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What Sterile Processing Should Know About Multidrug-Resistant Organisms (MDRO)

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Learning Objectives

1. **Explain how multidrug-resistant organisms (MDRO) came to exist.**
2. **Identify SPD tactics to protect staff and patients from MDRO.**

Contributed by:

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In 1929, Dr. Fleming discovered penicillin when a mold contaminated his petri dishes that were growing *Staphylococcus*, but it took approximately 10 years for the first human trials could begin. Thanks to collaborative efforts by British and American scientists, mass production was accomplished towards the end of World War I with wide prescription use by 1946.[1] The first strains of penicillin resistant bacteria were discovered before this; *E. coli* in 1940 and four strains of *S. aureus* in 1942.

Antibiotics are found throughout the microbial world. Microorganisms produce toxins like penicillin to protect themselves and their food sources. However, through mutation or gene transfer, organisms once susceptible to the toxins develop ways to alter the danger from toxins.

Though antibiotic resistance has always existed, the quantity of antibiotic-resistant microorganisms was low. It took the overuse and misuse of antibiotics to expedite their proliferation and set the stage for multidrug-resistant organisms. What started as a single case of penicillin resistant *S. aureus* in 1942 grew to more than 80% of all *S. aureus* infections by the 1960s.[2]

Overuse and misuse of antibiotics has led to the selection of drug-resistant organisms, as only those with resistance can survive. Studies have shown a direct link between higher antibiotic usage and increased presence of drug-resistant organisms within the environment.[5] Added to this is the impact of misuse. The CDC states that in the U.S. 28% of antibiotics prescribed by outpatient settings were not necessary.[6] Using antibiotics when it is not necessary creates an opportunity for bacteria living in the body to develop resistance.

Healthcare is not the only contributor. Agriculture overuses antibiotics to prevent infections within animals. Both the antibiotics and the animals' antibiotic-resistant organisms can be carried into the environment and to our dinner table. In a document review of drug-resistant outbreaks between 2012 and 2022, several outbreaks were attributed to antibiotic-resistant *Salmonella* and *E. coli* sourced to an animal-based food or animal fecal contamination of vegetable food sources.[8]

As scientists develop new antibiotics to combat drug-resistant microorganisms, the overuse and misuse of new antibiotics can lead to microbial resistance to them. The more types of antibiotics that a microorganism population is exposed to, the more drug resistances can be developed, leading to multidrug-resistant microorganisms.

Antimicrobial resistance does not always stay with the bacteria that developed it. Bacteria have the unique ability to share genetic information between different bacterial cells even if they are different kinds of bacteria. An *E. coli* bacterium can swap resistance mechanisms with that of *Klebsiella spp.* bacterium, for example. Practically, an individual harboring an antibiotic-resistant *E. coli* in their gut could find the other gut bacteria becoming antibiotic resistant too.

Individuals with colonies of antibiotic-resistant bacteria often show no symptoms or signs of infection. Several studies have evaluated colonization of individuals in long term care facilities, hospital respiratory patients, and a few within the community at large. The percentage of colonized individuals varies greatly but ranged between 4% and 30%.

"Studies have shown a direct link between higher antibiotic usage and increased presence of drug-resistant organisms."

How to reprocess devices that could have MDRO

It begins with universal precautions. Assume that every device has an MDRO. Devices should be transported in a closed, leak-proof, and puncture-resistant container. The container should be labeled as biohazardous. It's important to remember that the container itself could also be contaminated. Always use gloves when handling containers containing soiled instrumentation.

Durable medical equipment, such as IV pumps, could become contaminated while in use. The same precautions used for handling soiled instrumentation applies to handling durable equipment.

Wear appropriate personal protective equipment (PPE) that will prevent cross contamination from the soiled instrument, contaminated spills and splashes, and aerosolization during cleaning and rinsing of the devices.

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Quiz Answers:
1. C, 2. A, 3. D, 4. B, 5. A, 6. D, 7. C, 8. C, 9. D, 10. A

PPE should continue to be worn until the device has undergone a disinfection process.

Cleaning and rinsing followed by disinfection and sterilization render instruments and durable medical equipment ready for use. Each step in the process is necessary to ensure the removal and/or destruction of microorganisms. Sterilization is the highest level of microbial kill. Sterilants attack multiple components and processes within the microorganisms to inactivate or kill them. Steam sterilization is known to denature (deform) and coagulate proteins. Vaporized hydrogen peroxide, another sterilant, oxidizes organic compounds such as amino acids and proteins necessary for cell function. Additionally, healthcare sterilization processes use an overkill method to ensure that no microorganisms or viruses can survive the process, thus preventing the development of resistance.

High-level disinfectants kill or inactivate many microorganisms and viruses except for bacterial spores. Often high-level disinfectants can achieve sterilization given longer exposure times, higher concentrations, or, in some cases, higher processing temperatures. Misuse of reusable high-level disinfectant solutions and failure to decontaminate automated endoscope reprocessors as described in the instructions for use have led to the development of organisms with resistance to specific types of high-level disinfectants. In both cases, bacteria exposed to sublethal conditions developed resistance to glutaraldehyde-based high-level disinfectants. *Mycobacterium* and *Pseudomonas* bacteria that developed this resistance are also known to develop drug resistance.

Switching from a glutaraldehyde based high-level disinfectant, following equipment instructions for use, and using single dose high-level disinfectant chemistries instead of reusable can help reduce the possibility of developing a resistant population.

"It is possible for drug-resistant organisms to develop a disinfectant resistance."

Intermediate-level disinfectants are used to disinfect surfaces, instrumentation, and durable medical equipment. They kill most microorganisms including *Mycobacterium* but are not effective on bacterial spores or some fungi spores, protozoan cysts, and non-lipid or naked viruses. Examples include phenolics, iodophors, and some chlorine compounds. The last category of disinfectants is low-level disinfectants that are also used similarly to intermediate-level disinfectants. These kill all vegetative organisms except for bacterial spores, *Mycobacteria*, fungi spores, protozoan cysts, and non-lipid or naked viruses.

Several bacteria have developed resistances to specific formulations of intermediate and low-level disinfectants. Reasons include overuse and misuse of the disinfectants. Intermediate and low-level disinfectants are commonly used for disinfection of items that only contact intact skin (e.g. hands), and department surfaces, such as IV poles. Thorough cleaning is very important, especially for hand hygiene, to reduce the number of microorganisms. Ensuring that surfaces remain wet with the disinfectant for the required contact time helps to prevent sublethal exposures and the development of resistance. Lastly, rotating the intermediate or low-level disinfectant chemistry used will help prevent the development of resistance as each type of chemistry attacks the cells in a different way.

Do all drug-resistant microorganisms have resistance to sterilants and disinfectants?

Chemical drugs, sterilants, and disinfectants are all designed to attack and destroy microorganisms and viruses, but each does it in a different way. A bacterial mechanism that defends against penicillin will not work against an iodophor, for example.

It is possible for drug-resistant organisms to develop a disinfectant resistance. Studies on bacterial populations found in U.S. rivers showed antibiotic acquired resistance to sulfadiazine. These same bacteria showed an increased resistance to quaternary ammonium compound disinfectants.[9] At the time of this article, there have been no reported drug and disinfectant resistant microorganisms detected within healthcare facilities.

Sterile processing plays a critical role in MDRO management

The development of multi-drug resistant and disinfectant resistant organisms and viruses is not anticipated to slow in the future. Sterile processing has a critical role in stopping the spread of MDRO through good processing techniques and decontamination stewardship. **HPN**

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What Sterile Processing Should Know About Multidrug-Resistant Organisms (MDRO) - Practice Quiz

1. **When was penicillin widely prescribed?**
   A. 1929
   B. 1940
   C. 1946
   D. 1960

2. **What contributed to the proliferation of antibiotic-resistant organisms?**
   A. Overuse of antibiotics
   B. Sterilization failures
   C. Bacterial mutation
   D. The use of high-level disinfectants

3. **How can antibiotics enter the environment?**
   A. Insecticide runoff
   B. Contaminated feces
   C. Contaminated vegetables
   D. Overuse to prevent animal infections

4. **Creating new antibiotics eliminates the threat of MDROs.**
   A. True
   B. False

5. **Which microorganism can share genetic information of resistance?**
   A. Bacteria
   B. Helminths
   C. Protozoa
   D. Viruses

6. **What has happened to individuals who have MDROs but do not show symptoms?**
   A. Synthesized
   B. Sympathized
   C. Matured
   D. Colonized

7. **What should be used to prevent staff cross contamination with MDROs?**
   A. Device instructions for use
   B. Intermediate surface disinfection
   C. Personal Protective Equipment
   D. Sterilization

8. **Which type of high-level disinfectant has Mycobacterium developed resistance for?**
   A. Peracetic Acid
   B. Vaporized Hydron Peroxide
   C. Glutaraldehyde
   D. Ortho-phthaladehyde

9. **Which tactic can be used to prevent microorganisms from developing resistance to intermediate disinfectants?**
   A. Thorough cleaning
   B. Ensure surfaces remain wet
   C. Rotate disinfectants used
   D. All of the above

10. **Which statement is true?**
    A. Some drug-resistant organisms can develop disinfectant resistance.
    B. Antibiotic resistance causes disinfection resistance.
    C. Many MDROs in hospitals are also disinfectant resistant.
    D. Overuse of antibiotics causes disinfectant resistance.

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