Introduction to Infection Control

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Learning Objectives

1. Define terms used in infection control.
2. Review significant risk factors for infection.
3. Identify the four most common types of hospital-associated infections.
4. Discuss the concept referred to as the chain of infections.
5. Explain the differences among the modes of transmission.
6. Describe infection surveillance methods.
7. Describe the minimum elements of an effective program.
8. Determine what constitutes success in infection control.
9. Explain the role of the institutional environmental health and safety professional in infection control.

Infection control and prevention (IC) in a healthcare setting requires a comprehensive, coordinated program designed to prevent and control nosocomial or healthcare-associated infections (HAIs). The Centers for Disease Control and Prevention (CDC) restricts the usage of the term *nosocomial* to infections acquired in hospitals, whereas HAIs refer to infections in any type of healthcare setting (CDC 2007a).

IC is a required, patient-focused function for any healthcare setting desiring to maintain accreditation by the Joint Commission on Accreditation of Healthcare Organizations (Joint Commission or JCAHO). The Joint Commission’s description of IC states that there must be ongoing surveillance, data collection, and analysis of risks associated with the acquisition or transmission of infectious agents within the healthcare setting. Part of this IC program must include integrating with the community and recognizing that
IC is larger than just within hospital settings (JCAHO 2007). Therefore, IC also involves collaboration between healthcare professionals and community partners when confronting any infectious disease transmission, including the control or prevention of community-acquired infections (CAI). An example is the increase in CAI methicillin- (also called oxacillin-) resistant *Staphylococcus aureus* (MRSA) in jails or in contact sports such as wrestling in schools. The infection control professional (ICP) may provide educational assistance to the jail or school staff to underscore the importance of hand hygiene and environmental sanitation within institutional settings for the control of MRSA.

A recent concern is the need for multidisciplinary planning for pandemic influenza. A program aimed at the reduction of the spread of respiratory illness is the “Cover Your Cough” program developed by the CDC (CDC 2007b). This simple program is an effective tool that can be taught to school staff to help control the transmission of respiratory illness within the school or other institutional settings. Therefore, ICPs must be prepared to respond to potential disease threats not only in their healthcare setting, but also in their communities. This response may include development of educational hygiene programs, assistance with researching problems, policy development, or developing preventive measures for control.

IC programs focus on the epidemiology of infectious agents and methods of preventing their transmission (Bolyard et al. 1998). In some cases, IC activities have been based on traditions and scientifically unproven methods. A critical component of IC programs must be monitoring and evaluation of effectiveness to assure that the most optimal means of infection prevention or control are employed. Another important consideration is the protection of not only the patient but visitors and healthcare workers from the spread of infection. It is also important to recognize that certain patients, such as those receiving immunosuppressive drugs, and certain healthcare workers, such as laboratory personnel, are at an increased risk of acquiring HAIs. Prevention efforts should target these and other at-risk individuals. However, individuals not directly involved in patient care or diagnosis may also be at risk at certain times. For example, a maintenance worker may be required to enter an isolation room to repair defective equipment or perform service on a biological safety cabinet. An IC program must be both comprehensive and flexible enough to provide protection against infection under all of these diverse conditions.

**STUDY OF THE EFFICACY OF NOSOCOMIAL INFECTION CONTROL**

Formalized IC programs are a relatively recent development. Prior to the 1960s, there were few hospitals in the U.S. that had a formal program to identify and control nosocomial infections. In 1974, the CDC initiated the *Study of the Efficacy of Nosocomial Infection Control* (SENIC). This project was a stratified random sample of U.S. hospitals in 1970 and in 1976 comparing the types and
status of IC programs (Haley et al. 1985). The study found that there were three main elements of effective programs:

1. A systematic method of conducting epidemiologic surveillance for infections
2. Relevant written policies and procedures
3. Competent personnel

The first point should be self-evident. Unless personnel search for the presence of infections, it is unlikely that anyone will find them and even less likely that these infections will be controlled or prevented. Second, there must be written policies and procedures for patient-care tasks to enable uniformity in implementation and to monitor compliance. This was particularly important for certain high-risk tasks, such as placement of urinary catheters that have high infection potential. Lastly, effective programs were only possible if there were properly trained personnel to implement them. Therefore all hospitals should employ competent IC professionals, and all hospital employees should be trained in proper IC procedures that pertain to their departments.

Some other important information gleaned from this study was that in 1976, 37.7 million patients were admitted to U.S. hospitals; 2.1 million of these patients contracted infections while in the hospital. This corresponds to a 5.6 nosocomial infection rate per 100 patient admissions. Most importantly, the study found that 80% of all infections were of four types: urinary tract infections (UTIs), surgical site infections, pneumonias, and bacteremias.

It was important to note that 45% of patient infections were related to the use of medical devices. Not surprisingly, use of urinary catheters ranked number one. In addition, 71% of those with infections were patients who had surgery or other types of invasive procedures. While surgical-site infections were the most costly type of infection, nosocomial pneumonias had the highest death rate. In 1976, nosocomial infections caused 7.5 million extra hospital days, which accounted for nearly $1.0 billion (1976 dollars). In 2002 prices, the annual economic cost of HAIs is estimated to be $6.7 billion (Graves 2004). It has been well established that some patients will get infections while in the hospital despite of all efforts to prevent them because of their lowered immune system function. The SENIC researchers estimated that approximately 32% of all nosocomial infections were preventable. The major conclusions of the SENIC Study were:

- The more intensive the surveillance and control program, the higher percentage of prevention that was possible.
- If the program reduces just 6% of the infections, the cost of the IC program was justified.

The CDC estimates that annually, nearly two million patients in the U.S. become infected while in hospitals and about 90,000 of these patients die as a
result of their infection. As in the past, urinary tract infections, pneumonia, surgical-site infections, and bloodstream infections comprise most of all healthcare-associated infections (CDC 2005).

The investigation of sentinel events is part of the Joint Commission’s National Patient Safety Goals (Frain et al. 2004). The term sentinel event is used for an uncommon and worrisome occurrence. For example, if a patient dies or loses a limb due to MRSA and it was determined that infection occurred during a hospital stay, it would be considered a sentinel event. The goal of investigating sentinel events is to identify the credible root cause of the infection; thus, the focus of the investigation should be on processes and not on the outcomes. If a nurse or another healthcare provider fails to wash hands prior to performing a dressing change on a post-operative patient and the patient becomes infected with MRSA, one root cause might be a failure to enforce hospital hand-hygiene policy (assuming there is one). Or, the investigation may reveal that the nursing unit was shorthanded, and this staff shortage caused a lapse in hand-washing compliance. In this example, the root cause would be insufficient staffing levels. The issue of nursing shortages and increased HAIs is not hypothetical. Researchers have found a direct correlation between insufficient staffing levels and increases in HAIs (Stone et al. 2004). The ratio of registry nurses (also known as contract nurses) to in-house staff and skill levels were also important. Having lower ratios of registered nurses (RNs) to certified nursing assistants (CNAs) or having higher ratios of registry RNs to in-house staff were associated with increases in HAIs.

**DISEASE TRANSMISSION**

In order to fully understand the most effective means of preventing the spread of infections, it is necessary to understand the basic modes of transmission. Transmission of infections requires three elements:

- A source of infecting microorganisms
- A susceptible host
- A means of transmitting the microorganism

The concept of the chain of infection, displayed in Fig. 3.1, includes more than just the pathogenic agent, the host, and the mode of transmission. It recognizes that the agent has a reservoir serving as a continuing source of contamination and that the agent must escape from the reservoir in excretions or secretions (called a portal of exit) for transmission to take place. In order to infect a susceptible host, the agent must enter through mucus membranes, breaks in the skin, or other means (called a portal of entry). By assessing each element or link in the chain, it may be possible to identify the most optimal control strategy. Thus, if you break one link in the chain by
eliminating the reservoir or immunizing the host, there is no possibility of disease transmission (Kennamer 2002). In the previous example of transmission of MRSA from a caregiver to a post-operative patient, a break in the chain of transmission could have been achieved by treating the source (removing the reservoir), wearing gloves (preventing the means of escape), or through hand washing (interrupting the direct transmission).

Sources of Infectious Agents

The most common source of infectious agents is the patient’s own endogenous flora. These microorganisms typically do not harm us and are often beneficial because they may prevent the colonization of our skin or intestines with pathogenic organisms. However, when a patient’s immune system is weakened or there are new portals of entry, such as central venous or urinary catheters, these organisms become opportunistic pathogens. Other sources of infectious agents include inanimate objects such as food, instruments, or even environmental surfaces. For environmental surfaces to be a source of infection, typically the patient’s immune system must be severely compromised. Chapter 4 discusses the classification of environmental objects in terms of infection risk.

Other patients, personnel, or visitors may serve as important sources of cross-contamination. These infections are typically the most easily preventable