INFECTION CONTROL

When thinking about patient safety, the connection to infections might not readily come to mind as a strong correlate in comparison with other high-risk healthcare activities, such as the medication use process. Yet, there is a significant relationship between infections and patient safety. In fact, healthcare-acquired infections are one of the leading causes of morbidity and mortality in patients.[(1)] Organizations engaging in a patient safety program cannot underestimate the importance of recognizing this correlation. The pursuit of patient safety requires a robust and comprehensive program encompassing the surveillance, prevention, and control of healthcare-acquired infections. This chapter presents an outline of some of the basic considerations to be made in developing an effective institutional program.

KEY ISSUES

♦ The Magnitude of the Problem

Healthcare-associated infections are adverse patient events that are known to affect the health and safety of approximately two million persons annually. [(2)] A healthcare-associated infection is defined as any infection that occurs during or sometime after receiving healthcare activities and was not present or incubating at the time of initial care. Eighty-five percent (85%) of these infections comprise surgical site, pneumonia, bloodstream, and urinary tract infections. Others are skin infections, meningitis, endometritis, etc… [(3)] Healthcare-associated infections frequently cause patient care complications that prolong hospital stays.[(4)] Data show that for surgical site infections and bloodstream infections, patients remained hospitalized for an additional seven days, on the average. For complications resulting in pneumonia, the average length of stay was extended an additional six days. Overall, the average length of stay for all types of healthcare-associated infections was four days.[(5)]

Despite notable improvements in some areas, patients in intensive care units (ICUs) are at highest risk for nosocomial infections (those infections that occur while the patient is hospitalized). For years, the status of patients within various ICUs has been monitored using site-specific, risk-adjusted infection rates. During the period of 1990 and 1999, risk-adjusted ICU infection rates had decreased for all three body sites monitored in ICUs, including respiratory tract, urinary tract, and bloodstream infections. The bloodstream infection rates decreased substantially in medical ICUs (44%), coronary ICUs (43%), pediatric ICUs (32%), and surgical ICUs (31%). The percentiles in Table 1 represent a measure of the variations in device-associated rates in ICUs that are part of the National Nosocomial Infection Surveillance (NNIS) System. For example, the 25th percentile for ventilator-associated pneumonia (VAP) rates in the medical (nonsurgical) ICU was 3.3. In other words, seventy-five percent of reporting medical (nonsurgical) ICUs had a VAP rate of greater than 3.3. Device use ratios ranged from 0.22 for ventilators in coronary ICUs to 0.85 for urinary catheters in surgical ICUs.[(4)]

Examining the overall hospital-associated infection rate, on a national level, reveals that it has remained constant over the past twenty-five years - at a rate of approximately five to six percent of all admissions.[(3)] This is true even though there have been major improvements in healthcare practice during this period of time. The unchanging rate, despite advances in healthcare, is attributed to (a)higher acuity of hospitalized patients; (b) increased use of invasive devices; (c) increased numbers of immunocompromised patients;

(d) aggressive medical and therapeutic interventions; (e) antimicrobial resistance in microorganisms; and (f) disruptions in the environment of the healthcare facility (eg. renovations). It is important to keep in mind that though the overall hospital-associated infection rate has been stable, the rates of various types of healthcare-associated infections can vary among different healthcare facilities. Two factors that affect the magnitude of an individual facility's healthcare-associated infection problem are the underlying risk levels of its patients and the effectiveness of its infection prevention and control program.[5]

There are strong incentives for healthcare organizations to prevent the infectious complications of healthcare activities, not only from the standpoint of the human suffering that it inflicts on patients, visitors, and healthcare workers, but also because of the financial repercussions to all those who are directly affected, and to the organization and society in general. Preventing these adverse outcomes reduces morbidity, mortality, and the overconsumption of costly healthcare resources. It is estimated that in 1995, healthcare-associated infections cost $4.5 billion and contributed to more than 88,000 deaths.[3] Postoperative infections ranked as one of the three most expensive types of healthcare-associated infections, after pneumonia and bloodstream infections.[6] Costs are usually measured in three ways: added length of stay, increased costs of care, and patient mortality.[5] Since the transmission of infections is reciprocal, not only are patients and visitors at risk of contracting them, so are employees who work in healthcare facilities. The institutional repercussions of healthcare-associated infections on employee health can include infection-related absenteeism, worker claims concerning unsafe working conditions, and decreased employee workplace satisfaction. There is also the possibility of legal action being taken against the healthcare provider and the hospital and damage to the consumer marketability of the healthcare organization. [4] Clearly, any initiatives implemented by an organization for the purpose of improving the health and safety of patients, staff, and visitors, as well as for the financial wellbeing of the institution will be negated by the detrimental effects of healthcare-associated infections.[6]

♦ Preventable versus Non-Preventable Infections

In the early 1970s, the Centers for Disease Control and Prevention initiated the Study on the Efficacy of Nosocomial Infection Control Project (SENIC) to examine the effectiveness of nosocomial infection surveillance and control programs in the United States. SENIC found that approximately thirty-two percent (32%) of the four major types of nosocomial infections (surgical site, bloodstream, pneumonia, and urinary tract infections) are preventable by using specific infection surveillance and control guidelines. On the other hand, there are some healthcare-associated infections that are not preventable or are more difficult to prevent for a variety of reasons. For instance, some infections that are noted during care may actually have been acquired elsewhere. Hospitals may also perform some procedures that have an inherent risk of infection; as in those instances when certain drugs are intentionally administered in order to enhance the success of organ transplantation, while causing the patients to become more susceptible to infections.[7] Preventing these types of infections may prove challenging.

♦ Regulatory Compliance

Matters of infection surveillance, prevention, and control are regulated by multiple external agencies. The Occupational Safety and Health Administration (OSHA) began its infection control activities in 1987 with the draft publication of its blood-borne pathogens rules. These rules were finalized in 1991. OSHA regulations require that specific infection control training be provided to employees at the time of initial employment and at least annually thereafter to all employees with potential occupational exposure to blood and other body fluids. Additional OSHA requirements speak to the development and implementation of an exposure control plan, evaluation of workplace practices, and hepatitis B vaccination. The Food and Drug Administration (FDA) has activities related to food, blood, and antimicrobial products and chemical germicides that are used with medical devices. The Environmental Protection Agency (EPA) is also involved in the testing and use of hospital disinfectant products. As part

of the Center for Medicare and Medicaid Services (CMS) required conditions for certification and participation in Medicare and Medicaid programs, healthcare facilities must comply with federal standards that include specific requirements for an active infection control program. The main focus of external regulations is on the prevention of the spread of infections and the efficacy of antibiotics and devices.

♦ Accreditation Standards

The Joint Commission (TJC) states that the goal of the surveillance, prevention, and control of infection function within healthcare organizations is to identify and reduce the risk of infections in patients and healthcare workers. The expectation is that there be a well functioning program in place that coordinates all required activities in order to achieve effective surveillance, prevention, and control of infections within the organization. The program must be actively supported by leadership and focused on the improvement of organizational processes and outcomes. Other TJC standards that cross-reference with the surveillance, prevention, and control of infection function are those related to performance improvement and the environment of care.

♦ Legal Issues

An organization may sustain liability for a patient's infection if it can be shown that there was negligence on the part of the facility or any of its agents. To minimize the risk of failing to meet the expected legal "standard of care", healthcare organizations should educate staff in infection prevention and control practices and institute monitoring mechanisms to demonstrate that proper procedures are actually being followed. Policies written to minimize the risk of infection should reference standards that are evidence-based in order to provide a good rationale for compliance.

♦ The Role of the Infection Control Team

Each organization is unique and its specific needs must be considered when developing an infection control program. Because of these differing needs, there may be varying individuals, groups, and functions within the organization that are assigned responsibility for the program. However, as a general rule, the core of the infection prevention and control program is comprised of the infection control professional, the chair of the infection prevention and control committee, and/or the health-care epidemiologist. Also vital to the team membership is the individual who is responsible on an institutional level for employee health or administration. Another important consideration, given that the scope of hospitals has grown to include ambulatory care sites and specialty areas such as home care, is the criticality of incorporating these areas into the overall infection prevention and control program. The infection control team is ultimately responsible for carrying out all aspects of the infection prevention and control program.

A highly effective method of expanding front-line staff involvement in the program is the designation of infection control liaisons. These infection control liaisons can facilitate consistent communication between a department/unit/clinic and the infection control professional. Pertinent area directors can appoint liaisons. Liaisons can facilitate the following functions:

- Posting appropriate correspondence, including newsletters within work areas
- Informing staff members of changes in infection control practice or the addition of patient care equipment that requires reprocessing
- Notifying infection control staff members of unusual infection trends or of exposures to communicable diseases, such as chickenpox
- Notifying infection control staff of diseases that require reporting to the Health Department
- Assisting in the coordination of the scheduling of infection control inservices

- Providing an added infection control resource in their areas
- Notifying the infection control team of changes in or additions to patient care equipment or procedures that may have infection control implications

- **Surveillance/Data Management**

Surveillance/data management is an active method of detecting, reporting and analyzing the occurrence of healthcare-associated infections in patients and staff. The data collected are routinely evaluated in order to identify sources of infection, to determine methods of spread, and to make recommendations regarding prevention and control. The analysis of data, accompanied with feedback to appropriate staff, makes possible the identification of improvement areas that can then be effectively addressed. For example, most acute care hospitals collect data on bloodstream infections in patients within intensive care units in order to detect any adverse patterns or trends. Data can also be analyzed as a means of monitoring the effectiveness of central catheter infection prevention policies, to identify clusters of infections, and to determine areas for improvement. Employees with illnesses likely to be a result of employment (eg. scabies) or who are exposed to communicable diseases (eg. tuberculosis) are managed through an occupational health service, though infection control staff are integrally involved in these activities as well. A 1976 landmark study by the Centers for Disease Control and Prevention, known as the Study on the Efficacy of Nosocomial Infection Control (SENIC), showed that providing healthcare-associated infection data to clinical staff led to a thirty percent (30%) reduction in infection rates. This study demonstrates the importance of surveillance programs and giving feedback to the clinicians providing care.

- **Outbreak investigation**

Any unusual clustering of infections in patients or staff involving any location within the organization is investigated in order to identify potential problems. Recommendations are then made regarding review of activities or possible changes, if necessary. The epidemiological method is used throughout this process, using appropriate statistical analyses. This method entails evaluating the factors and risks involved in the specific events being studied through the use of descriptive and analytic techniques. **[A case example for this process can be found in the toolkit.]**

- **Prevention and Control**

All practices that have infection prevention and control elements are reviewed in order to ensure that there is consistency between organizational policies and procedures and accepted infection control practices. These include isolation/precautions for certain communicable diseases, disinfection/sterilization of instruments/equipment, and implementation of specific patient care practices, such as catheter and wound care, respiratory therapy, etc... This review must be performed on a regular basis since optimal practice tends to decline over time due to factors including staff turnover, competing requirements, unfamiliarity with potential risks, or the introduction of new practices. The results of analyses of compliance with practices are often the basis for continuous quality improvement projects and educational/training programs.

- **Education and Training**

Staff should be familiar with the elements of their organization's infection prevention and control program. This requires institutional level orientation in addition to departmental, work-area, and job-specific educational interventions. Staff members should undergo orientation to become familiarized with their expected individual responsibilities, as they relate to infection prevention and work place activities, before beginning patient care and/or other activities. However, organizations may encounter

staff-related infection prevention and control challenges. One such challenge is in the area of staff adherence to hand hygiene procedures. Studies have shown that compliance with hand hygiene practices tend to revert to a poor baseline approximately six months after an educational initiative. To counter this trend, a process should be developed to ensure that ongoing inservice education sessions and other related training occurs in order to increase staff members' knowledge of critical work-related issues. A variety of educational interventions and methods can be employed, including hands-on practice in the use of infection control techniques and the provision of verbal or written materials. Research also shows that the degree to which the infection control team and the leadership of an organization demonstrate their commitment to the infection prevention and control mission will have an influence on staff compliance.[8] This is partly due to the fact that necessary resources are provided to convey this message.

- **Occupational Health**

There are specific occupational health responsibilities associated with following up on exposures to communicable diseases, such as chickenpox or tuberculosis. These include the provision of employee health services, investigations of contacts, treatment of affected staff, and if necessary, the transfer of ill employees out of the workplace. As a preventive function, there is a need to implement a tuberculosis-testing program and to provide immunizations to staff as determined by the hospital or governmental mandates. Occupational health also involves the evaluation of many areas of employee safety. These include evaluation of exposures to blood or body fluids, protective equipment and garb, and safety devices. The occupational health function is an important component of an organization's infection prevention and control program.

CHALLENGES

- **Movement of patients to settings outside the hospital**

Increasingly, patients who would have traditionally been treated in the hospital are being cared for in their homes or in ambulatory care settings. Many of these patients have diseases such as cancer or HIV that make them particularly susceptible to infections. These patients often have invasive devices, such as urinary drainage catheters and vascular catheters used for infusion therapy or dialysis. In these cases, it is necessary for caregivers and patients to approximate the hospital environment around the usage of equipment and aseptic techniques. Hospitals with ambulatory, home or long-term care services must ensure that infection prevention and control activities (eg. policies and procedures, education, surveillance…) are comparable across the continuum of care.

Identifying infection control issues or clusters of infections among patients seen in the ambulatory care or home setting can be challenging. This is partly due to the fact that patients are being discharged from hospitals to these settings at a much quicker rate than in the past. Case in point; up to three-quarters of healthcare-associated surgical site infections do not become apparent until after patients leave the hospital.[6] Therefore, a good system of tracking patients across all care settings is essential in order to ensure accurate infection rate/data reporting.

- **Antibiotic-resistance**

Antibiotic-resistant microorganisms are a growing threat in healthcare settings. More than seventy percent (70%) of the bacteria that cause healthcare-associated infections are resistant to at least one of the drugs most commonly used to treat them. Infection prevention and control programs focus

isolation/precautions and other practices at microbes to prevent the spread of the microorganisms. The most common such microbes seen in hospitals include methicillin-resistant *S. aureus* and vancomycin-resistant Entercoccus. Michigan was the first state in which vancomycin-resistant *S. aureus* was identified - a new danger on the horizon. Risk factors that promote antimicrobial resistance in healthcare settings include the extensive use of antimicrobials, the transmission of infections due to these microbes, and the presence of susceptible hosts.

- **Compliance with Regulatory and Accreditation Entities**

All healthcare organizations are subject to regulation and oversight by various agencies, authorities, and governing bodies. Some of these entities promulgate rules or standards that are either difficult to institute, expensive, or are not consistent with recognized infection prevention and control principles. Examples are the requirements around the use of needle-less or safety devices and the reuse of disposable devices. Organizations might encounter some hesitation on the part of staff to change patient care practices from those involving conventional devices to those requiring the use of safety devices. Sometimes it is the financial implications of these requirements that make it challenging to implement and to ensure organizational compliance.

- **New technology**

The proper implementation of technological innovations, such as improved personal protection devices or new types of equipment demands learning new knowledge and skills. If not implemented in an appropriate manner, infections may occur. Staff must become familiar with manufacturers' directions and be properly trained in appropriate practices. Many problems connected with the use of technology can be avoided proactively with the involvement of infection prevention and control staff up front in the purchasing process.

TABLE 1. Device-associated infection rates, by type of device and type of intensive care unit (ICU) — National Nosocomial Infection Surveillance system, United States, 1997–1999

ICU/Type of infection	No. units	Total no. of days patient in ICU	Device days*	DU†	Device-associated infection rates						
					Mean	Percentiles 10th	25th	50th	75th	90th	
Coronary	377,242										
Catheter-associated urinary tract infection§		79	192,226	0.51	5.6	0.9	2.6	4.5	8.1	12.3	
Central line-associated bloodstream infection¶		79	118,914	0.32	4.3	0.0	1.8	3.9	5.9	9.1	
Ventilator-associated pneumonia**		78	83,735	0.22	7.6	1.0	3.9	7.1	10.5	14.8	
Medical (nonsurgical)	651,356										
Catheter-associated urinary tract infection		107	483,209	0.74	6.5	2.0	3.6	6.1	8.3	10.6	
Central line-associated bloodstream infection		108	337,722	0.52	6.1	1.6	3.7	5.7	7.6	10.1	
Ventilator-associated pneumonia		107	322,825	0.50	6.6	1.9	3.3	6.3	8.2	12.2	
Pediatric	318,629										
Catheter-associated urinary tract infection		55	103,505	0.32	4.9	0.0	2.0	4.7	6.6	8.6	
Central line-associated bloodstream infection		56	145,532	0.46	7.7	1.5	3.7	6.8	9.5	12.1	
Ventilator-associated pneumonia		56	142,475	0.45	5.0	0.2	1.6	3.7	7.9	11.3	
Surgical	665,638										
Catheter-associated urinary tract infection		122	566,054	0.85	5.0	1.5	2.8	4.4	6.9	10.1	
Central line-associated bloodstream infection		122	444,040	0.67	5.4	1.1	2.3	4.9	6.9	9.9	
Ventilator-associated pneumonia		120	319,627	0.48	13.0	5.2	7.3	11.3	14.9	23.6	

* Number of days a urinary catheter, central line, or ventilator was used by all patients.
† Device utilization ratio (device days divided by total number of days patient was in ICU).
§ Number of urinary catheter-associated urinary tract infections divided by number of days a urinary catheter was used multiplied by 1000.
¶ Number of central line-associated bloodstream infections divided by number of days a central line was used multiplied by 1000.
** Number of ventilator-associated cases of pneumonia divided by number of days a mechanical ventilator was used multiplied by 1000.

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