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LEARNING OBJECTIVES

1. *Name the three factors required to spread infection*
2. *Discuss the transmission pathways*
3. *Explain ways to break the chain of infection in the SPD*

SELF-STUDY SERIES

Breaking the chain of infection

by Arthur Henderson, RN, BA, CNOR, CRCST, GTS

Healthcare-associated infections strike fear into the hearts of infection preventionists, nursing administrators and patients. These potentially avoidable infections raise costs, delay discharges, prolong healing, and significantly increase each patient's risk of morbidity.

Preventing infections requires an all-hands-on-deck approach to breaking the chain of events that can lead to them. In addition to the infection prevention policies, procedures and practices operating throughout a healthcare facility, the work of the sterile processing department is a critical infection prevention function. A deeper understanding of the mechanisms of infection can inform this work and help optimize its infection control capabilities.

Infection factors

An infection happens when disease-causing agents enter the human body and begin to multiply. The agents invade the person's body tissues and cause a reaction. Some reactions are benign, like a runny nose, while others are deadly. There are many types of disease-causing agents. They include viruses, bacteria, protozoa, some parasites, and prions.

Infections require three contributing factors to spread:

1. *Reservoir:* the infected person acts as a reservoir that allows the disease-causing agent to multiply and grow.
2. *Transmission:* Transmission is the path the disease-causing agent will take to reach and infect a new person.
3. *Susceptible host:* this is a person who can be infected. Once infected, this person becomes a reservoir.

Infection transmission stops when one of these three factors is removed. Healthcare providers focus on preventing transmission and exposure of susceptible hosts to disease-causing agents, and they apply many strategies and tactics to prevent transmission. Each specific tactic is designed to address a particular route of transmission. For example, one important method of preventing transmission via reusable devices and instruments is sterilizing them between patients.

Reservoirs and transmission

An infected person (reservoir) sheds disease-causing agents. Shedding allows agents to be transported to a new person (host) to infect. ***Contact transmission*** is the most common way to spread infections. The host comes into direct contact with the disease-causing agents on/in the reservoir. How the agents reach the host depends on how they are shed.

Disease-causing agents have several ways to leave the reservoir. The most common ways are through body fluids and excretions. Urine, feces, and sputum top the list of common exit points for bacteria, viruses, and parasites. The skin can also be a departure point. Bacteria and parasites on the skin transfer to another person when touched. ***Direct contact*** with the reservoir or their excretions is the first path of transmission.

In healthcare, direct contact with body tissues and blood is also a concern. Staff members can contact blood and tissue when collecting samples from patients or performing medical procedures on them.

Indirect contact is the second most common method of infection transmission. Body fluids and tissues deposited on surfaces may remain infectious for hours or even days depending on the surface material. In some cases, such as with anthrax, the material can remain infectious for years. Contact with the contaminated surface is an indirect path for transmission. Common healthcare surfaces include walls, floors, door handles, linens, used medical devices, bed tables, sinks, toilets, transport carts and any other devices or surfaces that are in proximity to infected patients, patient secretions and body tissues. In the SPD, handling contaminated instruments during reprocessing can be a primary means of indirect contact transmission.

There are some disease-causing agents that travel by air. ***Airborne transmission*** is limited to disease-causing agents that are suspended in the air on tiny droplets or fine particles of dust for long periods of time. These agents ride the air currents to find the next person to infect. Tuberculosis is an example of a disease spread through the air.

Airborne transmission is not the same as ***droplet transmission***. Coughing and sneezing are examples of droplet dispersion. Droplet dispersion relies on the physical force provided by the reservoir to send the infectious material to a new person. Droplet dispersion also deposits infectious material on surfaces that can later be transferred to a new person. Droplet dispersion is a form of contact transmission.

The final way to spread infection is by ***vector transmission.*** A vector is a living organism that directly transmits the infectious agent into the body of a healthy person. Vector transmission can be a very complicated process involving many different organisms along the pathway to human infection. Ultimately, the infection reaches the human by an insect biting or burrowing through the skin, or by the person eating a vector. Table 1, below, shows common diseases and their vectors.

Table 1: Common Vectors and their Diseases in the United States

Vector / Transmission	Illness	Disease Agent	US Infections [1, 2, 3]
Flea / Bite	Bubonic Plague	Bacteria: *Yersinia pestis*	7 per year
Mosquito / Bite	West Nile Fever & Encephalitis	Virus: West Nile Virus (WNV)	900 per year
Mosquito / Bite	Malaria	Protozoa: *Plasmodium falciparum*	2,000 per year
Cow & Pig / Eat undercooked meat	Tapeworm	Worm (Helminth): *Taenia saginata Taenia solium*	<1,000 per year

The reservoir is the source of every infectious agent, so finding reservoirs is the first step to preventing transmission. This is harder than it seems. Reservoirs can be shedding infectious materials but have no signs of illness. This happens during the incubation time of the disease. The incubation time is the time after infection but before the onset of illness. During this time, infected people can be contagious and able to spread the disease without realizing that they are infected. Incubation times vary greatly among illnesses (Table 2, above-right). In rare cases, a person may become infected and never become ill or show any signs of infection. This asymptomatic infected person is referred to as a carrier. Carriers can spread diseases quickly and are difficult to identify.

Table 2: Incubation periods of different infectious agents

Type of Infectious Agent	Agent Name	Examples of diseases	Average Incubation Period (per CDC)
Virus	H1N1 H3N2	Influenza A / the Flu	2-4 days
	HIV-1 and HIV-2	Acquired Immune Deficiency Syndrome (AIDS)/HIV	40-60 days
Bacteria	*Borrelia burgdorferi*	Lyme disease	3-10 days
	Methicillin Resistant *Staphylococcus aureus*	MRSA	2-5 days
Protozoa	*Plasmodium falciparum*	Malaria	7-30 days
	Toxoplasma gondii	Toxoplasmosis	5-23 days
Parasites	*Taenia solium* *Taenia saginata*	Tapeworm	8-10 days 10-14 days
	Enterobius vermicularis	Pinworm	30-60 days
Prions	Prion Protein	Creutzfeldt-Jakob Disease (CJD)	11-12 years (estimated)
	Prion Protein	Mad Cow Disease (vCJD)	5-10 years (estimated)

Susceptible host

The last link in the infection chain is the susceptible host; a person who will get sick when exposed to an infectious agent. Many factors influence a host's risk of getting sick. Health conditions, age, immunizations, past infections, and natural immune defenses all play a role in the host's battle against infectious agents. People in poor health, the very young or old, the unimmunized, those with lowered immune systems, and persons recovering from a medical condition or surgery are more likely to get sick.

In addition to being susceptible to normally infectious agents, immunocompromised people can suffer infections from microorganisms that do not normally cause illness. Many microorganisms live in the environment and on people, and a healthy person can fight off these types of microbes and stay well.

Microorganisms that do not cause infection in healthy people but will cause serious infections in immunocompromised patients are known as *opportunistic microorganisms*. Many opportunistic microorganisms live in and on healthy people. *For example, Staphylococcus epidermidis* is a regular resident of human skin, where it lives without hurting its host. However, it is the most common source of infection on indwelling medical devices such as catheters and drain tubes. *Staphylococcus aureus* is another common microorganism that lives within the ears, nose, and throat. It too can cause infection in an immune depressed individual. The most well-known *Staph. aureus* disease is Methicillin-resistant *Staphylococcus aureus* or MRSA. And *Streptococcus pneumoniae* normally lives in the nose, throat, and mouth of healthy people. However, when conditions are right, the organism can migrate to the lungs and cause pneumonia.

Patients undergoing treatment within healthcare facilities are some of the most likely hosts for infection. Many suffer from existing medical conditions and undergo treatments that lower their ability to fight off infections. Preventing the spread of infectious agents to this vulnerable population is the main goal of infection prevention professionals.

Breaking the chain in the SPD

Infection risk can be greatly reduced by removing just one of the three contributing factors. Hospital policies and procedures should apply principles of infection prevention that target these elements.

Manage the reservoirs:

Sterile processing staff are the most likely reservoirs in the department. However,

Self-Study Test Answers: 1. A, 2. D, 3. B, 4. C, 5. A, 6. A, 7. C, 8. D, 9. B, 10. C

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any person can be a reservoir. Vendors, staff from other departments, and temporary employees are also potential reservoirs. Policies and procedures should be in place governing actions to take for a reported staff illness. Consider when to send staff home, precautions to take when working with a sick person, and what to do for items and staff exposed to an ill person during the incubation period. Also include policies and procedures for department visitors and contracted workers.

Staff should also take steps to prevent transmission of opportunistic microorganisms. The use of hair and beard nets, hospital-supplied clean scrubs and shoe covers all prevent the shedding of opportunistic microorganisms. Staff should wash hands often to reduce the microbial population and wear gloves as appropriate.

When staff have been exposed to a respiratory infectious agent such as influenza, consider wearing surgical face masks during the incubation time of the disease agent. Face masks may also be used during respiratory illness outbreaks that occur in the facility or community. Face masks should fit over the nose and mouth. The mask should not pucker or allow free exchange between the environment and the person's airway.

Identify the vehicles of transmission:
Infectious agents enter the sterile processing department in a variety of ways. Finding these routes and treating the infectious agents is the second way to break the infection chain in sterile processing departments.

Infectious agents hide in many places. The most obvious place is in and on the reusable medical devices and equipment used for surgical and diagnostic procedures. These items have contacted body fluids and tissues and may have transferred infectious agents from the patient to the item. In addition, items handled by nurses, doctors, and others during procedures allow for opportunistic microorganisms to transfer to the equipment. For these reasons, all items must be thoroughly cleaned and treated with an appropriate microbicidal process to prevent transfer of infectious materials to the next patient.

Water also harbors organisms that can cause disease. Tap water, hoses, spouts, drains, and even treated water can harbor *Pseudomonas aeruginosa*, *Legionella sp.* and other opportunistic microorganisms. Water sources should be periodically checked for infectious agents, and drains should be regularly treated to reduce microorganism levels.

Develop thorough, proactive infection prevention procedures:
All items processed by the sterile processing department should undergo a microbicidal process that is appropriate for the devices' use and patient population. Surgical instrumentation should be sterilized and items such as IV pumps should be disinfected. But there are times when it may be necessary to perform a higher level of microbicidal processing due to the presence of a particular infectious agent. For example, patient care items normally requiring low-level disinfection may need a higher level of disinfection when they have been used on a floor experiencing an outbreak of *Clostridioides difficile* (C. diff).

Facilities should also have policies and procedures in place for inactivating and disposing of instruments with suspected exposure to prion transmissible agents. Prions are not living organisms and require specialized treatment to render the instruments safe for disposal. Procedures should also include testing the surfaces and equipment used to treat these devices.

Sterile processing managers should also work directly with their infection prevention colleagues to identify and remediate any sources of infectious material transmission within the department. By taking advantage of the IP perspective, managers may discover modes for transmission that they were not aware of.

Reduce risk for susceptible hosts:
Since the majority of hospitalized patients are already susceptible to infectious agents, it's very difficult to break this link in a hospital setting. However, some steps can be taken to help reduce the risk. For example, staff should be encouraged to vaccinate, including against hepatitis B, the flu, chicken pox and meningitis.

Also, medical screenings can identify staff that are harboring infectious agents but may not know it. Screenings can be conducted for communicable diseases that have high rates of asymptomatic carriers. For example, approximately 13 million people in the US have latent tuberculosis and 5-10% of them will become active and transmissible within two years of exposure.[4] Knowing this, some facilities have implemented an annual screening for TB. Also, the number of healthcare workers carrying MRSA is estimated to be between 1.0 and 6.9%,[5] so nasal screenings for MRSA can also be conducted.

It's also important to note that infection prevention needs will change with seasons, outbreaks, pandemics, and patient population changes. To be proactive, sterile processing departments' infection prevention strategies should be reevaluated as these larger changes occur.

Knowledge reduces risk

Managing the spread of infection is a complex and multifaceted challenge. To successfully reduce the risk, all healthcare workers must act as infection prevention advocates. By gaining knowledge about the principles and factors involved in infection transmission, SPD staff is empowered to support all infection prevention policies and procedures in their department. They know they are protecting themselves, their fellow staff members, hospital visitors, vendors, clinicians, and of course, the patients their functions ultimately serve. HPN

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CONTINUING EDUCATION TEST • JULY 2020

Breaking the chain of infection

Circle the one correct answer:

1. What is the role of the reservoir in infection transmission?
a. Allow the infectious agent to multiply and grow
b. Inject the infectious agent directly into another person
c. Immunize staff members
d. Find areas where infectious agents might be

2. Which statement is true?
a. The reservoir never shows symptoms
b. A susceptible host sheds infectious agents
c. A reservoir only sheds infectious agents when they are showing symptoms
d. Once infected, a susceptible host becomes a new reservoir

3. Which is a form of direct contact transmission?
a. A technician touches a contaminated medical device during cleaning
b. An ill patient grabs the nurse's hand for comfort
c. A visitor touches a contaminated doorknob
d. A vendor breathes in aerosolized contaminated fluids from the ultrasonic cleaner

4. Droplet transmission is which form of transmission?
a. Airborne transmission
b. Vector transmission
c. Contact transmission
d. Insect transmission

5. A carrier is a person who is infected but shows no signs of infection.
a. True
b. False

6. When is an infected person contagious?
a. During the incubation period and while showing symptoms of illness
b. While showing symptoms of illness
c. During the incubation period but not when showing symptoms
d. Only when the person sneezes

7. What is an organism that normally does not cause infection but will do so under the right conditions called?
a. Advantageous microorganism
b. Parasitic microorganism
c. Opportunistic microorganism
d. Synergistic microorganism

8. Who is not a reservoir in sterile processing departments?
a. Sterile processing staff
b. Vendors
c. Visiting staff
d. Patients

9. Which are common vehicles of infectious materials or opportunistic microorganisms found in sterile processing departments?
a. Contaminated medical devices and toilet seats
b. Contaminated medical devices and sink drains
c. Waiting room furniture and contaminated medical devices
d. Sterilizer chambers and contaminated medical devices

10. Immunization of hospital staff and patients is used to proactively break which link in the chain of infection?
a. Reservoir
b. Transmission
c. Susceptible Host
d. Vector

CONTINUING EDUCATION TEST SCORING

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