Chapter 41. Preventing Health Care–Associated Infections

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Background

The occurrence and undesirable complications from health care–associated infections (HAIs) have been well recognized in the literature for the last several decades. The occurrence of HAIs continues to escalate at an alarming rate. HAIs originally referred to those infections associated with admission in an acute-care hospital (formerly called a nosocomial infection), but the term now applies to infections acquired in the continuum of settings where persons receive health care (e.g., long-term care, home care, ambulatory care). These unanticipated infections develop during the course of health care treatment and result in significant patient illnesses and deaths (morbidity and mortality); prolong the duration of hospital stays; and necessitate additional diagnostic and therapeutic interventions, which generate added costs to those already incurred by the patient's underlying disease. HAIs are considered an undesirable outcome, and as some are preventable, they are considered an indicator of the quality of patient care, an adverse event, and a patient safety issue.

Patient safety studies published in 1991 reveal the most frequent types of adverse events affecting hospitalized patients are adverse drug events, nosocomial infections, and surgical complications.[1, 2] From these and other studies, the Institute of Medicine reported that adverse events affect approximately 2 million patients each year in the United States, resulting in 90,000 deaths and an estimated $4.5–5.7 billion per year in additional costs for patient care.[3] Recent changes in medical management settings have shifted more medical treatment and services to outpatient settings; fewer patients are admitted to hospitals. The disturbing fact is that the average duration of inpatient admissions has decreased while the frequency of HAIs has increased.[4, 5] The true incidence of HAIs is likely to be underestimated as hospital stays may be shorter than the incubation period of the infecting microorganism (a developing infection), and symptoms may not manifest until days after patient discharge. For example, between 12 percent and 84 percent of surgical site infections are detected after patients are discharged from the hospital, and most become evident within 21 days after the surgical operation.[6, 7] Patients receiving followup care or routine care after a hospitalization may seek care in a nonacute care facility. The reporting systems are not as well networked as those in acute care facilities, and reporting mechanisms are not directly linked back to the acute care setting to document the suspected origin of some infections.

Since the early 1980s HAI surveillance has monitored ongoing trends of infection in health care facilities.[8] With the application of published evidence-based infection control strategies, a decreasing trend in certain intensive care unit (ICU) health care-associated infections has been reported through national infection control surveillance[9] over the last 10 years, although there has also been an alarming increase of microorganism isolates with antimicrobial resistance. These changing trends can be influenced by factors such as increasing inpatient acuity of illness, inadequate nurse-patient staffing ratios, unavailability of system resources, and other demands that have challenged health care providers to consistently apply evidence-based recommendations to maximize prevention efforts. Despite these demands on health care workers

and resources, reducing preventable HAIs remains an imperative mission and is a continuous opportunity to improve and maximize patient safety.

Another factor emerging to motivate health care facilities to maximize HAI prevention efforts is the growing public pressure on State legislators to enact laws requiring hospitals to disclose hospital-specific morbidity and mortality rates. A recent Institute of Medicine report identified HAIs as a patient safety concern and recommended immediate and strong mandatory reporting of other adverse health events, suggesting that public monitoring may hold health care facilities more accountable to improve the quality of medical care and to reduce the incidence of infections.[3] Since 2002, four States (Florida, Illinois, Missouri, and Pennsylvania) set legislation mandating health care organizations to publicly disclose HAIs.[10, 11] In 2006, the Association for Professionals in Infection Control and Epidemiology (APIC) reported that 14 States have mandatory public reporting, and 27 States have other related legislation under consideration.[12] Participation in public reporting has not been regulated by the Federal sector at this time. Some hospital reporting is intended for use solely by the State health department for generating confidential reports that are returned to each facility for their internal quality improvement efforts. Other intentions to utilize public reporting may be aimed at comparing rates of HAI and subsequent morbidity and mortality outcomes between different hospitals. This approach is problematic as there is currently a lack of scientifically validated methods for risk adjusting multiple variations (e.g., differences in severity of illnesses in each population being treated) in patients' intrinsic and extrinsic risks for HAIs.[13–15] Moreover, data on whether public reporting systems have an effective role in reducing HAIs are lacking.

To assist with generating meaningful data, process and outcome measures for patient safety practices have been proposed.[13, 14, 16] Monitoring both process and outcome measures and assessing their correlation is a model approach to establish that good processes lead to good health care outcomes. Process measures should reflect common practices, apply to a variety of health care settings, and have appropriate inclusion and exclusion criteria. Examples include insertion practices for central intravenous catheters, appropriate timing of antibiotic prophylaxis in surgical patients, and rates of influenza vaccination for health care workers and patients. Outcome measures should be chosen based on the frequency, severity, and preventability of the outcome events. Examples include intravascular catheter-related blood stream infection rates and surgical-site infections in selected operations. Although these occur at relatively low frequency, the severity is high—these infections are associated with substantial morbidity, mortality, and excess health care costs—and there are evidence-based prevention strategies available.[17, 18]

Definitions of Health Care-Associated Infections

The Centers for Disease Control and Prevention (CDC) developed baseline definitions for HAIs that were republished in 2004.[19] HAIs were defined as those that develop during hospitalization but are neither present nor incubating upon the patient's admission to the hospital; generally for those infections that occur more than 48 to 72 hours after admission and within 10 days after hospital discharge. Some hospitals use these definitions exactly as written; other hospitals may use some but not all of the CDC definitions; and other health care facilities may need to modify or develop their own definitions. Whatever definition is used, it should be consistent within the institution and be the same or similar to those developed by CDC or those used by other investigators. Having standard definitions is useful if the health care facility wants

to compare surveillance results or performance measures within its various medical/surgical specialties, against those of other health care institutions, or with national published data.

Patient Risk Factors for Health Care–Associated Infections

Transmission of infection within a health care setting requires three elements: a source of infecting microorganisms, a susceptible host, and a means of transmission for the microorganism to the host.

Source of Microorganisms

During the delivery of health care, patients can be exposed to a variety of exogenous microorganisms (bacteria, viruses, fungi, and protozoa) from other patients, health care personnel, or visitors. Other reservoirs include the patient's endogenous flora (e.g., residual bacteria residing on the patient's skin, mucous membranes, gastrointestinal tract, or respiratory tract) which may be difficult to suppress and inanimate environmental surfaces or objects that have become contaminated (e.g., patient room touch surfaces, equipment, medications). The most common sources of infectious agents causing HAI, described in a scientific review of 1,022 outbreak investigations,[20] are (listed in decreasing frequency) the individual patient, medical equipment or devices, the hospital environment, the health care personnel, contaminated drugs, contaminated food, and contaminated patient care equipment.

Host Susceptibility

Patients have varying susceptibility to develop an infection after exposure to a pathogenic organism. Some people have innate protective mechanisms and will never develop symptomatic disease because they can resist increasing microbial growth or have immunity to specific microbial virulence properties. Others exposed to the same microorganism may establish a commensal relationship and retain the organisms as an asymptomatic carrier (colonization) or develop an active disease process.

Intrinsic risk factors predispose patients to HAIs. The higher likelihood of infection is reflected in vulnerable patients who are immunocompromised because of age (neonate, elderly), underlying diseases, severity of illness, immunosuppressive medications, or medical/surgical treatments. Patients with alterations in cellular immune function, cellular phagocytosis, or humoral immune response are at increased risk of infection and the ability to combat infection. A person with a primary immunodeficiency (e.g., anemia or autoimmune disease) is likely to have frequently recurring infections or more severe infections, such as recurrent pneumonia.[21] Secondary immunodeficiencies (e.g., chemotherapy, corticosteroids, diabetes, leukemia) increase patient susceptibility to infection from common, less virulent pathogenic bacteria, opportunistic fungi, and viruses. Considering the severity of a patient's illness in combination with multiple risk factors, it is not unexpected that the highest infection rates are in ICU patients. HAI rates in adult and pediatric ICUs are approximately three times higher than elsewhere in hospitals.[22]

Extrinsic risk factors include surgical or other invasive procedures, diagnostic or therapeutic interventions (e.g., invasive devices, implanted foreign bodies, organ transplantations, immunosuppressive medications), and personnel exposures. According to one review article, at least 90 percent of infections were associated with invasive devices.[23] Invasive medical devices bypass the normal defense mechanism of the skin or mucous membranes and provide foci where

pathogens can flourish, internally shielded from the patient's immune defenses. In addition to providing a portal of entry for microbial colonization or infection, these devices also facilitate transfer of pathogens from one part of the patient's body to another, from health care worker to patient, or from patient to health care worker to patient. Infection risk associated with these extrinsic factors can be decreased with the knowledge and application of evidence-based infection control practices. These will be discussed in further detail in Chapter 42, "Targeting Health Care–Associated Infections: Evidence-Based Strategies."

Prolonged hospitalization, due to a higher acuity of illness, contributes to host susceptibility as there is more opportunity to utilize invasive devices and more time for exposure to exogenous microorganisms. These patients are also more susceptible to rapid microbial colonization as a consequence of the severity of the underlying disease, depending on the function of host defenses and the presence of risk factors (e.g., age, extrinsic devices, extended length of stay). Exposure to these colonizing microorganisms is from such sources as (1) endemic pathogens from an endogenous source, (2) hospital flora in the health care environment, and (3) hands of health care workers. A study related to length of hospitalization examining adverse events in medical care indicated that the likelihood of experiencing an adverse event increased approximately 6 percent for each day of hospital stay. The highest proportion of adverse events (29.3 percent) was not related to surgical procedures but linked instead to the subsequent monitoring and daily care lacking proper antisepsis steps.[24]

Means of Transmission

Among patients and health care personnel, microorganisms are spread to others through four common routes of transmission: contact (direct and indirect), respiratory droplets, airborne spread, and common vehicle. Vectorborne transmissions (from mosquitoes, fleas, and other vermin) are atypical routes in U.S. hospitals and will not be covered in this text.

Contact transmission. This is the most important and frequent mode of transmission in the health care setting. Organisms are transferred through direct contact between an infected or colonized patient and a susceptible health care worker or another person. Patient organisms can be transiently transferred to the intact skin of a health care worker (not causing infection) and then transferred to a susceptible patient who develops an infection from that organism—this demonstrates an indirect contact route of transmission from one patient to another. An infected patient touching and contaminating a doorknob, which is subsequently touched by a health care worker and carried to another patient, is another example of indirect contact. Microorganisms that can be spread by contact include those associated with impetigo, abscess, diarrheal diseases, scabies, and antibiotic-resistant organisms (e.g., methicillin-resistant *Staphylococcus aureus* [MRSA] and vancomycin-resistant enterococci [VRE]).

Respiratory droplets. Droplet-size body fluids containing microorganisms can be generated during coughing, sneezing, talking, suctioning, and bronchoscopy. They are propelled a short distance before settling quickly onto a surface. They can cause infection by being deposited directly onto a susceptible person's mucosal surface (e.g., conjunctivae, mouth, or nose) or onto nearby environmental surfaces, which can then be touched by a susceptible person who autoinoculates their own mucosal surface. Examples of diseases where microorganisms can be spread by droplet transmission are pharyngitis, meningitis, and pneumonia.

Airborne spread. When small-particle-size microorganisms (e.g., tubercle bacilli, varicella, and rubeola virus) remain suspended in the air for long periods of time, they can spread to other people. The CDC has described an approach to reduce transmission of microorganisms through

airborne spread in its *Guideline for Isolation Precautions in Hospitals.*[25] Proper use of personal protective equipment (e.g., gloves, masks, gowns), aseptic technique, hand hygiene, and environmental infection control measures are primary methods to protect the patient from transmission of microorganisms from another patient and from the health care worker. Personal protective equipment also protects the health care worker from exposure to microorganisms in the health care setting.

Common Vehicle. Common vehicle (common source) transmission applies when multiple people are exposed to and become ill from a common inanimate vehicle of contaminated food, water, medications, solutions, devices, or equipment. Bacteria can multiply in a common vehicle but viral replication can not occur. Examples include improperly processed food items that become contaminated with bacteria, waterborne shigellosis, bacteremia resulting from use of intravenous fluids contaminated with a gram-negative organism, contaminated multi-dose medication vials, or contaminated bronchoscopes. Common vehicle transmission is likely associated with a unique outbreak setting and will not be discussed further in this document.

Responsibility for Risk Reduction

Infection Control Department's Program Responsibilities

In 1985, the Study of the Efficacy of Nosocomial Infection Control (SENIC) project was published, validating the cost-benefit savings of infection control programs.[8] Infection control programs were proven to be effective as hospitals with certain practices reduced their infection rates by 32 percent, compared with an *increase* of 18 percent in hospitals without these components over a 5-year period.[8, 26] Essential components of effective infection control programs included conducting organized surveillance and control activities, a trained infection control physician, an infection control nurse for every 250 beds, and a process for feedback of infection rates to clinical care staff. These programmatic components have remained consistent over time and are adopted in the infection control standards of the Joint Commission (formerly the Joint Commission on Accreditation of Healthcare Organizations, JCAHO). The evolving responsibility for operating and maintaining a facility-wide effective infection control program lies within many domains. Both hospital administrators and health care workers are tasked to demonstrate effectiveness of infection control programs, assure adequate staff training in infection control, assure that surveillance results are linked to performance measurement improvements, evaluate changing priorities based on ongoing risk assessments, ensure adequate numbers of competent infection control practitioners, and perform program evaluations using quality improvement tools as indicated.

Infection Control Personnel

It has been demonstrated that infection control personnel play an important role in preventing patient and health care worker infections and preventing medical errors. An infection control practitioner[27] (ICP) is typically assigned to perform ongoing surveillance of infections for specific wards, calculate infection rates and report these data to essential personnel, perform staff education and training, respond to and implement outbreak control measures, and consult on employee health issues. This specialty practitioner gains expertise through education involving infection surveillance, infection control, and epidemiology from current scientific publications

and basic training courses offered by professional organizations or health care institutions.[28, 29] The Certification Board of Infection Control offers certification that an ICP has the standard core set of knowledge in infection control.[30, 31, 32]

Over time, the workload responsibilities of the ICP have significantly increased to encompass additional administrative functions and regulatory compliance reporting, sometimes covering prevention of infection activities in other facilities that belong to the health care system (e.g., long-term care, home care, and outpatient settings). The expanding scope of ICP responsibilities being performed with limited time and shrinking resources has created an imbalance in meeting all tasks, leading to regular completion of only essential functions and completing less essential functions when time permits. In a 2002 ICP survey examining resource allocations, the activity consuming the greatest amount of mean estimated time was surveillance, followed by education, prevention strategies to control transmission, infection control program communication, and outbreak control. In examining the tasks and the time allocations necessary to complete essential infection control responsibilities, a recent expert review panel recommended new and safer staffing allocations: 1 full-time ICP for every 100 occupied beds. Further staffing levels and recommendations are included for different types of health care facilities by bed size.[33] To maximize successful completion of current reporting requirements and strategies for the prevention of infection and other adverse events associated with the delivery of health care in the entire spectrum of health care settings, infection control personnel and departments must be expanded.[34]

Nursing Responsibilities

Clinical care staff and other health care workers are the frontline defense for applying daily infection control practices to prevent infections and transmission of organisms to other patients. Although training in preventing bloodborne pathogen exposures is required annually by the Occupational Safety and Health Administration, clinical nurses (registered nurses, licensed practical nurses, and certified nursing assistants) and other health care staff should receive additional infection control training and periodic evaluations of aseptic care as a planned patient safety activity. Nurses have the unique opportunity to directly reduce health care–associated infections through recognizing and applying evidence-based procedures to prevent HAIs among patients and protecting the health of the staff. Clinical care nurses directly prevent infections by performing, monitoring, and assuring compliance with aseptic work practices; providing knowledgeable collaborative oversight on environmental decontamination to prevent transmission of microorganisms from patient to patient; and serve as the primary resource to identify and refer ill visitors or staff.

Prevention Strategies

Multiple factors influence the development of HAIs, including patient variables (e.g., acuity of illness and overall health status), patient care variables (e.g., antibiotic use, invasive medical device use), administrative variables (e.g., ratio of nurses to patients, level of nurse education, permanent or temporary/float nurse), and variable use of aseptic techniques by health care staff. Although HAIs are commonly attributed to patient variables and provider care, researchers have also demonstrated that other institutional influences may contribute to adverse outcomes.[35, 36] To encompass overall prevention efforts, a list of strategies are reviewed that apply to the clinical

practice of an individual health care worker as well as institutional supportive measures. Adherence to these principles will demonstrate that you H.E.L.P. C.A.R.E. This acronym is used to introduce the following key concepts to reduce the incidence of health care–associated infections. It emphasizes the compassion and dedication of nurses where their efforts contribute to reduce morbidity and mortality from health care–associated infections.

Hand Hygiene

…so they shall wash their hands and their feet, that they die not:
and it shall be a statute for ever to them…
Exodus 30:21 Revised Standard Version

Overview. For the last 160 years, we have had the scientific knowledge of how to reduce hand contamination and thereby decrease patient infections from the seminal work on hand washing by the Hungarian obstetrician, Ignaz Semmelweis. Epidemiologic studies continue to demonstrate the favorable cost-benefit ratio and positive effects of simple hand washing for preventing transmission of pathogens in health care facilities.[37, 38] The use of antiseptic hand soaps (i.e., ones containing chlorhexidine) and alcohol-based hand rubs also effectively reduce bacterial counts on hands when used properly. Even though the clear benefits of hand washing have been proven in multiple settings, the lack of consistent hand-washing practices remains a worldwide issue. In a resource-poor area of Pakistan, a recent household hand-washing campaign demonstrated a 50 percent lower incidence of pneumonia in children younger than 5 years compared to households that did not practice hand washing. Children under 15 years in hand-washing households had a 53 percent lower incidence of diarrhea and a 34 percent lower incidence of impetigo. Hand washing with plain soap prevented the majority of illnesses causing the largest number of childhood deaths globally.[39] The World Alliance for Patient Safety, formed by the World Health Organization, has adopted infection reduction programs—in both developed and developing countries—as its first goal.[40, 41] The World Alliance for Patient Safety advocates a "clean care is safer care" program, in which health care leaders sign a pledge to take specific steps to reduce HAIs in their facilities. Hand hygiene is the first focus in this worldwide initiative.

Understaffing and hand hygiene. Hospitals with low nurse staffing levels and patient overcrowding leading to poor adherence to hand hygiene have been associated with higher adverse outcome rates and hospital outbreak investigations.[34, 42, 43] In an ICU setting,[44] it was demonstrated that understaffing of nurses can facilitate the spread of MRSA through relaxed attention to basic infection control measures (e.g., hand hygiene). In a neonatal ICU outbreak,[45] the daily census was above the maximum capacity (25 neonates in a unit designed for 15), and the number of assigned staff members was fewer than the number necessitated by the workload, which resulted in relaxed attention to basic infection-control measures (use of multidose vials and hand hygiene). During the highest workload demands, staff washed their hands before contacting devices only 25 percent of the time, but hand washing increased to 70 percent after the end of the understaffing and overcrowding period. Ongoing surveillance determined that being hospitalized during this period was associated with a fourfold increased risk of acquiring an HAI. These studies illustrate an association between staffing workload, infections, and microbial transmission from poor adherence to hand hygiene policies.

Time demands. A perceived obstacle is that time to complete patient care duties competes with time needed for hand washing, particularly in technically intense settings such as an ICU. Hospital observational studies demonstrate that the frequency of hand washing varies between

hospital wards and occurs an average of 5 to 30 times per shift, with more hand washing opportunities in an ICU.[46] With time limitations due to patient acuity demands or nurse-patient ratios and limited availability of sinks, the use of waterless, alcohol-based hand rubs has been shown to improve health care workers' compliance with hand hygiene practices in the ICU.[47]

Hand washing behaviors. Observational studies have found that on average, health care workers adhere to recommended hand hygiene procedures 40 percent of the time (with a range of 5 to 80 percent).[44] These studies implemented various interventions to improve hand washing, but summarized effects by measuring responses over a short time frame, without demonstrating long-lasting behavioral improvements. Two studies demonstrated the use of multidisciplinary interventions to change the organizational culture on frequency of hand washing that resulted in sustained improvements during a longer followup time period.[48, 49]

Behavioral theories that examine the relationship of multiple factors affecting behavioral choices have been applied to the complex issue of hand washing compliance. These theories illustrate the influence of the individual *intention* to perform hand washing and organizational influences that affect the outcome behavior. The Theory of Planned Behavior has been studied in this context, acknowledging that the intention to wash hands involves a person's (1) attitude whether or not the behavior is beneficial to themselves, (2) perception of pressure from peers, and (3) perceived control on the ease or difficulty in performing the behavior.[50–53] These perceptions are also influenced by the strength of the person's beliefs about the significance of the outcomes of the behavior; the normative beliefs, which involve the individual evaluation of peer expectations; and control beliefs, which are based on a person's perception of their ability to overcome obstacles that obstruct their completion of the behavior.

Monitoring compliance. Although standards for hand hygiene practices have been published with an evidence-based guideline[44] and professional collaborations have produced the *How-to-Guide: Improving Hand Hygiene,*[54] there is no standardized method or tool for measuring adherence to institutional policy. Varying quality improvement methodologies and a lack of consensus on how to measure hand hygiene compliance have made it difficult to determine the effectiveness of hand hygiene expectations within and across health care settings. The Joint Commission has instituted a partnership with major infection control leadership organizations in the United States and abroad to identify best approaches for measuring compliance with hand hygiene guidelines in health care organizations though its Consensus Measurement in Hand Hygiene (CMHH) project. The participating organizations include APIC, CDC, the Society for Healthcare Epidemiology of America, the World Health Organization World Alliance for Patient Safety, the Institute for Healthcare Improvement, and the National Foundation for Infectious Diseases. The final product of this project, due to be completed in early 2008, will be an educational monograph that recommends best practices for measuring hand hygiene compliance.[55]

Summary. Hand hygiene adherence and promotion involve multiple factors at the individual and system level to provide an institutional safety climate for patients and health care staff. Methods used to promote improved hand hygiene require multidisciplinary participation to identify individual beliefs, adherence factors, and perceived barriers. Program successes have been summarized and should be reviewed to establish improved hand hygiene as a priority program at your facility.[44, 56, 57]

Hand Hygiene: Key Points

- The practice of appropriate hand hygiene and glove usage is a major contributor to patient safety and reduction in HAIs. It is more cost effective than the treatment costs involved in a health care–associated infection.
- Joint Commission infection control standards include hand washing and HAI sentinel event review, which are applicable to ambulatory care, behavioral health care, home care, hospitals, laboratories, and long-term care organizations accredited by the Joint Commission.
- Hand hygiene is the responsibility of the individual practitioner and the institution. Developing a patient safety culture backed by administrative support to provide resources and incentives for hand washing is crucial to a successful outcome.
- Hand hygiene promotion should be an institutional priority.
- Select methods to promote and monitor improved hand hygiene. Monitor outcomes of adherence to hand hygiene in association with reduced incidence of HAI.
- Establish an evaluation model to recognize missed opportunities for appropriate hand hygiene.

Environmental Cleanliness

The health care environment surrounding a patient contains a diverse population of pathogenic microorganisms that arise from a patient's normal, intact skin or from infected wounds. Approximately 10^6 flat, keratinized, dead squamous epithelium cells containing microorganisms are shed daily from normal skin,[58] and patient gowns, bed linens, and bedside furniture can easily become contaminated with patient flora. Surfaces in the patient care setting can also be contaminated with pathogenic organisms (e.g., from a patient colonized or infected with MRSA, VRE, or *Clostridium difficile*) and can harbor viable organisms for several days. Contaminated surfaces, such as blood pressure cuffs, nursing uniforms, faucets, and computer keyboards,[59, 60] can serve as reservoirs of health care pathogens and vectors for cross-contamination to patients. Studies have demonstrated that health care workers acquire microorganisms on gloved hands without performing direct patient contact and when touching surfaces near a colonized patient.[59, 61] Another study determined that a health care worker's hand became contaminated after entering a regular patient's room (one who was not on contact precautions) and only touching common surfaces close to the patient (bed rails, bedside table), without direct patient contact. The same hand contact was done by other personnel in unoccupied rooms that had been terminally cleaned after patient discharge. Ungloved hands became contaminated with low levels of pathogenic microorganisms more than 50 percent of the time, even from surfaces in rooms that had been terminally cleaned after patient discharge.[62] It is important to consider this likelihood of hand contamination could occur (contamination would also apply to the external surface of gloves, if worn) and to perform routine hand hygiene to bare hands or ungloved hands to reduce hand contamination before touching clean**,** general-use surfaces (e.g., computer keyboard, telephone, med cart, medical record, cleaning supplies, etc.). Proper disinfection of common surfaces and proper hand hygiene procedures (after direct contact to surfaces or contact with glove usage) is also critically important to reduce direct or indirect routes of transmission.[63] Persistence of environmental contamination after room disinfection can occur and has been recently demonstrated to increase the risk of transmission to the next susceptible room occupants.[64–66]

Thus, patients with known colonization or diseases with multi-drug-resistant organisms or *Clostridium difficile* require Contact Precautions in addition to the Standard Precautions to reduce the risk of transmission from the patient and the contaminated environment to others.

Nurses can ensure clean medical equipment is used between patients and can work with environmental services personnel to maximize clean conditions in and around patient rooms. It is necessary to consistently perform hand hygiene after routine patient care or contact with environmental surfaces in the immediate vicinity of the patient. Infection control procedures are recommended to reduce cross-contamination under the following situations:[67]

1. Use EPA-registered chemical germicides for standard cleaning and disinfection of medical equipment that comes into contact with more than one patient.
2. If *Clostridium difficile* infection has been documented, use hypochlorite-based products for surface disinfection as no EPA-registered products are specific for inactivating the spore form of the organism.
3. Ensure compliance by housekeeping staff with cleaning and disinfection procedures, particularly high-touch surfaces in patient care areas (e.g., bed rails, carts, charts, bedside commodes, doorknobs, or faucet handles).
4. When contact precautions are indicated for patient care (e.g., MRSA, VRE, *C. difficile*, abscess, diarrheal disease), use disposable patient care items (e.g., blood pressure cuffs) wherever possible to minimize cross-contamination with multiple drug-resistant microorganisms.
5. Advise families, visitors, and patients regarding the importance of hand hygiene to minimize the spread of body substance contamination (e.g., respiratory secretions or fecal matter) to surfaces.

A patient safety goal could be to adopt a personal or an institutional pledge, similar to the following: I (or name of health care facility) am committed to ensuring that proper infection control and environmental disinfection procedures are performed to reduce cross-contamination and transmission so that a person admitted or visiting to this facility shall not become newly colonized or infected with a bacterium derived from another patient or health care worker's microbial flora.

Leadership

Health care workers dedicate enormous effort to providing care for complex medical needs of patients, to heal, to continuously follow science to improve the quality of care—all the while consciously performing to the best of their ability to *Primum non nocere* (First, do no harm). Though medical errors and adverse events do occur, many can be attributed to system problems that have impacted processes used by the health care worker, leading to an undesired outcome. Health care workers evaluate their professional impact based on outcomes that demonstrate that medical and nursing orders are completed properly, that a sentinel event did not occur, clinical judgment was properly utilized to improve patient care, and that most patients leave in stable or better health than when they arrived. With all the complicated patient care administered, if the patient did not acquire an infection during a hospitalization, is that an indication that all patient care interactions were practiced aseptically? Or could the lack of infection be attributed to some process interactions where the patient received a microbial exposure that was less than the threshold needed to acquire an infection or, fortuitously, the patient had enough natural immunity to ward off a potential infection? Although success is measured by an outcome with or without infection, we should consistently practice in such a manner to reduce patient exposure to exogenous microorganisms, which would consequently reduce the risk of infection.

Responsibility for risk reduction involves the institution administrators, directors, and individual practitioners. It is clear that leaders drive values, values drive behaviors, and

behaviors drive performance of an organization. The collective behaviors of an organization define its culture. The engagement of nursing leaders to collaborate with coworkers and hospital administrators in safety, teamwork, and communication strategies are critical requirements to improve safe and reliable care. Developed and applied concurrently, they weave a supporting framework for the effective implementation of new technologies and evidence-based practices.[68] If patients are not receiving all the evidence-based care that is indicated (regardless of a noninfectious outcome measure), then we have a professional obligation to demonstrate leadership to develop the methods to improve that care. The challenge is how to develop and sustain the change necessary to translate infection prevention knowledge into everyday clinical practice. As each person accepts his or her role in that responsibility, that leadership and role model example will influence a standard culture and expectation for all health care workers and support personnel to implement best practices.

Each institution must communicate the evidence-based practices to health care staff, have access to expertise about infection control practices, employ the necessary resources and incentives to implement change, and receive real-time feedback of national and comparative hospital-specific data.

> Health care institutions simply must expect more reliable performance of essential infection-control practices, such as hand hygiene and proper use of gloves. It is no longer acceptable for hospitals with substandard adherence to these basic interventions to excuse their performance as being no worse than the dismal results in published reports. Most institutions still tolerate defect or failure rates in hand hygiene of 40 percent or more—levels that would be considered shocking in any other industry[69] (p. 274).

Institution improvements should focus on process improvements that sustain best practices, using multifactorial approaches, and a commitment from the top administration through all levels of staff and employees to implement best practices.[70]

Proper Use of Personal Protective Equipment

Infection control practices to reduce HAI include the use of protective barriers (e.g., gloves, gowns, face mask, protective eyewear, face shield) to reduce occupational transmission of organisms from the patient to the health care worker and from the health care worker to the patient. Personal protective equipment (PPE) is used by health care workers to protect their skin and mucous membranes of the eyes, nose, and mouth from exposure to blood or other potentially infectious body fluids or materials and to avoid parenteral contact. The Occupational Safety and Health Administration's Bloodborne Pathogens Standard states that health care workers should receive education on the use of protective barriers to prevent occupational exposures, be able to identify work-related infection risks, and have access to PPE and vaccinations.[71]

Proper usage, wear, and removal of PPE are important to provide maximum protection to the health care worker. However, PPE may not be 100 percent protective, individual work practices may lead to exposure (e.g., needlestick injury), breaches in PPE might occur, and some breaches may go unrecognized. All PPE should be removed when leaving the patient care area.[25] Gloves prevent gross contamination of the hands when touching body fluids, reduce the likelihood that microorganisms present on the hands of personnel will be transmitted to patients during invasive or other patient care procedures, and reduce the likelihood that hands of personnel contaminated with microorganisms from a patient or a fomite can transmit these microorganisms to another

patient. Gloves may have small, unapparent defects or may be torn during use, and hands can become contaminated during removal of gloves,[72–75] thus hand hygiene is essential before donning another pair of gloves.

Various types of masks, goggles, and face shields are worn alone or in combination to provide barrier protection. A surgical mask protects a patient against microorganisms from the wearer and protects the health care worker from large-particle droplet spatter that may be created from a splash-generating procedure. When a mask becomes wet from exhaled moist air, the resistance to airflow through the mask increases. This causes more airflow to pass around edges of the mask. The mask should be changed between patients, and if at anytime the mask becomes wet, it should be changed as soon as possible. Gowns are worn to prevent contamination of clothing and to protect the skin of health care personnel from blood and body fluid exposures. Gowns specially treated to make them impermeable to liquids, leg coverings, boots, or shoe covers provide greater protection to the skin when splashes or large quantities of potentially infective material are present or anticipated. Gowns are also worn during the care of patients infected with epidemiologically important microorganisms to reduce the opportunity for transmission of pathogens from patients or items in their environment to other patients or environments. When gowns are worn, they must be removed before leaving the patient care area and hand hygiene must be performed.

Improper use and removal of PPE can have adverse health consequences to the health care worker. During the 2003 severe acute respiratory syndrome (SARS) outbreak in Canada, 44 percent of the probable SARS cases were in health care workers. After institutional implementation of SARS-specific infection control precautions, 17 workers developed disease. Fifteen were interviewed to determine their knowledge and work practices that could have contributed to their infection. Only 9 (60 percent) reported they had received formal infection control training; 13 (87 percent) were unsure of the proper order in which to don and remove PPE; 6 (40 percent) reused items (e.g., stethoscopes, goggles, and cleaning equipment) elsewhere on the ward after initial use in the room of a SARS patient; and 8 (54 percent) were personally aware of a breach in infection control precautions. Fatigue and multiple consecutive shifts may have contributed to the transmission.[76]

From the experiences observed during the SARS outbreak, CDC developed training materials to increase the safety of the health care worker environment through improved use of PPE by health care personnel. Posters (bilingual), slides, and video information are available on the CDC Web site: http://www.cdc.gov/ncidod/dhqp/ppe.html.

Consistent Evidence-Based Practices

Professional organizations for infection control and health care epidemiology publish evidence-based guidelines regarding the practice of health care infection control, strategies for surveillance and prevention, and control of HAIs in U.S. health care facilities. These consensus-based scientific publications provide priority recommendations on the basis of the existing scientific data; theoretical rationale; and applicability of well-designed experimental, clinical, or epidemiologic studies to prevent HAIs in different patient care settings. Additionally, the Joint Commission's initiative, Shared Visions—New Pathways 2004 accreditation process, focuses on continuous compliance with its standards, which contributes to health care organizations' maintenance of safe, quality care and improved organizational performance.[77]

Despite the high educational level of health care workers and knowledge of aseptic practices, adherence to published infection control precautions is not consistently applied.[78] In one study, a

self-reported questionnaire demonstrated that although all health care providers knew the appropriate protective barrier equipment required for a particular patient care interaction, their reasons for nonadherence included perceived time constraints (64 percent), inconvenience (52 percent), and presumption that the patient was not infected (34 percent).[79] The observed rate of compliance was inversely related to the years of health care experience.

Translation of evidence-based guidelines into clinical practice may require more than reliance on an individual practitioner's knowledge and intentions. Organizational interventions may be necessary to better understand the barriers that impede the process of effectively reviewing and implementing evidenced-based practices into daily clinical practice.[80–83] Standard policies and standards of practice should be time specific, measurable, and should also define the specific population of patients that will be affected. When the institution implements an evidence-based guideline that updates the current policy, a multidisciplinary intervention should be planned to ensure staff concurrence with the change; agreement that the new approach is crucial; an assurance that there will be adequate staff, knowledge, and resources to implement the change; and a method to evaluate the impact of the change.[84]

Antimicrobial-Resistance Campaign

"In theory, there is no difference between theory and practice. But in practice, there is."
Jan L. A. van de Snepshceut, computer scientist and educator

Background. After the first use of penicillin in the 1950s, antibiotic resistance developed rapidly in some bacteria such as *Staphylococcus aureus.* Over the last several decades, a shift in the etiology of more easily treated pathogens has increased toward more antimicrobial-resistant pathogens with fewer options for therapy. Infections from antimicrobial-resistant bacteria increase the cost of health care, cause higher morbidity and mortality, and lengthen hospital stays compared to infections from organisms susceptible to common, inexpensive antimicrobials. Antimicrobial resistance has continued to emerge as a significant hospital problem affecting patient outcomes by enhancing microbial virulence, causing a delay in the administration of effective antibiotic therapy, and limiting options for available therapeutic agents. In a 2003 Institute of Medicine report, antimicrobial resistance was noted as a paramount microbial threat of the 21st century.[85]

Burden of organisms. Rates of antimicrobial resistance among hospital and community pathogens have increased considerably during the past decade. More than 70 percent of the bacteria that cause hospital-associated infections are resistant to at least one of the drugs most commonly used to treat these infections.[86] According to 2003 National Nosocomial Infections Surveillance System data from ICU patients, 60 percent of *Staphylococcus aureus* isolates were resistant to methicillin, oxacillin, or nafcillin (MRSA)—an 11 percent increase from data reported the year before.[87] There was a nearly 50-percent increase in nonsusceptible *Klebsiella pneumoniae* isolates to 3rd generation cephalosporins between 2002 and 2003. Although the rate of vancomycin-resistant enterococcus (VRE) has shown a less drastic increase than previous years, it still increased 12 percent in 2003 (for a total of 28.5 percent of all enterococci isolates).

Another recent national survey of antimicrobial resistance trends and outbreak frequency was performed among U.S. hospitals (those hospitals having at least 50 beds, both general medical and surgical services, and accreditation by the Joint Commission) using the American Hospital Association annual survey data set.[88] A total of 494 of the 670 hospital laboratories (74 percent) responded. Antimicrobial resistance rates were highest for oxacillin-resistant *Staphylococcus*

aureus (ORSA, also referred to as MRSA) (36 percent); two-thirds of the hospitals reported increasing MRSA rates, 4 percent reported decreasing rates, and 24 percent reported MRSA outbreaks.

Mechanism of antibiotic resistance. The treatment of bacterial infections is not a straightforward process. Bacterial microorganisms are initially susceptible to a new antibiotic, but over time, as use of the antibiotic increases, new generations of the organism will selectively adapt by developing antibiotic resistance. These organisms have the ability to undergo protective spontaneous mutation within themselves or acquire an exogenous antibiotic-resistant gene through genetic transfer from another organism, which enables it to inactivate an antibiotic or nullify its killing activity. The human microbial population includes a combination of susceptible bacteria and antibiotic-resistant bacteria. Antimicrobial usage changes the competitive balance of the microbial population by decreasing the amount of susceptible bacteria, providing an opportunity for resistant bacteria to flourish. Areas within hospitals such as ICUs that have high rates of antimicrobial usage also have the highest rates of antimicrobial resistance.

Patients can acquire an antibiotic-resistant organism through other mechanisms. Increased antibiotic treatments received in community settings can lead to the presence or colonization of antimicrobial-resistant organisms in the community population, which can be introduced into the hospital by patients on admission. These colonized organisms may not be detected if the patient is admitted for noninfectious reasons. This underscores the need for routine hand hygiene after all patient care, not just after care to patients on Contact Precautions. Often, it becomes apparent that silent transmission has occurred when the newly discovered presence of a resistant organism can be traced back to another patient who is later found to have been infected or colonized with the resistant organism. More frequently, however, the exact source of resistant organisms or the source of transmission within the institution remains undetermined.

Prevention of antibiotic-resistant organisms. Authors of evidence-based guidelines on the increasing occurrence of multidrug-resistant organisms propose these interventions: stewardship of antimicrobial use, an active system of surveillance for patients with antimicrobial-resistant organisms, and an efficient infection control program to minimize secondary spread of resistance.[89–91] Antimicrobial stewardship includes not only limiting the use of inappropriate agents, but also selecting the appropriate antibiotic, dosage, and duration of therapy to achieve optimal efficacy in managing infections. A prospective study on hospital mortality due to inadequate antimicrobial treatment demonstrated that the infection-related mortality rate for patients receiving inadequate antimicrobial treatment (42 percent) was significantly greater than the infection-related mortality rate of patients receiving adequate antimicrobial treatment (17.7 percent) in a medical or surgical ICU setting.[92]

Earlier guideline recommendations by professional organizations were published between 1995 and 1997 for the prevention of antimicrobial resistance in hospitals.[93–95] To evaluate the application of the recommendations, a cross-sectional survey was performed to determine what types of antimicrobial-use programs were being used among 47 U.S. hospitals participating in the ICU component of the CDC's National Nosocomial Infections Surveillance System.[96] All 47 hospitals had some established programs, although their practices did not meet all of the published recommendations. For example, one programmatic practice was to consult with an infectious disease physician or pharmacist (used 60–70 percent of the time) to discuss initial antimicrobial options; however, only 40 percent reported a system to measure compliance with administering the recommended antimicrobial agent. The Cochrane Collaboration reviewed 66 published papers to develop "interventions to improve antibiotic prescribing practices for

hospital inpatients."[97] Interventions were aimed at varying outcomes (e.g., increase/decrease treatment, regimen, timing of dosing, restrictive or persuasive methods to reduce unnecessary antibiotic use). Studies showed that about half of the time, hospital physicians were not prescribing antibiotics properly. Nonetheless, most interventions demonstrated some improvement in antibiotic prescribing to reduce antimicrobial resistance or hospital-acquired infections. Hospital campaigns to prevent antimicrobial resistance include steps to (1) employ programs to prevent infections, (2) use strategies to diagnose and treat infections effectively, (3) operate and evaluate antimicrobial use guidelines (stop orders, restrictions, and criteria-based clinical practice guidelines), and (4) ensure infection control practices to reduce the likelihood of transmission.[98] Nurse practitioners have a role as part of the health care team diagnosing and treating infections appropriately and should be familiar with strategies to improve antimicrobial use. All health care workers play a critical role in reducing the risk of transmission.

Based on the factors contributing to antibiotic resistance in health care settings that were identified through data collection, guidelines, professional recommendations, and scientific research, the CDC compiled several tools in 2002 to increase awareness in health care settings. The Campaign to Prevent Antimicrobial Resistance in health care settings utilizes four strategies to increase awareness and encourage the best practices for antibiotic use and interventional programs to prevent resistance: prevent infection, diagnose and treat infection effectively, use antimicrobials wisely, and prevent transmission. Laminated cards, posters, slide sets, and fact sheets that can be used in a health care setting to promote recognition and utilization are listed at http://www.cdc.gov/drugresistance/healthcare/default.htm. A summary of the CDC's 12-step program and specific nursing interventions is provided in Appendix 2.

Summary of key concepts. A program that only scrutinizes and monitors antimicrobial use will not be effective to reduce antimicrobial resistance; it must also implement proper infection control measures and have laboratory, surveillance, and administrative support. The optimal strategy for control of antibiotic-resistant organisms is not the same for every health care facility as this individually depends on the levels of endemic colonization, presence of one or more resistant organisms, and levels of infection (low or outbreak levels). The ICP and hospital epidemiologist at each facility are valuable resources to provide programmatic education and recommend targeted infection control measures (e.g., use of personal protective barriers, hand hygiene resources, patient placement/segregation, and admission surveillance cultures). Similar to the example of antibiotic consultation practices and outcome measures, this plan will have little effect or opportunity to reduce the morbidity and mortality of infectious complications unless there is committed organizational support, including expert recommendations that are adopted into daily practice routines. Nursing personnel have the most patient contact and the most opportunity to interrupt the chain of transmission through adherence to consistent aseptic practices.

Respiratory Hygiene and Cough Etiquette

Respiratory viruses are easily disseminated in a closed setting such as a health care facility and can cause outbreaks that contribute to the morbidity of patients and health care staff. Personnel and patients with a respiratory illness commonly transmit viruses through droplet spread. Droplets are spread into the air during sneezing, talking, and coughing and can settle on surfaces. Transmission occurs by direct contact with mucous membranes or by touching a contaminated surface and self-inoculating mucous membranes. Respiratory viruses can sometimes have aerosol dissemination.

Precautions to prevent the transmission of all respiratory illnesses, including influenza, have been developed.[99] The following infection control measures should be implemented at the first point of contact with a symptomatic or potentially infected person. Occupational health policies should be in place to guide management of symptomatic health care workers.

1. Post visual alerts (in appropriate languages) at the entrance to outpatient facilities instructing patients and escorts (e.g., family, friends) to notify health care personnel of symptoms of a respiratory infection when they first register for care.
2. Patients and health care staff should consistently practice the following:
   a. Cover the nose/mouth when coughing or sneezing.
   b. Use tissues to contain respiratory secretions and dispose of them in the nearest waste receptacle after use.
   c. Perform hand hygiene after having contact with respiratory secretions and contaminated objects or materials.
3. During periods of increased respiratory infection activity in the community or year-round, offer masks to persons who are coughing. Either procedure masks (i.e., with ear loops) or surgical masks (i.e., with ties) may be used to contain respiratory secretions. Encourage coughing persons to sit at least 3 feet away from others in common waiting areas.
4. Health care personnel should wear a surgical or procedure mask for close contact (and gloves as needed) when examining a patient with symptoms of a respiratory infection. Maintain precautions unless it is determined that the cause of symptoms is not an infectious agent (e.g., allergies).

Evaluation

The ICP or a nurse on a specific patient care unit should design a periodic evaluation program of infection control practices, including aseptic technique practices. Evaluation methods include a self-assessment survey of intended practices, direct observational assessments by another health care worker or a patient, and self-completion of checklists that review work practices and identify opportunities for improvement within the health care operations. If deficiencies or problems in the implementation of standardized infection control procedures are identified, further evaluation activities (e.g., root-cause analysis) may be indicated to identify and rectify the contributing factors to the problem.[100]

Most evaluation reviews are generated after a major, life-threatening error occurs, which usually happens infrequently. Historically, when an evaluation determined that a process completed by personnel was deficient, problem-solving efforts focused on the identification of the specific individual(s) who "caused" the problem. Later, quality improvement efforts focused on developing a culture of safety and recognized that additional contributions to errors were due to complex, poorly designed systems. The advantage of an evaluation that reviews system problems is that it encourages health care professionals to report adverse events and near misses that might be preventable in the future, while balancing the identification of system problems with holding individual providers responsible for their everyday practices. Improvement is impossible without evaluation reports to provide data on the factors that contribute to mistakes and lead to subsequent individual and system changes that support safer practices.[101]

An evaluation strategy examining process measures include the following examples:

- Document staff use of maximum sterile barriers (cap, mask, sterile gown, sterile gloves, large sterile sheet) and aseptic technique for the insertion of central intravenous catheters or guidewire exchange.
- Document timing of antibiotic prophylaxis when used in surgical patients (e.g., within 1 hour of incision).
- Document if hand hygiene is performed and clean or sterile gloves are worn before assessing a catheter insertion site or changing a dressing on intravascular catheters.
- Document time elapsed from when patient culture (microbiology and susceptibility) results are reported and when the appropriate isolation precautions are instituted (patient room placement, signs, PPE used, disposable equipment used, medical record documentation, etc.).
- Ensure that staff (nurses, doctors, and housekeeping) enter a contact isolation room using the specified personal protective barriers (e.g., gloves, gown) on each entry.
- Ensure that staff properly remove PPE after leaving a patient's room.
- Assess the annual rates of influenza vaccination for health care workers and other personnel eligible to receive vaccination; assess the rates of influenza vaccination for patients.
- Ensure that needle disposal containers are no more than three-quarters full at time of disposal.
- Periodically monitor and record adherence with the hand hygiene guidelines: the number of times personnel washed their hands divided by the number of hand-hygiene opportunities, computed by ward or by service. Provide feedback to personnel regarding their performance.
- Monitor the volume of alcohol-based hand rub (or detergent used for handwashing or hand antisepsis) used per 1,000 patient days.
- When outbreaks of infection occur, assess the adequacy of health care worker hand hygiene.
- When a patient with a known colonization or infection with a multidrug-resistant organism (e.g., MRSA, VRE) is transferred to your facility, evaluate effectiveness of system notification to health care personnel in the receiving facility.
- Record compliance with hospital policy for catheter-site dressing changes.

Research Implications[*]

1. Research and apply behavioral and management sciences to achieve implementation of evidence-based clinical guidelines and compliance with infection prevention policies.
2. Develop methods to improve the appropriateness of antimicrobial use based on identified antimicrobial control measures and institution microbial susceptibility patterns.
3. Collect data for the economic impact of HAIs and other adverse effects and resulting return of investment for prevention methods.
4. Identify specific components of infection prevention and control programs and staffing in health care institutions that are effective (and cost effective) in reducing rates of infection.

[*] Adapted from Lynch et al. 2001[104] and Aboelela et al. 2006.[105]

5. Improve health care institution information systems for seamless review of appropriateness of infection control-related care based on patient diagnosis.
6. Determine standard indices for measurement of effectiveness and cost of infection control measures.
7. Measure effect of staffing changes (reduced personnel, prolonged work hours, varying levels of formal education) on patient outcomes related to infectious outcomes of morbidity and mortality (e.g., colonization of microorganisms, postoperative wound infections, and catheter-related infections).
8. Design studies so that independent effects of specific interventions can be identified.
9. Monitor the implementation of interventions in a multicenter study to examine a cause-and-effect response and differentiate between efficacy and effectiveness.
10. Develop interdisciplinary research teams to improve the rigor and sophistication of studies conducted.

Conclusions

It is the responsibility of all health care providers to enact principles of care to prevent health care–associated infections, though not all infections can be prevented. Certain patient risk factors such as advanced age, underlying disease and severity of illness, and sometimes the immune status are not modifiable and directly contribute to a patient's risk of infection. Depending on the patient's susceptibility, a patient can develop an infection due to the emergence of their own endogenous organisms or by cross-contamination in the health care setting. Benefits of antimicrobial therapy will alter the microbial flora by reducing one microbial presence but may allow the emergence of another, causing a new infection (e.g., antibiotic-associated diarrhea).

Nurses can reduce the risk for infection and colonization using evidence-based aseptic work practices that diminish the entry of endogenous or exogenous organisms via invasive medical devices. Proper use of personal protective barriers and proper hand hygiene is paramount to reducing the risk of exogenous transmission to a susceptible patient. For example, microorganisms have been found in the environment surrounding a patient and on portable medical equipment used in the room. Environmental surfaces around a patient infected or colonized with a multidrug-resistant organism can also become contaminated. Health care workers should be aware that they can pick up environmental contamination of microorganisms on hands or gloves, even without performing direct patient care. Proper use and removal of PPE followed by hand hygiene will reduce the transient microbial load that can be transmitted to self or to others. Identified aseptic and infection control practices have been proven to reduce the dissemination of organisms to a single patient, to prevent repeated transmissions that contribute to an outbreak situation among multiple patients, or to become established in the health care environment as endemic hospital flora.

Nursing has many complicated scopes of practice, which challenge time management, priority setting, and efficiency of practice. Although system and administrative support is beneficial to supporting aspects of nursing care, direct care is performed by individuals. Every individual nurse focuses on making a difference throughout the daily workloads and enormous responsibilities but changes in a patient's medical condition can become overwhelming. One nurse comes to mind who found the resolve to make significant strides within the patient ward dealing with chronically overwhelming situations. She was administratively responsible for

directing and addressing the challenges of all patients' chronic wound infections, ongoing cross-contamination, lack of needed medical supplies and equipment, severe understaffing, working extra shifts, and still finding time to provide care and comfort to patients. By her personal efforts to improve wound care, aseptic practices, and hand hygiene among all nursing and medical staff, mortality dropped in a dramatic decline from 33 percent to 2 percent within a 9-month period.[102] These sustained and dedicated efforts to reduce patient infections and improve patient care in light of overwhelming adversity set a standard of practice for all nurses to follow. That nurse was Florence Nightingale, defining the art of nursing in the 1850s. Although medical care is more advanced and technically more complex since that time, it was the dedication of a nurse (like you) to ensure aseptic practices despite the significant nursing demands of patient care that makes the difference for the patients—then and now.

National surveys of the public have repeatedly found nursing to be one of the most trusted professions. The public trusts us to provide safe care and employ best practices by following certain principles: (1) to not work while having an infectious illness, (2) to be knowledgeable about the methods to protect our patients from transmission of disease, (3) to perform aseptic practice and monitor patient infections, (4) to participate in quality improvement initiatives to reduce infections, and (5) to provide care even if it means self-risk from infection. As nurses we have an ethical obligation to meet that trust and uphold the highest standards for our patients and the public, whether we are providing direct care, teaching about proper health care, or overseeing nursing practice.[103]

It has been demonstrated that nursing and medical practices can pick up transient microorganisms from intact patient skin and from environmental surfaces. Although the amount of contamination is not quantified and the exact incidence is not apparent, it does occur. Hand hygiene and aseptic practices before caring for a susceptible patient can reduce the transient carriage and transfer of microorganisms. The protective benefits of infection control using evidence-based practices are cost effective and numerous: they not only contribute to the best individual patient care outcome, but also protect health care workers, increase public awareness in all health care settings about infection control issues, and maintain the highest standards in nursing, which positively contributes to our goal for the best possible patient and public health outcomes.

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Appendix 1. Resources

Federal Agencies

Agency for Healthcare Research and Quality
Measuring health care quality, outcomes, and effectiveness, etc.
http://www.ahrq.gov/

Centers for Disease Control and Prevention: CDC for Healthcare Providers
Health care infections, hepatitis, antimicrobial resistance, health care worker protection. Slide presentations. Fact sheets. http://www.cdc.gov/CDCForYou/healthcare_providers.html

Guidelines http://www.cdc.gov/ncidod/dhqp

Prevention of Catheter-Associated Urinary Tract Infections, 1981
Environmental Infection Control in Healthcare Facilities, 2003
Hand Hygiene in Healthcare Settings, 2002
Preventing Healthcare-Associated Pneumonia, 2003
Guidelines for Infection Control in Health Care Personnel, 1998
Infection Prevention and Control in the Long-Term Care Facility, 1997
Guideline for Isolation Precautions in Hospitals, 1996
Guidelines for the Prevention of Intravascular Catheter-Related Infections, 2002
Management of Multidrug-Resistant Organisms in Healthcare Settings, 2006
Guideline for Prevention of Surgical-Site Infection, 1999
Public Health Service Guidelines on the Management of Exposure to HBV, HCV, and HIV with PEP Recommendations, 2001
Updated U.S. Public Health Service Guidelines for the Management of Occupational Exposures to HIV and Recommendations for Post-Exposure Prophylaxis, 2005
Guidelines for Preventing the Transmission of M. *tuberculosis* in Health Care Settings, 2005

Food and Drug Administration
Information for Health Professionals (Medical Devices, Drugs, etc.)
http://www.fda.gov/oc/oha/default.htm

U.S. Department of Health and Human Services
Pandemic Flu.
http://pandemicflu.gov/

National Institutes of Health: National Institute of Allergy and Infectious Diseases
Health, science, research, research funding, news.
http://www3.niaid.nih.gov/

Occupational Safety and Health Administration
Hospital eTool (health care hazards, infection, housekeeping, nursing homes)
http://www.osha.gov/SLTC/etools/hospital/hazards/infection/infection.html

Professional Organizations

American Nurses Association
Center for Occupational and Environmental Health
Occupational health, RNno harm, influenza posters, safe needles.
http://www.nursingworld.org/MainMenuCategories/OccupationalandEnvironmental.aspx

Association for Professionals in Infection Control and Epidemiology
Educational brochures, assorted topics; Protect Our Patients Campaign.
http://www.apic.org/Content/NavigationMenu/Education/EducationResources/Educational_Brochur.htm
Community-associated MRSA references.
http://www.apic.org/AM/Template.cfm?Section=Home&Template=/CM/ContentDisplay.cfm&ContentFileID=5801

Joint Commission (Joint Commission on Accreditation of Healthcare Organizations)
Infection control initiatives, standards.
http://www.jointcommission.org/PatientSafety/InfectionControl/

National Quality Forum
Health care quality and reporting.
http://www.qualityforum.org/

Society for Healthcare Epidemiology of America (SHEA)

Guidelines, outbreak resources, drug-resistant organisms.
http://www.shea-online.org/index.cfm

Journals, Articles

MedlinePlus Infection Control (National Library of Medicine)
http://www.nlm.nih.gov/medlineplus/infectioncontrol.html

Infection Control and Hospital Epidemiology online journal (SHEA)
http://www.journals.uchicago.edu/ICHE/home.html

American Journal of Infection Control online journal (APIC)
http://www.apic.org/Content/NavigationMenu/Publications/AJIC/AJIC.htm

Hand Hygiene Resources

Centers for Disease Control and Prevention
Posters, brochures, media kit.
http://www.cdc.gov/handhygiene/default.htm

Institute for Healthcare Improvement
Improving Hand Hygiene. A Guide for Improving Practices among Healthcare Workers.
http://www.ihi.org/IHI/Topics/CriticalCare/IntensiveCare/Tools/HowtoGuideImprovingHandHygiene.htm

World Health Organization
Guidelines on Hand Hygiene in Healthcare. Advanced draft available.
http://www.who.int/patientsafety/information_centre/documents/en/index.html

U.S. Department of Veterans Affairs
Infection—Don't Pass It On (posters, stickers, buttons).
http://www.publichealth.va.gov/InfectionDontPassItOn/Default.htm

Appendix 2. Campaign To Prevent Antimicrobial Resistance in Health Care Settings

Centers for Disease Control and Prevention

Adapted from information on http://www.cdc.gov/drugresistance/healthcare/default.htm

Strategy	Steps	Related Fact	Nursing Actions
Prevent Infection	1. Influenza and Pneumococcal vaccinations	Predischarge immunizations of at-risk hospital patients and health care personnel will prevent infections.	♦ Give influenza and *pneumococcal* vaccine to at-risk patients before discharge. ♦ Receive annual influenza vaccinations.
	2. Get the catheter out	Catheters and other invasive devices are the # 1 exogenous cause of hospital-onset infections.	Use catheters— ♦ Only when essential. ♦ With proper insertion and care protocols. ♦ Only as long as needed.
Diagnose and Treat Infection Appropriately	3. Target the pathogen	Appropriate therapy (correct regimen, timing, dosage, route, and duration) saves lives.	♦ Culture the patient. ♦ Verify empiric therapy is to a likely pathogen and definitive therapy is treating a known pathogen.
	4. Access the experts	Infectious disease expert collaboration improves the outcome of serious infections.	Incorporate guidance from infectious disease experts into daily care plan. All full-time, part-time, and contract staff should know and utilize recommendations.
Use Antimicrobials Wisely	5. Practice antimicrobial control	Programs to improve antibiotic use are effective.	Know your pharmacy policies on ordering, restrictions, switching, and stopping. Utilize or develop online ordering with computerized decision support/rationale.
	6. Use local data	The prevalence of resistance can vary by time, locale, patient population, hospital unit, and length of stay.	Know the common organisms in your clinical area and the effective antibiotics used to treat each infection.
	7. Treat infection, not contamination	A major cause of antimicrobial overuse is “treatment” based on results of patient cultures that become contaminated.	Utilize proper protocols to collect patient blood and other specimens for culture. Submit to laboratory in proper medium/collection containers and within the recommended time.
	8. Treat infection, not colonization	A major cause of antimicrobial overuse is “treatment” based on colonization.	Be familiar with practice guidelines for clinical assessments of new symptoms (i.e., fever) in critically ill patients and when cultures are warranted.
	9. Know when to say “no” to vanco	Vancomycin overuse promotes emergence, selection, and spread of resistant pathogens.	Be familiar with hospital policy on proper vancomycin utilization and when it should be discouraged (e.g., routine surgical prophylaxis and the exceptions, etc.).

Strategy	Steps	Related Fact	Nursing Actions
	10. Stop antimicrobial treatment	Failure to stop unnecessary antimicrobial treatment contributes to overuse and resistance.	Be aware of the patient's infection status and need for an antibiotic. Stop or don't use antibiotics when ♦ The infection is cured; ♦ Cultures are negative and infection is unlikely; and ♦ Infection is not diagnosed.
Prevent Transmission	11. Isolate the pathogen	Patient-to-patient spread of microorganisms can be prevented.	Practice strict aseptic technique to prevent transmission of organisms. Strict oversight of proper contact precautions when used and proper room disinfection.
	12. Break the chain of contagion	Health care personnel can spread antimicrobial-resistant pathogens from patient to patient.	Clean hands can pick up and transfer microorganisms. Hand hygiene is essential—set an example for others.