

Introduction to Infection Prevention



Course Author(s): Barbara A. MacNeill, DMD, MS; Géza T. Terézhalmy, DDS, MA

CE Credits: 2 hours

Intended Audience: Dentists, Dental Hygienists, Dental Assistants, Office Managers, Dental Students, Dental Hygiene Students, Dental Assistant Students

Date Course Online: 07/01/2019

Last Revision Date: N/A

Course Expiration Date: 06/30/2022

Cost: Free

Method: Self-instructional

AGD Subject Code(s): 148

Online Course: www.dentalcare.com/en-us/professional-education/ce-courses/ce582

Disclaimer: Participants must always be aware of the hazards of using limited knowledge in integrating new techniques or procedures into their practice. Only sound evidence-based dentistry should be used in patient therapy.

Note to Iowa dental professionals: This course complies with the Iowa Dental Board for recertification in the area of infection control standards, as established by the Centers for Disease Control and Prevention (CDC).

Conflict of Interest Disclosure Statement

- Dr. MacNeill reports no conflicts of interest associated with this course.
- Dr. Terézhalmy has done consulting work for Procter & Gamble and has served on the dentalcare.com Advisory Board.

Introduction – Infection Prevention

One of the elements of a “safe healthcare setting” is the implementation of strategies that minimize or prevent healthcare-associated infections (HAIs). While the risk of transmission of pathogenic microorganisms in oral healthcare settings is rare, HAIs do present a potential hazard to healthcare providers and patients alike. A critical element of basic expectation for safe care is the implementation of Standard and Transmission-base Precautions and an ongoing education and training program.

Course Contents

- Overview
- Learning Objectives
- Introduction
- Requisites for the Transmission of Pathogenic Organisms
 - Sources of Infectious Agents
 - Susceptible Host
 - Modes of Transmission
- Standard Precautions
- Transmission-based Precautions
 - Contact Precautions
 - Droplet Precautions
 - Airborne Precautions
- Putative Pathogens Associated with HAIs in Oral Healthcare Settings
- Fundamental Elements of an Effective Infection Prevention Strategy
- Infection Prevention Education and Training
- Basic Expectations for Safe Care
- Summary
- Course Test
- References
- About the Authors

Overview

The risk of transmission of pathogenic microorganisms in oral healthcare settings is rare, yet healthcare-associated infections do present a potential hazard to oral healthcare personnel and patients alike. This course introduces participants to information related to (1) the “chain of infection,” (2) Standard and Transmission-base Precautions, (3) factors that affect the quality of an effective infection prevention program, and (4) infection prevention education and training requirements.

Learning Objectives

Upon completion of this course, the dental professional should be able to:

- Discuss the requisites for the transmission of pathogenic organisms, i.e., the “chain of infection.”
- Discuss the rationale for Standard Precautions and their application in oral healthcare settings.
- Discuss the rationale for Transmission-based Precautions and their application in oral healthcare setting.

- Discuss the requisites for an effective infection prevention strategy related to structure, process, and outcome.
- Discuss the requisites of an infection prevention education and training program for healthcare personnel related to infection prevention.

Introduction

The primary obligation and ultimate responsibility of **healthcare personnel** (HCP) is the timely delivery of quality care, within the bounds of the clinical circumstances presented by patients. The provision of quality care depends on proper diagnosis and treatment planning; and the implementation of preventive, therapeutic, or palliative and supportive strategies in the privacy of a comfortable and **safe healthcare setting**.

The term “healthcare personnel” applies to all paid and unpaid persons who work in a healthcare facility, i.e., any person who has professional or technical training in a healthcare-related field and provides patient care in a healthcare setting or any person who provides services that support the delivery of healthcare.¹ One of the elements of a “safe healthcare setting” is the implementation of strategies that minimize or prevent **healthcare-associated infections** (HAIs).

The term HAI refers to an infection acquired during the delivery of healthcare in any setting, e.g., hospitals, long-term care facilities, ambulatory settings (e.g., dental offices), and home care.¹ It is a broad term that reflects the uncertainty of where a pathogen might have been acquired, especially since patients frequently move among various settings within the healthcare system. The term **nosocomial infection** is reserved for an infection acquired in a hospital setting.¹

Requisites for the Transmission of Pathogenic Organisms

Infection is the invasion and multiplication of microorganisms in body tissues resulting in local cellular injury as a consequence of competitive metabolism, toxin production, and immune-mediated reactions. The “chain of

infection," i.e., the transmission of pathogenic organisms in any setting requires three elements: (1) a source or reservoir of infectious agents, (2) a susceptible host with a portal of entry receptive to that agent, and (3) a mode of transmission for the agent.¹

Sources of Infectious Agents

Pathogens associated with HAIs are derived primarily from human sources, but contaminated objects and environmental sources are also implicated.¹ Human sources include patients, HCP, house hold members, and visitors. A source-individual may have an acute infection, or may be transiently or chronically colonized by pathogenic organisms. It is also important to recognize that the source-individual may be asymptomatic or may be in the incubation (subclinical) phase of infection.

Susceptible Host

Infection is the result of complex interactions between host and pathogenic organisms. While the numbers, pathogenicity, virulence, and antigenicity of organisms are important determinants; the establishment of infection and its severity relate to the state of host defense mechanisms.¹ Some susceptible hosts become colonized but remain asymptomatic. Others progress from colonization to symptomatic disease, either immediately or following a period of asymptomatic latency.

Modes of Transmission

Pathogens may be transferred from the source to a host by direct or indirect contact transmission and by respiratory transmission. Respiratory transmission may result from inhalation of droplets; or from inhalation of droplet nuclei, i.e., airborne transmission.¹ Droplets and droplet nuclei are generated when people talk, breath, cough, or sneeze; or when water is converted to a fine mist by medical/dental devices, such as high-speed handpieces, ultrasonic instruments, or by lasers and electrosurgical units.¹

Direct contact transmission occurs when pathogens are transferred between individuals without a contaminated intermediate person, object, or environmental surface.¹ For example, when blood or other potentially infectious

materials from an infected person enters the body of a susceptible person through direct contact with mucous membrane or breaks in the skin, e.g., when pathogens are transferred from a patient to a HCP during ungloved contact with mucous membrane or skin.

Indirect contact transmission occurs when pathogens are transferred between individuals via a contaminated intermediate person, object, or environmental surface.¹ For example, when the hands of HCP become contaminated and hand hygiene is not performed prior to touching the next patient; when contaminated patient-care items are shared between patients without having been adequately cleaned, disinfected, or sterilized; or in association with contaminated sharps and needlestick injuries.

Respiratory transmission associated with the inhalation of droplets, i.e., airborne particles of moisture greater than 5 µm that may contain potentially infectious pathogens, is generally limited to within 3 feet of the source; but it may also result from physical transfer of pathogens from a body surface, such as the hands contaminated with respiratory secretions; or contact of a susceptible host with contaminated intermediate objects or environmental surfaces.¹

Airborne transmission is a form of respiratory transmission associated with inhalation of **droplet nuclei**, i.e., residuals of droplets ranging in size from 1-5 µm that while suspended in air dried out, but may still contain potentially infectious pathogens.¹ In a cool setting, droplet nuclei may remain in the air indefinitely and travel long distances, i.e., extend beyond 3 feet of the source. Droplet nuclei may also contaminate intermediate objects or environmental surfaces.

Standard Precautions

In response to the HIV epidemic, Universal Precautions were instituted in the mid-1980s. It stipulated that patients with HIV infection can be asymptomatic and unaware that they are contagious; therefore, all blood and body fluids contaminated with blood were to be treated as infectious. The Occupational Safety and Health Administration (OSHA) based its 1991 final rule on Occupational Exposure to Bloodborne

Pathogens in Healthcare Settings on the concept of Universal Precautions.²

In 1996, the Centers for Disease Control and Prevention (CDC) expanded Universal Precautions into the concept of Standard Precautions.³ Standard Precautions apply not only to contact with blood and body fluids contaminated with blood, but to contact with all other potentially infectious material, i.e., contact with all body fluids, secretions and excretions, nonintact skin, and mucous membranes regardless of suspected or confirmed presence of an infectious agent.

Standard Precautions apply to the care of all patients in all healthcare settings, regardless of the suspected or confirmed presence of pathogenic organisms.^{3,4} Periodically, outbreak investigations indicate the need to reinforce existing standards or to implement new precautions.¹ Three of these recommendations, i.e., respiratory hygiene/cough etiquettes, sharp safety, and safe injection practices, are now considered standards of care and are considered parts of Standard Precautions, which include:

Education

- To establish the rationale for policies and practices intended to prevent HAIs.

Immunization

- To reduce the risk of vaccine-preventable HAIs.

Engineering and work practice controls

- To eliminate or isolate hazards and promote safer behavior in the work place:
 - Respiratory hygiene/cough etiquette
 - Hand hygiene
 - Personal protective equipment
 - Sharp safety
 - Safe injection practices
 - Sterile instruments and devices
 - Clean and disinfected environmental surfaces

Administrative controls

- To promote an understanding of policies and practices related to medical conditions, post exposure evaluation and follow-up, and work restrictions.

Transmission-based Precautions

When Standard Precautions do not completely interrupt the transmission of a pathogen, Transmission-based Precautions are implemented.¹ These precautions may be applied empirically, predicated on clinical signs and symptoms of infection, until the suspected pathogen is either identified or the infectious status of the patient is ruled out. Transmission-based Precautions include: (1) contact precautions, (2) droplet precautions, and (3) airborne precautions associated with droplet nuclei.¹

Transmission-based Precautions should remain in effect for limited periods of time, i.e., while the risk for transmission of the infectious agent persists or for the duration of the illness.¹ For most infectious diseases, this time period reflects known patterns of persistence or shedding of pathogens related to the natural history of the infectious process and its treatment.¹ For some diseases, Transmission-based Precautions remain in effect until culture or antigen-detection tests become negative.¹

Individuals with congenital, acquired, or therapeutic immunosuppression and those with chronic debilitating diseases may shed pathogenic organisms for prolonged periods of time and transmission may occur during apparent asymptomatic periods; therefore, the duration of contact, droplet, or airborne precautions may extend for many weeks or even months.¹ Finally, it may be prudent to assume that persons with multidrug-resistant organisms remain permanently colonized.¹

Contact Precautions

Contact precautions are intended to prevent transmission of pathogens spread by contact with an infected person, contaminated objects, or environmental surfaces.¹ In the waiting room, greater than 3 feet of physical separation is recommended between infected and other patients.¹ HCP must wear a gown and gloves for all interactions with the patient. The gown and gloves should be donned upon entering and removed before exiting the dental treatment room.¹

Droplet Precautions

Droplet precautions are intended to prevent the transmission of pathogens by droplets through close respiratory or mucous membrane contact with respiratory secretions. The risk of inhalation is generally limited to within 3 feet of the source. In the waiting room, a ≥ 3 foot physical separation between infected and other patients is recommended.¹ HCP must wear a surgical mask for all close contact with the patient. The mask should be donned upon entering and removed before exiting the dental treatment room.¹

Airborne Precautions

Airborne precautions are intended to prevent the transmission of pathogenic organisms by droplet nuclei, i.e., to prevent the transmission of infectious agents that remain suspended in air for long periods and travel long distances from the source such as the rubeola virus, the varicella virus, and *Mycobacterium tuberculosis*.¹ Airborne precautions consist of a three-level hierarchy of (1) administrative controls, (2) environmental controls, and (3) respiratory-protection controls.^{1,5,6}

Administrative controls are intended to identify and isolate; and ultimately, to either refer the patient with a suspected or confirmed airborne infectious disease to a facility with an airborne infection isolation room (AIIR); or to return the patient home, when deemed medically/dentally appropriate.^{5,6} A high index of suspicion and rapid implementation of administrative controls are essential to prevent or interrupt the transmission of airborne pathogens.

When reviewing medical histories (initial and/or periodic updates), including a review of organ systems; all patients should be routinely asked about (1) their history of exposure to infectious pathogens, (2) any medical conditions that may increase their susceptibility to infectious diseases, and (3) any signs and symptoms of infectious disease.⁵ Ideally, the medical history should be elicited from patients in their primary language.

Provisional diagnosis of an airborne infectious disease should be considered for any patient with signs and symptoms of respiratory tract

infection. Patients with suspected or documented airborne infectious disease should be isolated from other patients in a private room with the door closed and instructed to observe strict respiratory hygiene/cough etiquette. HCP should wear at least a surgical mask, but preferably an N95 disposable respirator (see respiratory-protection controls below).⁵

Patients with suspected or confirmed airborne infectious disease requiring urgent dental care must be promptly referred to an oral healthcare facility with an AIIR (see environmental controls below); and while performing procedures on such patients, HCP must use at least an N95 disposable respirator (see respiratory-protection controls below). Routine dental care should be postponed until a physician either rules out infection or confirms that the patient is no longer infectious.⁵

Environmental controls are physical or mechanical measures that prevent the spread and reduce the concentration of infectious droplet nuclei in ambient air. Patients with suspected or confirmed airborne infections requiring care must be treated in an AIIR engineered to (1) provide negative pressure in the room; (2) have an 6-12 air change rate per hour (ACH), and (3) direct exhaust of air to the outside of the building or recirculate air in the room through a high efficiency particulate air (HEPA) filter.^{1,5-7}

Respiratory-protection controls mandate the use of respiratory equipment in situations that pose a high risk for exposure to droplet nuclei.^{1,5} Oral HCP providing care to a patient with suspected or confirmed airborne infectious disease must use a respirator with a filtration capacity of $\geq 95\%$.^{1,5} The N-series disposable, non-powered, air-purifying, particulate-filter respirators are available with filtration efficiencies of 95% (N95), 99% (N99), and 99.7% (N100).⁷

Putative Pathogens Associated with HAIs in Oral Healthcare Settings

Oral HCP and patients can be exposed to bloodborne pathogens and other pathogenic microorganisms. These organisms can be transmitted in oral healthcare settings from patient-to-patient, patient-to-provider, and

provider-to-patient through contact with infected blood and other potentially infectious materials; inhalation of droplets and droplet nuclei generated when infected persons cough, sneeze, shout, sing, or talk; and less frequently by contact with freshly contaminated articles and environmental surfaces.⁴

Standard Precautions apply to contact with blood and other potentially infectious materials, nonintact skin, and mucous membranes; other measures, such as Transmission-based Precautions, might be necessary to prevent the spread of some pathogenic organisms (e.g., *Mycobacterium tuberculosis*).⁴ Still other infections are vaccine preventable. It is axiomatic that oral HCP should be familiar with the modes of transmission of putative pathogens in oral healthcare settings and take appropriate precautions to minimize HAIs.^{1,8-26}

Hepatitis B virus^{1,8}

- **Condition:** acute and/or chronic inflammatory liver disease.
- **Modes of transmission:** bloodborne pathogen; transmitted by contact with infected blood and other potentially infectious material, e.g., saliva, semen, and vaginal secretions; healthcare and public safety personnel are at risk for occupational exposure.
- **Precautions:** vaccine-preventable; standard precautions.

Hepatitis C virus^{1,9}

- **Condition:** acute and chronic inflammatory liver disease.
- **Modes of transmission:** bloodborne pathogen; **transmitted** primarily through large or repeated percutaneous exposure to infected blood: most frequent mode of transmission is needle sharing among IV drug users; after a needlestick or sharps exposure to HCV-positive blood, the risk of HCV infection among HCP is approximately 1.8%.
- **Precautions:** standard precautions.

Human Immunodeficiency Virus^{1,10}

- **Condition:** acquired immune deficiency syndrome (AIDS).
- **Modes of transmission:** bloodborne pathogen; acquired most readily either

across mucous membranes or parenterally; in healthcare settings the risk for transmission following a percutaneous (needlestick injury) or mucous membrane (eyes, nose, and mouth) exposure to blood infected with the HIV is approximately 0.3% and 0.09%, respectively.

- **Precautions:** standard precautions.

Measles virus^{1,11}

- **Condition:** measles (rubeola).
- **Modes of transmission:** airborne droplets and droplet nuclei generated by an infected person during talking, breathing, coughing, and sneezing; by direct contact with nasal or throat secretions from an infected person; and less frequently by touching freshly contaminated articles and environmental surfaces.
- **Precautions:** vaccine-preventable; airborne and standard precautions.

Mumps virus^{1,12}

- **Condition:** mumps.
- **Modes of transmission:** airborne droplets of saliva and mucus from the mouth, nose, and throat of infected persons generated during speaking, breathing, coughing, or sneezing; by direct contact with saliva and mucus from an infected person; and less frequently by touching freshly contaminated articles and environmental surfaces.
- **Precautions:** vaccine-preventable; droplet and standard precautions.

Rubella (German measles) virus^{1,13}

- **Condition:** German measles (rubella).
- **Modes of transmission:** airborne droplets generated during talking, breathing, coughing, and sneezing; by direct contact with nasal or throat secretions; and less frequently by touching freshly contaminated articles and environmental surfaces.
- **Precautions:** vaccine-preventable; droplet and standard precautions.

Varicella Zoster virus^{1,14,15}

- **Condition:** chickenpox and varicella zoster infections.
- **Modes of transmission:** person to person by direct contact with vesicular fluid; inhalation of aerosols from vesicular fluid

or infected respiratory tract secretions; and less frequently, by contact with freshly contaminated articles and environmental surfaces.

- **Precautions:** vaccine-preventable; airborne, contact, and standard precautions.

Herpes simplex virus^{1,16,17}

- **Condition:** primary and recurrent mucocutaneous herpetic infections.
- **Modes of transmission:** direct contact with lesions or infected body fluids, e.g., vesicular exudates, saliva, and genital fluids; less frequently by touching freshly contaminated articles and environmental surfaces.
- **Precautions:** contact and standard precautions.

Human papilloma virus^{1,18}

- **Condition:** nodular or papillomatous or wart-like lesions.
- **Modes of transmission:** person-to-person through cuts, abrasions or small tears in skin or mucous membranes.
- **Precautions:** vaccine-preventable; standard precautions.

Influenza virus^{1,19}

- **Condition:** seasonal influenza.
- **Modes of transmission:** person-to-person primarily via droplets generated during talking, breathing, coughing, and sneezing; and less frequently by contact with freshly contaminated articles and environmental surfaces.
- **Precautions:** vaccine-preventable, droplet and standard precautions.

Mycobacterium tuberculosis^{1,20}

- **Condition:** tuberculous infection and tuberculosis (extrapulmonary, pulmonary, laryngeal).
- **Modes of transmission:** inhalation of droplets and droplet nuclei generated when infected persons cough, sneeze, shout, sing, or talk; and less frequently by contact with freshly contaminated articles and environmental surfaces.
- **Precautions:** airborne and standard precautions.

Corynebacterium diphtheriae^{1,21}

- **Condition:** diphtheria (respiratory mucosa and skin).
- **Modes of transmission:** person-to-person usually through respiratory droplets generated by coughing or sneezing; contact with contaminated objects; and rarely, *C. diphtheriae* is shed from skin lesions or contaminated clothes.
- **Precautions:** droplet and standard precautions.

Clostridium tetani^{1,22}

- **Condition:** tetanus.
- **Modes of transmission:** spores enter the body through non-intact skin, usually cuts or puncture wounds caused by contaminated objects; less commonly, tetanus has been linked to clean superficial wounds, chronic sores, insect bites, dental infections, compound fractures with exposed bone, and intravenous (IV) drug use.
- **Precautions:** vaccine-preventable; standard precautions.

Bordetella pertussis^{1,23}

- **Condition:** pertussis (whooping cough).
- **Modes of transmission:** person-to-person by direct contact with respiratory secretions or by airborne droplets generated by coughing or sneezing.
- **Precautions:** vaccine-preventable; droplet and standard precautions.

Neisseria meningitidis^{1,24}

- **Condition:** bacterial meningococcal disease (meningitis).
- **Modes of transmission:** airborne droplets and direct contact with respiratory secretions and saliva.
- **Precautions:** vaccine-preventable; droplet and standard precautions.

Streptococcus pneumoniae^{1,25}

- **Condition:** middle ear infections (acute otitis media) in children; pneumonia among adults.
- **Modes of transmission:** transmitted person-to-person via airborne droplets generated by coughing and sneezing and by direct contact with respiratory secretions and saliva.

- **Precautions:** vaccine-preventable; droplet and standard precautions.

Methicillin-resistant *Staphylococcus aureus*^{1,26}

- **Condition:** infections usually involve the skin.
- **Modes of transmission:** direct contact with an infected wound or contaminated bed linens, bed rails, bathroom fixtures, medical equipment, and personal items; about one in three people carry *S. aureus* and two in 100 carry MRSA in their nose or on skin.
- **Precautions:** contact and standard precautions.

Fundamental Elements of an Effective Infection Prevention Strategy

While the transmission of pathogenic organisms in oral healthcare settings is rare, cross-infection (e.g., the transmission of pathogens from patient-to-patient, patient-to-provider, and provider-to-patient) does present a potential hazard to healthcare personnel (HCP) and patients alike.^{3,4} To prevent or minimize HAIs, all healthcare facilities are mandated to develop a written **infection prevention protocol** predicated on a hierarchy of preventive strategies specific for oral healthcare settings.^{2,4}

The dentist has primary responsibility for compliance with infection prevention guidelines. However, an **Infection Prevention Coordinator** (IPC) may be assigned to coordinate the program.^{1,4} The IPC should be knowledgeable to (1) develop and maintain the infection prevention protocol; (2) provide an explanation of its contents upon request; and (3) monitor the effectiveness of the program over time to ensure that the criteria are relevant, the procedures are efficient, and the practices are successful.^{1,4}

Infection prevention strategies should be appropriate for the setting and extend to all aspects of the clinical process. As the protocol deviates from optimal design and implementation, the quality (value, outcome) of the program decreases at an accelerated rate. Information from which inference can be drawn about the quality of infection control/exposure control practices may be classified under three headings: structure, process, and outcome.¹⁻⁴

Structure refers to the attributes of the healthcare setting. This includes the (1)

availability of material resources (e.g., sterilization area and equipment), (2) human resources (e.g., number and qualification of personnel), and (3) organizational resources (e.g., the timely availability of post-exposure evaluation and follow-up). Structure affects the amenities of the healthcare setting, which may be either conducive or inimical to good infection control/exposure control practices.

Process refers to what is actually being done to prevent or minimize HAIs. It includes (1) compliance with establishment of standards, i.e., the hierarchy of preventive strategies based on knowledge derived from well conducted trials, extensive observations, or in the absence of such data it should reflect the best informed, most authoritative opinion available; (2) the development and execution of activities intended to meet those standards; and (3) continuous monitoring of compliance.

Outcome refers to the impact infection prevention strategies have on (1) enhanced knowledge, (2) changed behavior, and (3) improved health of HCP and patients. Because so many factors influence outcome, it is not possible to know with absolute certainty the extent to which an observed outcome is attributable to an antecedent structure or process. However, outcome assessment does provide a mechanism to monitor performance (compliance).

Infection Prevention Education and Training

Compliance with Standard and Transmission-based Precautions is significantly improved when HCP understand the rationale for written policies and practices. Infection prevention education and training is mandated (1) prior to initial assignment of HCP to tasks in which exposure to blood and other potentially infectious material may occur, (2) when new tasks or procedures affect the employee's occupational exposure, and (3) and at a minimum annually.^{2,4} Education and training has been related to a decrease in HAI.

The objectives of the education training program are to instruct HCP regarding the risk of occupational exposure to potentially infectious agents and infection prevention procedures/protocols appropriate for

and specific to their assigned duties. The educational information provided should be appropriate in content and vocabulary to the educational level, literacy, and language of the HCP. Documentation of participation in infection prevention education training program must be maintained for 3 years.²⁴

Basic Expectations for Safe Care

A Summary of Infection Prevention Practices in Dental Settings: Basic Expectations for Safe Care published by the CDC in 2016 includes an Infection Prevention Checklist for Dental Settings ([Appendix A](#)).²⁷ The Infection Prevention Checklist, Section I: Policies and Practices, Section I.1, provides a tool to monitor institutional compliance with administrative

measures and Section I.2 to monitor infection prevention education and training that fulfill basic expectations for safe care.²⁷

Summary

Standard Precautions, at times augmented with Transmission-based Precautions, provide a hierarchy of preventive strategies to eliminate or minimize HAIs in all healthcare settings. Creating and maintaining a safe work-environment is predicated on institutional as well as personnel commitment and accountability. Participation in an ongoing education and training programs provides the background and the rationale for understanding elements of an effective infection prevention program.

Course Test Preview

To receive Continuing Education credit for this course, you must complete the online test. Please go to: www.dentalcare.com/en-us/professional-education/ce-courses/ce582/test

1. **The term “healthcare personnel” applies to all paid and unpaid persons who _____.**
 - A. have professional training in a healthcare-related field and provide patient care in a healthcare setting
 - B. have technical training in a healthcare-related field and provide patient care in a healthcare setting
 - C. provide services that support the delivery of healthcare
 - D. All of the above.

2. **The term nosocomial infection refers to an infection acquired during the delivery of healthcare in _____.**
 - A. hospitals
 - B. long-term care facilities
 - C. ambulatory settings, e.g., oral healthcare settings
 - D. home care settings

3. **The “chain of infection,” i.e., the transmission of infectious agents in healthcare settings requires a _____.**
 - A. source or reservoir of infectious agents
 - B. susceptible host with a portal of entry receptive of the agent
 - C. mode of transmission for the agent
 - D. All of the above.

4. **All of the following statements are correct with respect to the source or reservoir of infectious agents responsible for HAIs EXCEPT which one?**
 - A. Pathogens associated with HAIs are derived primarily from human sources, but contaminated objects and environmental sources are also implicated.
 - B. Human sources include patients and HCP, but not house hold members and visitors.
 - C. A source individual may have acute infection, or may be transiently or chronically colonized by pathogenic organisms.
 - D. The source individual may be asymptomatic or may be in the incubation phase of infection.

5. **Which of the following statements is correct with respect to infection in a susceptible host with a portal of entry receptive of the agent?**
 - A. The numbers, pathogenicity, virulence, and antigenicity of organisms are important determinants of infection.
 - B. The establishment of infection and its severity relate to the state of host defense mechanisms.
 - C. Some susceptible hosts become colonized but remain asymptomatic, others progress from colonization to symptomatic disease, either immediately or following a period of asymptomatic latency.
 - D. All of the above.

6. **Pathogens may be transferred from the source to a host by _____.**
 - A. direct or indirect contact transmission
 - B. respiratory transmission, i.e., inhalation of droplets
 - C. airborne transmission, i.e., inhalation of droplet nuclei
 - D. All of the above.

- 7. All of the following statements are correct with respect to droplet nuclei (airborne transmission) EXCEPT which one?**
- A. Droplet nuclei are airborne particles ranging from 1-5 μm that may contain potentially infectious pathogens.
 - B. The risk of inhalation of droplet nuclei is generally limited to within 3 feet of the source.
 - C. Droplet nuclei are residuals of droplets that, while suspended in air dried out and in a cool environment may remain suspended in air indefinitely.
 - D. Transmission of droplet nuclei may result from contact of a susceptible host with contaminated intermediate objects or environmental surfaces.
- 8. Which of the following precautions apply to the care of all patients in all healthcare settings, regardless of the suspected or confirmed presence of an infectious agent and constitutes the primary strategy for the prevention of healthcare-associated infections?**
- A. Universal Precautions
 - B. Standard Precautions
 - C. Transmission-based Precautions
 - D. All of the above.
- 9. Which of the following statements is correct with respect to transmission-based precautions?**
- A. Transmission-based precautions are implemented empirically until the suspected pathogen is either identified or the infectious status of the patient is ruled out.
 - B. There are three categories of transmission-based precautions; contact precautions, droplet precautions, and airborne precautions related to droplet nuclei.
 - C. Transmission-based Precautions should remain in effect for limited periods of time, i.e., while the risk for transmission of the infectious agent persists or for the duration of the illness.
 - D. All of the above.
- 10. Which of the following precautions are intended to prevent the transmission of pathogens spread by direct or indirect contact with an infected patient, or a contaminated object, or an environmental surface?**
- A. Contact precautions
 - B. Droplet precautions
 - C. Airborne precautions
 - D. All of the above.
- 11. Which of the following controls apply to airborne precautions?**
- A. Administrative controls
 - B. Environmental controls
 - C. Respiratory-protection controls
 - D. All of the above.
- 12. Which of the following reflect/represent the primary objective(s) of administrative controls?**
- A. Identification of the patient with a suspected or confirmed airborne infectious disease.
 - B. Isolation of the patient with a suspected or confirmed airborne infectious disease.
 - C. Either the referral of the patient with a suspected or confirmed airborne infectious disease to a facility with an airborne infection isolation room (AIIR); or the return of the patient home, as deemed medically/dentally appropriate.
 - D. All of the above.

- 13. Which of the following statements is correct with respect to airborne infection isolation rooms (AIIRs)? AIIRs _____.**
- A. are engineered to provide negative pressure in the room so that air flows under the door gap into the room
 - B. have an air changes per hour rate of 6-12 ACH
 - C. direct exhaust of air from the room to the outside of the building or recirculate air in the room through a high efficiency particulate air (HEPA) filter
 - D. All of the above.
- 14. Oral HCP providing dental care on a patient with suspected or confirmed airborne infectious disease must use a respirator with N95 or higher filtration capacity to prevent inhalation of infectious particles that are less than 5 µm in size (droplet nuclei).**
- A. True
 - B. False
- 15. All of the following statements related to the HBV are correct EXCEPT which one?**
- A. Following exposure to the HB virus, a person may develop acute and/or chronic inflammatory liver disease.
 - B. HBV is a bloodborne pathogen transmitted through contact with infected blood and other potentially infectious material, e.g., saliva, semen, and vaginal secretions.
 - C. When treating patients with HBV infections, follow transmission-based precautions.
 - D. Infection with the HBV is vaccine-preventable.
- 16. After a needlestick or sharps exposure to HIV-positive blood, the risk of HIV infection among healthcare personnel is approximately 1.8%.**
- A. True
 - B. False
- 17. Mycobacterium tuberculosis is transmitted by inhalation of droplets and droplet nuclei generated when infected persons cough, sneeze, shout, sing, or talk; and less frequently by contact with freshly contaminated articles and environmental surfaces requiring airborne and standard precautions.**
- A. True
 - B. False
- 18. All of the following statements are correct with respect to the office Infection Prevention Coordinator (IPC) except which one? The IPC shall _____.**
- A. be knowledgeable to develop and maintain the office infection control/exposure control protocol
 - B. provide both access to and an explanation of its contents upon request
 - C. have overall responsibility for compliance with infection control guidelines
 - D. monitor the effectiveness of the program over time to ensure that the criteria are relevant, the procedures are efficient, and the practices are successful

- 19. Which of the following statements is correct with respect to fundamental elements needed to prevent the transmission of pathogens in healthcare settings?**
- A. Infection prevention strategies should be appropriate for the setting and extend to all aspects of the clinical process.
 - B. As the protocol deviates from optimal design and implementation, the quality (value, outcome) of the program decreases at an accelerated rate.
 - C. Information from which inference can be drawn about the quality of infection prevention practices may be classified under three headings: structure, process, and outcome.
 - D. All of the above.
- 20. All of the following statements related to infection prevention education and training are correct EXCEPT which one?**
- A. Compliance with Standard and Transmission-based Precautions is significantly improved if HCP understand the rationale for written policies and practices.
 - B. Participation in an infection prevention education and training program is mandated on a onetime basis, i.e., prior to initial assignment of HCP to tasks in which exposure to blood and OPIM may occur.
 - C. The objectives of the education training program are to instruct HCP regarding the risk of occupational exposure to potentially infectious agents and infection prevention procedures/protocols appropriate for and specific to their assigned duties.
 - D. Documentation of participation in infection prevention education training program must be maintained for 3 years.

References

1. Siegel JD, Rhinehart E, Jackson M, et al. 2007 Guideline for Isolation Precautions: Preventing Transmission of Infectious Agents in Health Care Settings. *Am J Infect Control*. 2007 Dec;35 (10 Suppl 2):S65-164. doi: 10.1016/j.ajic.2007.10.007.
2. U.S. Department of Labor, Occupational Safety and Health Administration. 29 CFR Part 1910.1030. Occupational exposure to bloodborne pathogens; needlesticks and other sharps injuries; final rule. *Federal Register* 2001;66:5317-5325. As amended from and includes 29 CFR Part 1910.1030. Occupational exposure to bloodborne pathogens; final rule *Federal Register* 1991;56:64174-64182. Accessed June 24, 2019.
3. Garner JS. Guideline for isolation precautions in hospitals. The Hospital Infection Control Practices Advisory Committee. *Infect Control Hosp Epidemiol*. 1996 Jan;17(1):53-80.
4. Kohn WG, Collins AS, Cleveland JL, et al. Guidelines for infection control in dental health-care settings--2003. *MMWR Recomm Rep*. 2003 Dec 19;52(RR-17):1-61.
5. Jensen PA, Lambert LA, Iademarco MF, et al. Guidelines for preventing the transmission of *Mycobacterium tuberculosis* in health-care settings, 2005. *MMWR Recomm Rep*. 2005 Dec 30; 54(RR-17):1-141.
6. Sehulster L, Chinn RY; CDC; HICPAC. Guidelines for environmental infection control in health-care facilities. Recommendations of CDC and the Healthcare Infection Control Practices Advisory Committee (HICPAC). *MMWR Recomm Rep*. 2003 Jun 6;52(RR-10):1-42.
7. Centers for Disease Control and Prevention. NIOSH-Approved Particulate Filtering Facepiece Respirators. Accessed June 24, 2019.
8. CDC. Viral Hepatitis B – Hepatitis B Information. Accessed June 24, 2019.
9. CDC. Viral Hepatitis - Hepatitis C Information. Accessed June 24, 2019.
10. CDC. HIV/AIDS. Accessed June 24, 2019.
11. CDC. Measles (Rubeola). Accessed June 24, 2019.
12. CDC. Mumps. Accessed June 24, 2019.
13. CDC. Rubella (German measles, Three-day Measles). Accessed June 24, 2019.
14. CDC. Chickenpox (Varicella). Accessed June 24, 2019.
15. CDC. Shingles (Herpes Zoster). Accessed June 24, 2019.
16. Miller CS, Danaher RJ. Asymptomatic shedding of herpes simplex virus (HSV) in the oral cavity. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod*. 2008 Jan;105(1):43-50. Epub 2007 Aug 20.
17. Lewis MA. Herpes simplex virus: an occupational hazard in dentistry. *Int Dent J*. 2004 Apr; 54(2):103-11.
18. CDC. Human Papillomavirus (HPV). Accessed June 24, 2019.
19. CDC. Influenza (Flu). Accessed June 24, 2019.
20. CDC. Tuberculosis (TB). Accessed June 24, 2019.
21. CDC. Diphtheria. Accessed June 24, 2019.
22. CDC. Tetanus. Accessed June 24, 2019.
23. CDC. Pertussis (Whooping Cough). Accessed June 24, 2019.
24. CDC. Meningococcal Disease. Accessed June 24, 2019.
25. CDC. Pneumococcal Disease. Accessed June 24, 2019.
26. CDC. Methicillin-resistant *Staphylococcus aureus* (MRSA) Infections. Accessed June 24, 2019.
27. CDC. Summary of Infection Prevention Practices in Dental Settings: Basic Expectations for Safe Care. 2016. Accessed June 24, 2019.

About the Authors

Barbara A. MacNeill, DMD, MS



Dr. MacNeill graduated from the University of Pennsylvania School of Dentistry and completed her two-year General Practice Residency at University of Texas Health Science Center at San Antonio. She is a Clinical Assistant Professor in the Department of Comprehensive Dentistry and the Assistant Dean of Clinics at UT Health. She is the former Director of the Advanced General Dentistry Clinic, running clinic operations of the AEGD and Faculty Practice Clinics, and former Director of the Advanced Education in General Dentistry program. She is the Councilor for the ADEA Section on Postgraduate General Dentistry, Chair for the Texas Chapter of American College of Dentists, and former board member for the San Antonio Academy of General Dentistry.

Email: macneill@uthscsa.edu

Géza T. Terézhalmy, DDS, MA



Dr. Terézhalmy is Professor and Dean Emeritus, School of Dental Medicine, Case Western Reserve University. In addition, he is a Consultant, Naval Postgraduate Dental School, National Naval Medical Center. Dr. Terézhalmy earned a BS degree from John Carroll University; a DDS degree from Case Western Reserve University; an MA in Higher Education and Human Development from The George Washington University; and a Certificate in Oral Medicine from the National Naval Dental Center. Over the past 40+ years, Dr. Terézhalmy held more than 30 positions in professional societies, served as editor or contributing editor for several publications, co-authored or contributed chapters for several books, conducted oral healthcare related research, and had over 225 papers and abstracts published.

Email: gtt2@case.edu