites of secretions/excretions that cannot be contained or covered
- ▶ On units or in facilities where ongoing transmission is documented or suspected
- ▶ *C. difficile* infection
- ▶ Norovirus
- ▶ Shingles when resident is immunocompromised, and vesicles cannot be covered
- ▶ Other conditions as noted in Appendix A- Type and Duration of Precautions Recommended
- ▶ For Selected Infections and Conditions
- ▶ Gown and gloves upon ANY room entry
- ▶ Room restriction except for medically necessary care



CONTACT PRECAUTIONS



Visitors must report to Nursing Station before entering.

-  Perform hand hygiene before entering and before leaving room.
-  Wear gloves when entering room or cubicle, and when touching patient's intact skin, surfaces, or articles in close proximity
-  Wear gown when entering room or cubicle and whenever anticipating that clothing will touch patient items or potentially contaminated environmental surfaces.
-  Use patient-dedicated or single-use disposable shared equipment or clean and disinfect shared equipment (BP cuff, thermometers) between patients.

PRECAUCIONES DE CONTACTO

Los visitantes deben presentarse primero al puesto de enfermería antes de entrar. Lávese las manos. Póngase guantes al entrar al cuarto.

2006 CDC MDRO GUIDELINES

PRECAUTIONS IN LONG-TERM CARE

V.A.5.c.ii.1 "For relatively healthy residents (e.g., mainly independent) follow Standard Precautions making sure that gloves and gowns are used for contact with uncontrolled secretions, pressure ulcers, draining wound, stool incontinence, and ostomy tubes/bags."

V.A.5.c.ii.2. For ill residents (e.g., those totally dependent upon healthcare personnel for healthcare and activities of daily living...) and for those residents whose infected secretions or drainage cannot be contained, use Contact Precautions, in addition to Standard Precautions."

V.A.5.c.iii. For MDRO colonized or infected patients without draining wounds, diarrhea, or uncontrolled secretions, establish ranges of permitted ambulation, socialization, and use of common areas based on their risk to other patients and on the ability of the colonized or infected patients to observe proper hand hygiene and other recommended precautions to contain secretions and excretions.

RECOMMENDATIONS

RESIDENT CHARACTERISTICS

▶ Five 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)

(Kellar M. APIC Infection Connection. Fall 2010 ed.)

Component	Recommendation
Personal Protective Equipment (PPE)	
Gloves	For touching blood, body fluids, secretions, excretions, contaminated items; for touching mucous membranes and non-intact skin
Gown	During procedures and patient-care activities when contact of clothing/exposed skin with blood/body fluids, secretions, and excretions is anticipated
Mask, eye protection	During procedures and patient-care activities likely to generate splashes or sprays of blood, body fluids, secretions, especially suctioning, endotracheal intubation

ENHANCED BARRIER PRECAUTIONS

- ▶ A type of precaution between standard and contact precautions
- ▶ Expands the use of PPE beyond situations in which exposure to blood and body fluids is anticipated (i.e. Standard Precautions)
- ▶ Refers to the use of gown and gloves during high-contact resident care activities that provide opportunities for transfer of MDROs to staff hands and clothing

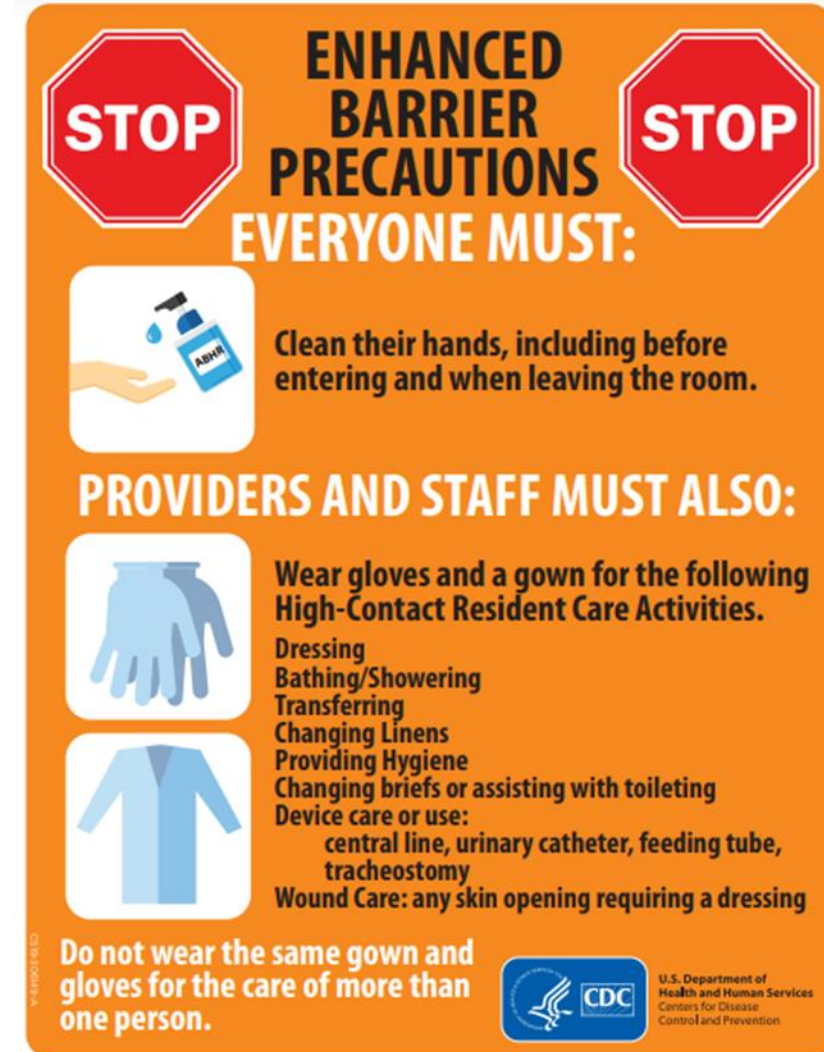
As of July 2019, Novel or Targeted MDROs are defined as:

- Pan-resistant organisms,
- Carbapenemase-producing Enterobacteriaceae,
- Carbapenemase-producing *Pseudomonas* spp.,
- Carbapenemase-producing *Acinetobacter baumannii*, and
- *Candida auris*

ENHANCED BARRIER PRECAUTIONS


- ▶ Examples of high-contact resident care activities requiring gown and glove use for **Enhanced Barrier Precautions** include:
- ▶ Dressing
- ▶ Bathing/showering
- ▶ Transferring
- ▶ Providing hygiene
- ▶ Changing linens
- ▶ Changing briefs or assisting with toileting
- ▶ Device care or use: central line, urinary catheter, feeding tube, tracheostomy/ventilator
- ▶ Wound care: any skin opening requiring a dressing

Gown and gloves would not be required for resident care activities other than those listed above, unless otherwise necessary for adherence to Standard Precautions. Residents are not restricted to their rooms or limited from participation in group activities





The infographic is titled "ENHANCED BARRIER PRECAUTIONS EVERYONE MUST:" and is flanked by two red octagonal "STOP" signs. It is divided into three sections. The first section, "EVERYONE MUST:", features an icon of hands being washed with blue soap and water, with the text "Clean their hands, including before entering and when leaving the room." The second section, "PROVIDERS AND STAFF MUST ALSO:", features an icon of blue gloves and an icon of a blue gown. The text for this section reads: "Wear gloves and a gown for the following High-Contact Resident Care Activities. Dressing, Bathing/Showering, Transferring, Changing Linens, Providing Hygiene, Changing briefs or assisting with toileting, Device care or use: central line, urinary catheter, feeding tube, tracheostomy, Wound Care: any skin opening requiring a dressing." The third section at the bottom left states: "Do not wear the same gown and gloves for the care of more than one person." The bottom right corner features the CDC logo and the text "U.S. Department of Health and Human Services Centers for Disease Control and Prevention".

STOP **ENHANCED BARRIER PRECAUTIONS** **STOP**
EVERYONE MUST:


 Clean their hands, including before entering and when leaving the room.

PROVIDERS AND STAFF MUST ALSO:

  Wear gloves and a gown for the following High-Contact Resident Care Activities.

Dressing
Bathing/Showering
Transferring
Changing Linens
Providing Hygiene
Changing briefs or assisting with toileting
Device care or use:
central line, urinary catheter, feeding tube,
tracheostomy
Wound Care: any skin opening requiring a dressing

Do not wear the same gown and gloves for the care of more than one person.

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

CONTACT AND ENHANCED BARRIER PRECAUTIONS

- ▶ **Contact or Enhanced Barrier Precautions:**
- ▶ Post clear signage on the door or wall outside the room
- ▶ Make PPE available immediately outside the room
- ▶ Ensure access to alcohol-based hand rub in every resident room (ideally inside and outside)
- ▶ Trash can available for PPE disposal
- ▶ Periodic monitoring and assessment of compliance
- ▶ Provide education to residents, family and visitors
- ▶ Adherence to other measures including hand hygiene, environmental cleaning and cleaning, disinfection of medical devices

QUESTIONS?

- ▶ Questions are typed in the Q&A box



REFERENCES

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Images provided by CDC's Public Health Image Library: <https://phil.cdc.gov/default.aspx>