

BLOODBORNE PATHOGENS AND INFECTION CONTROL

Infectious diseases can be transmitted from person to person. They can be spread through the air, by contact with blood or other body fluids, by touching contaminated surfaces, or by contact with infected wounds. Microscopic organisms that can cause infection are everywhere in the environment, especially in the healthcare setting. To prevent infections from spreading to other patients, healthcare workers, or the community at large, all healthcare workers must understand how bacteria, viruses, and other microorganisms are transmitted that cause infections.

Learning Goals:

1. Identify a basic definition of infection control.
2. Identify the most common way microorganisms spread from person to person.
3. Identify three body fluids/secretions that can be infectious.
4. Identify a definition of standard precautions.
5. Identify a definition of universal precautions.

Introduction

The primary responsibilities for Certified Nursing Assistants (CNAs) is to protect themselves and patients in the healthcare setting. In order to keep patients safe as well as to protect one's role as a CNA, basic principles of infection control must be understood and carried out. There will be many times when the CNA will care for people with infectious diseases during the course of a career. Unlike some pathologies such as cancer or diabetes, infectious diseases can be transmitted from person to person. They can be spread through the air, by contact with blood or other body fluids, by touching contaminated surfaces, or by contact with infected wounds. Also, microscopic organisms that can cause infection are everywhere in the environment, and they are especially plentiful in the setting of healthcare. In order to prevent these infections from moving to other patients, to the healthcare worker, or to the community at large, it is necessary to understand how bacteria, viruses, and other microorganisms that cause these infections can be transmitted. It is also necessary to know how to work with people who have, or may have, a transmittable disease to avoid becoming infected or infecting others.

The Basics Of Disease Transmission

Infectious diseases are diseases that can be spread from person to person. They are caused by different types of microorganisms. Microorganisms are microscopic life forms that cannot be seen and they are, literally, everywhere. Bacteria and viruses are examples of common microorganisms. They live in the air, in the water, in the soil, and they live in and on our bodies. Microorganisms are found on the skin, lungs, stomach, etc. This sounds

**The basic definition of infection control is:
*A system of techniques used to prevent infections and reduce the spread of infections.***

unpleasant but many of these microorganisms are actually very helpful. In the stomach and the gastrointestinal tract, they help to digest food. In other parts of the body they help fight infection and help maintain the proper internal environment that the body needs to function.

However, there are microorganisms that are not a normal part of the human body internal environment and that can cause illness, and there are microorganisms that do normally live in or on a person but that can cause illness if they are particularly strong or the person is vulnerable. These microorganisms that cause, or can cause illness or disease are called pathogens.

Some pathogens such as the virus that causes the flu produce an illness that is relatively mild and rarely causes serious harm. Some pathogens can cause a more serious illness such as pneumonia, but pneumonia can usually be successfully treated with antibiotics. And there are pathogens such as human immunodeficiency virus (HIV), the virus that causes acquired immune deficiency syndrome (AIDS). There is no cure for AIDS and no vaccine to prevent infection with HIV.

But regardless of how dangerous a pathogen may be, these microorganisms are potentially dangerous because they can move from one person to another. The pathogens are communicable and contagious. They can be spread from the healthcare worker to a patient, they can move from a patient to others, or they can be carried by a healthcare worker from an infected patient to other people. Pathogens that are relatively harmless, such as the flu virus, may even be dangerous if they infect someone who is weak or vulnerable. Someone who has AIDS, someone who has cancer, or a person with diabetes may not be able to contain an infection in the way that normally healthy person would. These patients may suffer serious consequences from a simple infection.

There are five basic ways an infection can spread. Some pathogens can only be spread by one of the transmission routes but some can be spread by several.

Airborne Transmission

Microorganisms are always living in the mouth, the nose, the lungs, and the other parts of the respiratory tract. When someone exhales, talks, sneezes, or coughs, these bacteria and viruses are attached to droplets of moisture and move from the infected person to the air. The infected droplets can move long or short distances, and they can remain suspended in the environment for quite a while or for only a short period of time. How far they move, and how long they stay suspended in the air differs with each microorganism.

The risk, of course, is that a dangerous pathogen will move far enough and stay in the air long enough for it to enter the respiratory tract of someone in the area and cause harm. Chicken pox, measles, and tuberculosis are common diseases that have airborne transmission. Influenza can also be spread by airborne transmission, but this method of transmission is limited to short distances of approximately three feet or so.

Blood Transmission

Pathogens such as hepatitis B, hepatitis C, and HIV are spread by contact with infected blood. This can happen if a healthcare worker is stuck by a needle or splashed with blood in the eyes, mouth, or nose. It can also happen if blood-contaminated medical equipment that is used for more than one patient is not properly cleaned and sterilized, or if the equipment is used improperly, *i.e.*, if a single-use, disposable medical item is used twice.

People who use intravenous (IV) drugs and share needles are at high risk for blood transmission of pathogens. Blood transmission can occur through the skin, but only if there is an abrasion or a cut, an entry port for the microorganism. The eyes, mouth, and nose have mucous membranes. These are much more porous than the surface of the skin and bacteria and viruses can easily pass through them and reach the circulation.

Contact Transmission

Contact transmission of a microorganism occurs when someone has direct contact with the infectious agent. This contact may be simple skin-to-skin contact such as touching a contaminated wound or a contaminated object. Contact transmission is one of the ways that the cold and the influenza viruses are transmitted. These viruses are expelled when an infected person breathes, coughs, or sneezes and the virus settles on objects in the environment, objects such as a computer keyboard, a doorknob, or a telephone receiver. An uninfected person will touch that object, touch his/her nose or mouth and the virus enters the respiratory tract.

Other relatively common diseases that are spread through contact transmission are hepatitis A (contact with infected stool), methicillin-resistant staphylococcus aureus (commonly known as MRSA), and many microorganisms that contaminate wounds. Contact transmission of a pathogen is possible by contact with almost any infected body fluid, *i.e.*, blood, mucous, semen; sweat and tears are not generally considered to be high-risk body fluids and contact transmission of a pathogen from these fluids would be very unlikely.

Droplet Transmission

Droplet transmission could be considered to be a mix of airborne transmission and contact transmission. Droplet transmission occurs when an

infected person breathes, coughs, sneezes, or talks and small droplets that are contaminated enter the air and are breathed in by other people. Droplet transmission can also happen during medical procedures such as suctioning. Most experts feel that droplet transmission only occurs within an area of three feet from an infected person, although some people feel the distance may be up to 10 feet. Diseases that can be spread by droplet transmission include influenza, mumps, and pertussis, a.k.a. whooping cough.

Sexual Transmission

Herpes, HIV, gonorrhea, hepatitis C (possibly), syphilis, chlamydia, and other diseases can be spread during sexual contact. These contacts can be male-to-female, female-to-male, male-to-male, and female-to-female. The sexual contact can be anal, oral, or vaginal.

So, infectious pathogens are everywhere in the environment and there are many ways they can be spread. It might seem surprising then that most of us are healthy most of the time. However, for disease transmission to occur the proper conditions must be in place. Movement of a microorganism from one person is just the first step in the development of an infection. For the infection to progress to the development of an infectious illness that produces signs and symptoms, the following factors have to be in place.

- The microorganism must be capable of causing an illness; it must be a pathogen
- The pathogen must be strong enough to cause an illness; it must be virulent

Contact transmission is easily overlooked. Viruses and bacteria live everywhere and even brief and casual contact with something that is contaminated is enough for a microorganism to move from that object or body fluid to you. And even brief and casual contact between you and someone else may be enough to spread that bacteria or virus to the patient.

- The pathogen must be strong enough to resist the immune system
- There must be a sufficient number of the pathogens
- The pathogen must move from person-to-person; transmission mechanism
- There must be an entry point - airborne, blood, sexual contact, *etc.*
- The victim - commonly called the host - must be susceptible

The Process Of Disease Transmission

The last part of this process, the susceptibility of the host, can be complicated. The susceptibility could be inherited, or the host may have a weak immune system. For example, infants and the elderly people do not have strong immune systems, and people who have certain cancers or who have HIV/AIDS have compromised immune systems. There are also some drugs that can weaken the immune system and make people who are taking these drugs susceptible to infections.

This is a complicated process and certain parts of the process of how someone develops an infection cannot easily be influenced; for example, host susceptibility is hard to change, limiting the strength of the pathogen cannot be practically done, nor can controlling host entry points. However, years of experience and research have proved that the best way to prevent pathogen transmission is to practice good infection control procedures and techniques. Practicing good infection control can dramatically reduce the risk of a pathogen moving from person to person.

Infection control is designed to prevent infectious illnesses by disrupting/preventing airborne, blood, contact, droplet, and sexual transmission of pathogens from infected people to uninfected people or from the environment to a host.

Infection Control: Standard Precautions

The two basic goals of infection control are to protect the patient and health care personnel from infection. Infection control starts with standard precautions. Standard precautions are the methods recommended by the Centers for Disease Control and Prevention (CDC) for preventing the transmission of infections. Standard precautions include: 1) handwashing, 2) respiratory hygiene/cough etiquette, 3) safe injection practices, and 4) the use of personal protective equipment (PPE). Each of these has specific techniques, rules, and procedures that will be discussed. But the principle that underlies all of the aspects of standard precautions, and the principle that must be remembered, is that *blood and all body fluids and secretions (with the exception of sweat and tears) should always be considered potentially infectious.*

'*Universal precautions*' is a term that refers to infection control protocols and techniques that were used before standard precautions. They are essentially the same as standard precautions, which are a bit more complex and it is now the preferred term.

Of course, patient care inevitably involves the possibility of exposure to blood and body fluids and secretions. Many times, a CNA will know that he/she is caring for a patient with an infectious disease but it is possible the CNA could be in close contact with someone who has a communicable illness or a high level of a pathogen and neither the CNA nor the patient knows. So, standard precautions are always used when delivering patient care.

Infection control is extremely important. It has been estimated that each year millions of patients develop illnesses because microorganisms are spread to them from health care workers or from the surrounding environment. Many of these healthcare-acquired infections are very serious,

and the patients can suffer serious harm from them. However, it has also been recognized that these illnesses can be prevented if health care workers carefully and conscientiously follow standard methods of infection control. Infection control is simple but it can be time consuming. Knowing and using good infection control procedures will not only protect patients and clients and the community at large, it will also protect the healthcare worker.

Handwashing

Handwashing has been recognized by the CDC as the most important way to prevent the spread of infection. If it is done properly, handwashing has been proven to greatly reduce the number of healthcare-acquired infections. Handwashing is not complicated, but doing it right does take a bit of time. When working on a busy hospital floor or a clinic, it can be tempting to save time by cutting corners when washing the hands. It can also be tempting to cut corners with handwashing because it may seem as if spreading bacteria or viruses is something that only happens when handling a contaminated bandage or working with a person who has a communicable disease. But microorganisms live everywhere, and it takes very little for them to move from a contaminated surface to the healthcare worker, and from the healthcare worker to a patient. Even brief, casual contact with an infected object can be enough for the pathogen to move to the healthcare worker and then potentially to someone else.

Healthcare Handwashing Protocol

The following rules should be followed with regard to healthcare workers and hand hygiene. Handwashing should occur as follows:

- At the beginning of the day before starting patient care.
- When the hands are visibly soiled.
- Before contact with a patient.

- After contact with a patient.
- Between contact with patients.
- Before and after eating.
- After you sneeze or cough.
- After contact with body secretions, such as urine, stool, blood, saliva, or mucous.
- After contact with surfaces that may be contaminated.
- Before and after putting on gloves.
- Before and after using the bathroom.
- At the end of the day.

It is not enough to simply rinse briefly and then dry off after handwashing. To be effective, handwashing must be done properly. The entire procedure should take 40-60 seconds if done correctly.

- Remove all jewelry. It has been proven that microorganisms can survive under rings, watches, *etc.*, even if hands have been washed. Use lukewarm water and wet the hands up to the level of the wrists.
- A reasonable amount of antimicrobial soap should be used; these are soaps that have alcohol or some other disinfecting component.
- The soap should be rubbed gently for 15 seconds all over the hands. Particular attention should be paid to the areas between fingers and the areas around fingernails. This process should be repeated for 15 seconds on the other hand. Soapy hands should not be rubbed under running water.
- If blood, urine, or some other body secretion are suspected to contaminate fingernails or anywhere near nails, a scrub brush should be used to wash these areas.
- Running water should be used to rinse the hands.
- Hands should be dried thoroughly with disposable paper towels.

- Use the towel to turn the water off; do not touch the faucet with your clean hands.
- Discard the towel.

Infectious disease specialists recommend that healthcare workers keep their fingernails short. Long fingernails can puncture rubber gloves, and it is difficult to clean away microorganisms from under long fingernails. Also, there is a much greater chance for bacteria and viruses to live and thrive on the hands when fingernails are long.

During the course of a normal work day healthcare workers may find handwashing needs to occur dozens of times. Even if a person's skin is not sensitive, frequent handwashing can cause hands to become cracked, dry, and sore. This becomes very uncomfortable if hand irritation reaches a point of open skin areas, and, importantly, can be a health hazard for the healthcare worker and patients because one of the most important defenses against infection - an intact skin surface - has been compromised. Cracks in the skin that can allow entry of microorganisms can be too small to be seen.

Dry and cracked skin can be prevented. It can help to use warm - not hot - water when handwashing. Handwashing should be limited to 15 seconds for each hand. The hands should be gently patted dry if they are chapped and sore and a lubricating/moistening lotion used at the end. For open areas on the hands from handwashing, if the healthcare worker feels at risk, an immediate supervisor should be notified. Healthcare workers could be at risk for transmission of an infectious disease by the entry of a pathogen through the breaks in the skin.

Alcohol-Based Hand Sanitizers

Alcohol-based hand sanitizers are considered to be safe and effective for handwashing in healthcare settings. These products typically contain 62%

ethyl alcohol, a substance that has been proven to be very effective in eliminating pathogens from skin. The only limitation to their use is if hands become visibly contaminated or dirty. If that happens, the soap and water technique should be used. Guidelines for using alcohol-based hand sanitizers are listed here.

- Apply a palm-sized amount of the alcohol-based sanitizer in one hand.
- Rub the hand palms together.
- Rub the right palm on the back of the left hand, and intertwine the fingers and rub.
- Rub the left palm on the back of the right hand, and intertwine the fingers and rub.
- Palm to palm, intertwine the fingers and rub.
- Rub the backs of the fingers of each hand in the opposite palm.
- Hold the left thumb in the right hand, close the hand and rub.
- Hold the right thumb in the left hand, close the hand and rub.

The procedure should take no more than 20-30 seconds. Alcohol-based hand sanitizers should be used in the same situations that were listed above.

Remember, when hands are washed the intention is to make them clean *and* to remove pathogens, but handwashing does not sterilize the skin.

Sterilization is a term that means complete removal of all pathogens, and this can only be done using extremely high temperature or with sterilization chemicals that would damage the skin. Medical devices that are used for surgery or that will be reused can be sterilized, but skin cannot be sterilized.

Respiratory Hygiene And Coughing Etiquette

Respiratory hygiene and coughing etiquette is one of the simpler parts of standard precautions. It is used to prevent the transmission of respiratory

illnesses such as influenza, and involves the following basic common-sense steps.

- Cover the nose and mouth with a tissue when coughing or sneezing.
- Wash the hands after coughing or sneezing.
- When using a tissue, throw it away and then wash the hands.
- Consider offering a simple face mask to patients who are coughing or sneezing.
- Someone who is coughing should sit at least three feet away from other people.

Safe Injection Practices

Safe injection practices are an important part of standard precautions. It is unlikely that a CNA would be involved in any care or procedures that involve needles or sharps. However, CNAs should know the basics of safe injection practices because they may be asked to dispose of needles or sharps. The basics of safe injection practices are listed below.

- Needles should never be recapped.
- Needles are single-use only and never to be reused, even if it is to be used with the same patient.
- Needles should never be bent or broken before discarding them.
- All needles and sharps should be properly disposed of in the appropriate containers. These containers are usually red, they are made of a hard plastic, they have a biohazard symbol on the side, and they are usually marked "SHARPS."
- Never dispose of a needle or a sharp in the trash. Blood-borne infectious diseases such as hepatitis B, hepatitis C, and HIV can live in/on needles and sharps for several days after they have first been contaminated with

blood. A contaminated needle or sharp in the trash can puncture anyone who handles the trash.

If a healthcare worker is stuck with a used needle or splashed on the skin or in the eyes, mouth or nose with blood or any type of body fluid, the worker's supervisor should be notified *immediately*. Healthcare workers who suffer a needle stick or a splash contact with blood may be at risk for becoming infected with hepatitis B, hepatitis C, or HIV. Trying to make an independent decision about whether the needle or splash exposure is serious or not serious should not be done by the healthcare worker. If the risk of infection is high, the needle stick injury, or exposure to blood should be reported immediately while at work and treatment started very soon after the exposure. Healthcare workers at risk of exposure to infection must be evaluated as soon as possible by a medical clinician.

Any healthcare worker should be informed of the risk of becoming infected from a needle stick or a splash with blood. The risk differs, and it depends on the pathogen, contamination of the needle or sharp, how deep the wound is, and several other factors. The risk of developing an infection with HIV after a needle stick is approximately 1 in 300, and the risk of developing an HIV infection after being splashed in the mouth or on an open cut is approximately 1 in 3000. Of course, as mentioned previously the risk of infection depends on many factors, and healthcare workers should never try to decide independently if a needle stick or other exposure is/is not high-risk.

Personal Protective Equipment

Personal protective equipment includes disposable gloves, gowns, shoe covers, hair covers, and masks and face shields. Personal protective

equipment (PPE) is single-use and disposable. The rules for using PPE are as follows.

- Gloves do not replace the need for handwashing.
- Gloves should be worn when handling any body fluids or secretions (except sweat and tears) or any object that may be contaminated with them, or if likely to be handling any body fluids or secretions (except for sweat and tears) or any object that may be contaminated with them.
- Gloves should be worn if touching mucous membranes or non-intact skin.
- Wearing two pairs of gloves is not necessary.
- If wearing other PPE, gloves should be put on last. Gloves are removed first if they are worn with other PPE.
- Wash the hands before putting on gloves. Put the gloves on by pulling them on by the bottom edge.
- Remove gloves by grabbing the end of one glove and peeling it off. Then with the ungloved hand, slide a finger or two between the skin and the remaining glove and peel it off without touching the outside.
- Wash hands after removing gloves.
- Do not use the same pair of gloves to perform two different tasks.
- Never wear the same pair of gloves to care for two different patients.
- Wear a disposable gown, shoe covers, and a hair cover if there is a chance of being splashed with blood, urine, or other body fluids.
- Wear a face mask and/or eye protection if there is a chance of being splashed with blood or body fluids.
- Discard all PPE in the proper receptacles.

Infection Control: Transmission Precautions

Standard precautions are the cornerstone of infection control; however, certain patients need protection that goes beyond standard precautions. These patients have infectious diseases that can be easily transmitted to healthcare personnel or to other patients. These special transmission precautions are airborne transmission precautions, droplet transmission precautions, and neutropenic transmission precautions. Of course, standard precautions should always be used in conjunction with these other transmission precautions.

It is not the healthcare worker's responsibility to determine which special transmission precautions are needed for any particular patient. A medical clinician or an infectious disease specialist will make that determination, and the rules and procedures for the specific transmission precaution are usually prominently posted. Also, some patients may only need to be placed on airborne transmission precautions for a certain period of time.

Airborne Transmission Precautions

Airborne transmission precautions are used to prevent the transmission of infectious diseases that are easily spread through the air. These diseases are: 1) chicken pox (varicella), 2) herpes zoster, 3) measles (rubella), 4) smallpox, and 5) tuberculosis. Airborne transmission precautions are needed because these diseases are spread by infected droplets that are coughed or exhaled from the lungs and respiratory tract of an infected patient. The droplets stay in the air for a relatively long time and they can travel a relatively long distance - unlike droplets that are infected with common cold or influenza viruses.

The use of airborne transmission precautions was once called placing a patient in isolation. Currently, airborne transmission precautions require a patient to be placed in a single room that has a special ventilation system. The door should be closed at all times. Anyone entering the room must wear special PPE that prevents inhalation of airborne droplets. This should be: 1) a N-95 mask, or 2) a powered air-purifying respirator. It is not necessary to remember these terms, but it is important to remember that a simple paper face mask is not sufficient protection. If a patient must be transported or moved, the patient should wear the required respiratory protection, as well.

Droplet Transmission Precautions

Droplet precautions are used if a patient is known to have or is suspected to have an infectious disease that is transmitted by coughing, sneezing, or talking. Some of these diseases are: 1) influenza, 2) mumps, and 3) pertussis (whooping cough). These activities spread infected droplets into the air and onto surfaces in the environment. However, unlike the infected droplets from a patient who has chicken pox or tuberculosis, these droplets do not travel very far and do not remain in the air for a long time. Patients who require droplet precautions should be in a private room.

Respiratory or cough etiquette must be strictly observed. Anyone who is within three feet of the patient should wear a mask; a simple paper face mask is sufficient.

Neutropenic Precautions

Neutropenic precautions are also called reverse isolation. A patient who needs neutropenic precautions has a seriously compromised immune system and cannot protect himself/herself from infections. Examples of medical or

health conditions in patients needing protection with reverse isolation would include those listed here.

- *AIDS*

AIDS attacks the immune system.

- *Certain Types of Cancers*

Certain cancers such as Hodgkin's disease affect the immune system, and patients who have these cancers would need neutropenic precautions.

- *Severe Burns*

One of the most important protective mechanisms against infection is intact skin, which acts as a physical barrier that prevents the access of pathogens to the blood stream and organ systems. Small breaks in the skin are not large enough to be a risk; but with large damaged skin areas, as with a patient who has many severe burns, the risk for infection is greatly increased.

- *Organ Transplant*

Regardless of how well the organ is matched to the organ recipient, there is always a risk that the body's immune system will recognize the transplanted organ as a foreign object and try and reject it. To prevent that from happening, organ transplant patients are given strong immune suppressing drugs, so these patients are highly susceptible to developing infections and need neutropenic precautions.

A patient who needs neutropenic precautions should be placed in a private room with special ventilation. Standard precautions and respiratory hygiene

or cough etiquette should be used. In addition, other precautions and PPE may be needed; each case is handled differently.

Summary

Microorganisms are potentially dangerous because they can move from one person to another. Pathogens are communicable and contagious. They can be spread from the healthcare worker to a patient, they can move from a patient to others, or they can be carried by a healthcare worker from an infected patient to other people. Even those pathogens that are considered relatively harmless, such as the flu virus, can be dangerous if they infect someone who is weak or vulnerable.

When working on a busy hospital floor or a clinic, it can be tempting to save time by cutting corners when washing the hands. It can also be tempting to cut corners with handwashing because it may seem as if spreading bacteria or viruses is something that only happens when handling a contaminated bandage or working with a person who has a communicable disease. But microorganisms live everywhere, and it takes very little for them to move from a contaminated surface to the healthcare worker, and from the healthcare worker to a patient. Even brief, casual contact with an infected object can be enough for the pathogen to move to the healthcare worker and then potentially to someone else.

Standard precautions are the cornerstone of infection control. But certain patients need protection that goes a bit beyond standard precautions; these patients have infectious diseases that can be easily transmitted to healthcare personnel or to other patients. These special transmission precautions are airborne transmission precautions, droplet transmission precautions, and neutropenic transmission precautions.

Infection control is one of the most important aspects of a healthcare worker's job. Pathogens and the risk of infection are a constant presence, and healthcare workers must conscientiously observe principles of infection control and practice recommended techniques to avoid the transmission of infection. As far as risk assessment, the first thing healthcare workers should remember is that infection control is intended to prevent the transmission of microscopic pathogens that are literally everywhere, especially in a healthcare setting.