Aseptic Technique

Aseptic technique is a set of specific practices and procedures performed under carefully controlled conditions with the goal of minimizing contamination by pathogens. Preventing surgical site infection in the operating room is the primary goal of the surgical team, and all activities performed by the team support this goal. Some of these activities include patient risk assessment, environment cleaning, disinfection and sterilization of instrumentation, patient antibiotic prophylaxis, and the use of standard precautions. However, operating room activities pertaining to asepsis and aseptic practices have the greatest direct impact upon the surgical team in helping to reduce the patient's risk to surgical site infection.

Aseptic technique is employed to maximize and maintain asepsis, the absence of pathogenic organisms, in the clinical setting. The goals of aseptic technique are to protect the patient from infection and to prevent the spread of pathogens. Often, practices that clean (remove dirt and other impurities), sanitize (reduce the number of microorganisms to safe levels), or disinfect (remove most microorganisms but not highly resistant ones) are not sufficient to prevent infection.

The Centers for Disease Control and Prevention (CDC) estimates that over 27 million surgical procedures are performed in the United States each year. Surgical site infections are the third most common nosocomial (hospital acquired) infection and are responsible for longer hospital stays and increased costs to the patient and hospital. Aseptic technique is vital in reducing the morbidity and mortality associated with surgical infections.

Aseptic technique can be applied in any clinical setting. Pathogens may introduce infections to the patient through contact with the environment, personnel, or equipment. All patients are potentially vulnerable to infection, although certain situations further increase vulnerability, such as extensive burns or immune disorders that disturb the body's natural defenses. Typical situations that call for aseptic measures include surgery and the insertion of intravenous lines, urinary catheters, and drains.

Regardless of where they practice, preventing the transmission of microorganisms is a concern of all nurses. One way that nurses accomplish this goal is by asepsis. As mentioned before, asepsis means to "make free from disease-producing organisms" (I hope that you have this by now!) A large number of microorganisms live and multiply on every surface. They are in the air, they grow on the skin, and they flourish in the digestive tract. Certain microorganisms are necessary for normal body function. Some microorganisms help produce food and maintain the planet's ecology. Most of the time, humans and microorganisms live in harmony. When this balance is upset, however, microorganisms are capable of causing infection.

Infectious disease is the most common reason people contact healthcare providers and accounts for more clinic and physician office visits than any other in the United States. Preventable infectious diseases are common worldwide, resulting in great suffering and the unnecessary loss of many lives. The economic costs of preventing and treating infection are great. Recent years have shown an alarming increase in multidrug-resistant organisms, such as tuberculosis, vancomycin-resistant enterococci (VRE), Escherichia coli, and Staphylococcus aureus, that antibiotics can no longer eradicate easily. Additional emerging infectious diseases that underscore the need for precise infection control practices include the Ebola virus, Hantavirus, and severe acute respiratory syndrome (SARS). Please see the *Cutting Edge* course on "Superbugs" for in depth information on these infectious diseases.

Microorganisms capable of harming people are called pathogens or pathogenic. When pathogens enter and multiply within body tissues, they disrupt normal physiologic processes and produce an infection. The organisms or their toxins disrupt normal cell function or kill the cells entirely. Sepsis, a term that means poisoning of tissues, often is used to describe the presence of infection. Transport of an infection or the products of infection throughout the body by the blood is known as septicemia.

In common usage “infected” and “septic” often are used interchangeably. In most instances when a patient is said to be infected, it means that he or she has a disease caused by microorganisms. When the client is referred to as septic, it means that he or she is displaying the manifestation of systemic or widespread microbial destruction of tissues, often accompanied by high fever or hypotension.

Infectious disease refers to the pathologic events that result from the invasion and multiplication of microorganisms in a host. Toxins and enzymes produced by the microorganisms cause tissue injury. This injury produces manifestations of infection: fever; rashes; malaise; nausea and vomiting; diarrhea; purulent discharge from wounds; a hot, red, tender area around wounds or puncture sites; aches and pains; or total body collapse.

We will be covering five agents that cause infection including bacteria, viruses, fungi, parasites, and multidrug-resistant organisms.

Bacteria are single-celled, independently living microorganisms, some of which are capable of causing disease in humans. Bacteria may be transmitted through air, food, water, soil, vectors, or sexual activity. They differ in size and shape, growth and replication requirements, and the method by which they inflict harm to the host. All bacteria are capable of diminishing organ function by invading tissues and initiating inflammation. Some are capable of producing metabolic toxins, which they secrete into the host (exotoxin producers). Examples of exotoxins producers are diphtheria, botulisms, and tetanus. Others can produce poisons that are contained in their cell walls and release after the death of microorganisms (e.g., gram-negative endotoxin producers). Gonorrhea and meningococcal meningitis are examples of gram-negative nedotoxins.

Viruses are living microorganisms composed of particles of nucleic acid and protein that are often membrane bound. They reproduce inside licing cells and cause various disease. Some viral infections are acute and controlled by the host's defense mechanisms; others spread throughout the body and cause severe tissue damage or result in chronic illness, such as hepatitis and human immunodeficiency virus (HIV).

Fungi are single-celled organisms that include molds and yeasts, Candida albicans, present as part of the normal human flora on mucous membranes and skin and in the gastrointestinal tract and vagina, can cause yeast infections of the mouth, skin, vagina, and intestinal tract in immunocompromised adults. Candida infections are known as opportunistic infections because they do not result in disease in individuals with properly functioning immune systems. Because Candida is an element of normal human flora and has the ability to live on many environmental surfaces, hospital-acquired (nosocomial) Candida fungal infections are becoming increasingly common and fatal, especially in the intensive care unit due to the numerous invasive therapies that are administered (Bustamante, 2009). Fungal infections of the hair, skin, and nails also frequently occur in humans. Fungi also infest and destroy plant life and cause fermentation in food and milk.

Parasites are multicellular organisms that live on other organisms without contributing anything to their hosts. Examples of parasites include protozoa, helminth, and arthropod species. Sexual contact, insects, and domestic animals frequently carry parasites to humans.

Protozoa are free-living microorganisms that commonly thrive in water. Humans often contract diseases related to protozoa through unsanitary conditions surrounding food preparation or handing. Malaria and sleeping sickness are examples of diseases caused by protozoa. Helminths are worms that infect the gastrointestinal tract or other body tissues of humans. Examples of helminthes include tapeworms, hookworms, and trichinae (or porkworm). Arthropods, including mites, fleas, and ticks, are often responsible for skin and systemic disease.Microbes, just like humans, adapt to an ever-changing environment to compete for survival. In the 1940's, strains of staphylococcus emerged that were immune to the antimicrobial activity of penicillin. Scientists developed new penicillins to treat these drug-resistant strains effectively. With time, increasing numbers of microbial organisms have developed drug-resistant strains and have caused problems for patients and healthcare workers in the hospital and the community. Organisms for which resistance is a concern in the community include members of the Enterobacteriacea, including Salmonella and Shigella; Mycobacterium tuberculosis; Streptococcus pneumonia; Haemophilus influenza; and Neisseria gonorrhea. In hospital setting, the most significant resistant organisms are methicillin-resistant Staphylococcus aureus (MRSA), Clostridium difficile, Candida, extended-spectrum beta-lactamase-producing gram-negative bacilli (ESBL), and VRE (Safdar & Maki, 2008; Sefton, 2010).

Factors that have contributed to the evolution of resistant microbial organisms include the following:

- Over prescription of antibiotics
- Use of inappropriate antibiotics for the infecting organism
- Incomplete use of antibiotics prescriptions as symptoms subside
- Harboring and spreading of resistant organisms by carriers who remain symptom free, usually unaware that they have been infected.
- Increased use of antibiotics in farming, thus contaminating milk and meat.

Resistance to the drugs used to treat these organisms is emerging rather quickly, limiting treatment options and increasing mortality and healthcare costs. Therefore, prevention and control of infections are crucial. The Centers for Disease Control and Prevention (CDC) has outlined four prevention that includes lessen the risk of infection: 1) infection prevention that includes the use of bundles to provide diligent care for vascular and urinary catheters and ventilators; 2) swift and precise diagnosis and treatment of the infectious organism; 3) accurate use of antimicrobials; and 4) meticulous adherence to evidence-based transmission prevention strategies. It is well documented that heathcare workers' hand serve as vehicles, transmitting multidrug-resistant organisms from one client to another; this is why handwashing remains the most effective method of transmission prevention (CDC, 2006).

The life cycle of pathogens frequently is described as an uninterrupted chain of events. For organisms to spread disease, they must grow, reproduce, and move from one source to another. Nursing interventions are directed at stopping the transmission from the source to the client and at controlling other links in the chain, thereby controlling infection. The “chain of infection” including the infectious agent, the source, the portal of exit, the mode of transmission, the portal of entry, and a susceptible host.

The Chain of Infection

Infectious agent	Susceptible host	Portal of entry	Source	Portal of exit	Mode of transmission
Bacteria	Elderly	Membranes	Human beings	Sputum	Contact
Fungi	Ill	Nonintact skin	Animals	Emesis	Vehicle
Virus	Trauma	GI tract	Inanimate objects	Stool	Airborne
Parasites	Surgery	GU tract		Blood	Vectorborne
		Respiratory tract			

The first link in the chain of infection is the microbial agent, which may be a bacterium, virus, fungus, or parasite. The ability of the infectious agent to cause disease depends on its pathogenicity, virulence, invasiveness, and specificity. Pathogenicity is the organism’s ability to harm and to cause disease. Virulence relates to the vigor with which the organisms can grow and multiply. Invasiveness describes the organism’s ability to enter tissues. Specificity refers to the organism's attraction to a specific host. The more pathogenic, virulent, and invasive the organism is, the more likely it can overcome normal body defenses, causing an infection. These four characteristics are determined by the structure or chemical composition of the microorganisms, which includes the organism's ability to attach to skin and mucous membranes, the production of enzymes that counteract the immune system's response to invasion, and the production of toxins.

The source of organisms, also called reservoirs, are elements in the environment. Inanimate objects (formites), human beings, and animals are sources. Inanimate objects include medication, air, food, water, or any other material on which organisms can find nourishment or lie dormant and survive. Human sources include other patients, healthcare personnel, family members, visitors, and patients themselves. Patients may become infected from people who have active disease, people in the incubation portion of their own disease, or people who harbor pathogens but have no symptoms of disease (known as carriers). A person's own bacterial flora may cause contamination when it is transferred to another organ or tissue. Endogenous microorganism from the client's gastrointestinal tract cause disease if they become established in the lungs, urinary tract, or a wound.

Animals are often sources of disease for human beings. Insects and rats have been responsible for historic epidemics in the past and continue to spread disease today. Scientists are particularly concerned with the threat of a pandemic of avian influenza, also known as influenza A viruses, which affects birds. Currently, the virus has been mutating over time, and there have been several cases in which persons have been infected through contact with domestic poultry. There is concern that further mutation may increase human-to-human susceptibility. In fact, scientists believe that certain genetic elements of the highly contagious human influenza A viruses came initially from birds, providing a history of an animal-to-human link, specifically from birds to humans. Currently, there is no immunity available should this adaptation occur. Current influenza medications are thought to be of benefit if infection occurs, but drug resistance is very possible.

The portal of exit provides a means for the microorganism to leave the source. Sputum, emesis, stool, urine, blood, wound drainage, or secretions from genitals all permit microorganisms to exit the source. Animal discharge or blood organisms carried by mosquitoes also can provide a means of escape.

Mode of transmission refers to the way in which the organism moves or is carried from the source's portal of exit. The five main routes of transmission are contact, vehicle, droplet, airborne, and vectorborne.

Contact transmission is the most frequent of transmitting infections in healthcare facilities. Contact transmission is by direct or indirect contact.

Direct contact involves body surface-to-body surface contact causing the physical transfer of organisms between an infected or colonized person and a susceptible host. Healthcare personnel can transfer organisms to patients during care such as bathing, dressing changes, and insertion of invasive devices.

Direct transfer also may occur between two patients, with one acting as the source and the other as the host. Indirect contact occurs when a susceptible host is exposed to a contaminated object, such as a dressing, needle, or surgical instrument.

Vehicle transmission involves the transfer of microorganisms by way of vehicle, or contaminated items that transmit pathogens. Food can carry Salmonella, water can carry Legionella, drugs can carry bacteria from contaminated infusion supplies, and blood can carry hepatitis and HIV.

Droplet transmission occurs when mucous membranes of the nose, mouth, or conjunctiva are exposed to secretions of an infected person who is coughing, sneezing, or talking. Droplets do not remain suspended in the air for very long and seldom travel more than 3 feet; thus, transmission is not via the airborne route.

Airborne transmission occurs when fine particles are suspended in the air for a long time or when dust particles contain pathogens. Air currents widely disperse organisms, which can be inhaled by or deposited on the skin of a susceptible host.

Vectors can be biologic or mechanical. Biologic vectors are living creatures that carry pathogens, such as rats, insects, or birds. Transmission by biologic vectors is of great concern in tropical areas, where mosquitoes transmit diseases such as malaria. Mechanical vectors are inanimate objects that are contaminated with infected body fluids. Central line catheters, which are used for medication, blood draws, and total parenteral nutrition (TPN), and ventilators, are examples of mechanical vectors. Contaminated needles and syringes shared by intravenous (IV) drug users are also examples of mechanical vectors. Both hepatitis B and HIV commonly are spread in this manner.

The portal of entry permits the organism to gain entrance into the host. Pathogens can enter susceptible hosts through body orifices such as the mouth, nose, ears, vagina, or urethra. Breaks in the skin or mucous membranes from wounds or abrasions increase opportunities for organisms to enter the host. The practice in modern medicine of placing tubes for long-term IV or gastric feedings and drainage of body cavities further increases the number of potential routes of entry into the body, thus increasing the risk of infection. Central venous access devices (CVAD) account for approximately 250,000 catheter-related bloodstream infections a year in the United States (Rosenthal, 2006).

A host is a person whose own body defense mechanisms, when exposed, cannot withstand the invasion of pathogens. The body has numerous defense mechanisms that naturally resist entry and multiplication of pathogens. When infectious disease occurs in a human, the agent of infection has overcome the body's ability to resist infection. A primary focus of nursing practice is identifying patients whose defenses may be compromised and working to enhance their defense.

Aseptic technique is most strictly applied in the operating room because of the direct and often extensive disruption of skin and underlying tissue. Aseptic technique helps to prevent or minimize postoperative infection.

The most common source of pathogens that cause surgical sit infections is the patient. While microorganisms normally colonize parts in or on the human body without causing disease, infection may result when this endogenous flora is introduced to tissues exposed during surgical procedures. In order to reduce this risk, the patient is prepared or prepped by shaving hair from the surgical site; cleansing with a disinfectant containing such chemicals as iodine, alcohol, or chlorhexidine gluconate; and applying sterile drapes around the surgical site.

The dramatic reduction in the incidence of infectious disease that occurred during the late 1800s and 1900s resulted largely from the understanding that microorganisms cause disease and that they can be controlled through aseptic practices. Established control methods include use of physical agents, such as disinfectants, on agents outside the body; use of chemical agents, such as antiseptics, on inanimate objects and on the body surface; and use of chemotherapeutic agents, such as antibiotics, to combat microorganisms on body surfaces and inside the body.

The two major categories of aseptic practice are medical asepsis and surgical asepsis. Medical asepsis refers to measures taken to control and reduce the number of pathogens present. It is also known as “clean technique”. Measures used to prevent the spread of organisms from place to place include hand hygiene, gloving, gowning, and disinfecting to help contain microbial growth. Surgical asepsis refers to “sterile technique.” To be sterile, an object must be free of all microorganisms. Sterile technique is used to prevent the introduction of spread of pathogens from the environment into the patient. Sterile technique is employed when a body cavity is entered with an object that may damage the mucous membranes, when surgical procedures are performed, and when the patient’s immune system is already compromised. Procedures requiring sterile technique include insertion of IV catheters, injections, urinary catheterization, some irrigation of drainage tubes that enter sterile parts of the body, and all operative procedures.

For patients whose immune systems are compromised, certain procedures that normally would require clean technique should be performed using sterile technique. Examples of such patients include premature newborns, burns, transplant recipients, and patients receiving chemotherapy or radiation.

Medical asepsis includes all measures aimed at reducing the number or spread of microorganisms. Using barriers and cleaning and sterilization are important medical aseptic measures, but the most important of all is hand hygiene.

In all clinical settings, hand washing is an important step in asepsis. The "2012 Standards, Recommended Practices, and Guidelines" of the Association of Perioperative Registered Nurses (AORN) states that proper hand washing can be "the single most important measure to reduce the spread of microorganisms." In general settings, hands are to be washed when visibly soiled, before and after contact with the patient, after contact with other potential sources of microorganisms, before invasive procedures, and after removal of gloves. Proper hand washing for most clinical settings involves removal of jewelry, avoidance of clothing contact with the sink, and a minimum of 10-15 seconds of hand scrubbing with soap, warm water, and vigorous friction.

All healthcare personnel and patients and their family members should learn proper hand washing techniques. Provide patients with material that explain the importance of washing their hands before and after toileting. Instruct all visitors to wash their hands before contact with patients and before leaving a patient's room. If infection is to be controlled, the paramount importance of adequate hand washing cannot be stressed too often, no matter how unsophisticated it may seem.

From the 2010 CDC guidelines for hand hygiene in healthcare settings (Boyce & Pittet, 2010), recommended hand hygiene techniques including the following:

- When using alcohol-based products, apply product to the palm of one hand and rub both hands together, covering all surfaces of hands and fingers, until hands are dry. Follow the manufacturer's recommendations regarding the volume of product to use.

- If washing hands with soap and water, apply an amount of product recommended by the manufacturer to hands; rub hands together vigorously for at least 15 seconds, covering all surfaces of the hands and fingers. Rinse hands with water and dry thoroughly with a disposable towel. Use towel to turn off the faucet. Avoid hot water, to reduce the risk of dermatitis with repeated exposures.

A surgical scrub is performed by members of the surgical team who will come into contact with the sterile field or sterile instruments and equipment. This procedure requires use of a long-acting, powerful, antimicrobial soap on the hands and forearms for a longer period of time than used for typical hand washing. Institutional policy usually designates an acceptable minimum length of time requires; the CDC recommends at least two to five minutes of scrubbing. Thorough drying is essential, as moist surfaces invite the presence of pathogens. Contact with the faucet or other potential contaminants should be avoided. The faucet can be turned off with the use of a foot pedal. An important principle of aseptic technique is that fluid (a potential mode of pathogen transmission) flows in the direction of gravity. With this in mind, hands are held below elbows during the surgical scrub and above elbows following the surgical scrub. Despite this careful scrub, bare hands are always considered potential sources of infection.

As an infection control measure, hand-hygiene compliance by healthcare workers remains poor (Karabey, Ay, Derbertli, 2010). Some factors that contribute to poor compliance with hand hygiene (Katz, 2009) include:

- Lack of awareness of client care activities that require hand hygiene, such as performing routine and “clean” activities, including taking blood pressure or shaking hands with patients
- Common misperception that wearing gloves and gowns can substitute for hand hygiene
- Understaffing and high workloads
- Inaccessibility of sinks or dispensers for soap or alcohol-based cleanser
- Skin irritation and dryness

Studies have documented that easily accessible dispensers with an alcohol-based, waterless hand-hygiene antiseptic can lead to higher rates of hand washing by healthcare workers (Bischoff, Reynolds, 2002).

The CDC developed and implemented national guidelines for hand hygiene in 2002. Equipment necessary for hand hygiene (soap, running water, and paper towels or waterless alcohol-based antiseptics) is inexpensive and should be available readily to all healthcare providers. High-risk areas, such as newborn nurseries; critical care, transplantation, and burn units; and operative suites, may also require the use of antiseptic cleansing agents, nail files or sticks, and antiseptic-impregnated scrub brushes.

Health care professionals are recommended to wash their hands before and after every patient care contact. The use of gloves during patient care does not eliminate the need for hand hygiene. It is recommended to wash hands in the following situations:

- At the beginning and end of shift
- Before contact with patient

- Between contact with different patients
- Before and after contact with wounds, dressings, specimens, or bedclothes
- Before performing any invasive procedures
- Before administering medication
- After contact with any patient secretion or excretion
- Before and after using the bathroom
- After sneezing, coughing, or blowing your nose
- After removing gloves
- Before eating
- After picking your nose (This one is for my kids – hopefully! ☺)

Sterile surgical clothing or protective devices such as gloves, faces, face masks, goggles, and transparent eye/face shields serve as barriers against microorganisms and are donned to maintain asepsis in the operating room. This practice includes covering facial hair, tucking hair out of sight, and removing jewelry or other dangling objects that may harbor unwanted organisms. This garb must be put on with deliberate care to avoid touching external, sterile surfaces with nonsterile objects including the skin. This ensures that potentially contaminated items such as hands and clothing remain behind protective barriers, thus prohibiting inadvertent entry of microorganisms into sterile areas. Personnel assist the surgeon to don gloves and garb and arrange equipment to minimize the risk of contamination.

The concept of what is “essential” for asepsis remains controversial. Sellors et al. surveyed obstetric anesthetists in Australia to determine what practitioners believe to be “essential” aseptic precautions when inserting an epidural catheter for labor analgesia. Surprisingly, there was a wide variation in what was considered to be “essential” (Table 1). These findings likely reflect the paucity of scientific evidence currently available to support, or refute, the efficacy of these aseptic precautions.

Table 1

Survey of "Essential Components" Necessary

For Proper Aseptic Technique

Essential Aseptic Technique	(% of **YES** Respondents)	(% of **NO** Respondents)
Jewelry removed		
Rings	55	44
Watch/bracelet	86	14
Protective barriers		
Surgical scrubs	17	83
Mask	71	29
Surgical cap	26	73
Gown	87	12
Sterile gloves	99	1
Hand washing		
None	2	-
Soap and Water	7	-
Antiseptic hand washes	48	-
Full surgical wash	42	-

Other	1	-
Skin preparation		
Iodine	41	-
Chlorhexidine	19	-
Chlorhexidine + alcohol	13	-
Alcohol	14	-
No preference	5	-
Other	5	-
Surgical drape		
Full	62	-
Partial	32	-
None	2	-
Not specified	4	-
Other		
Not talking	16	-

The hands of health care providers are the most common vehicle by which microorganisms are transmitted between patients. As a result, hand washing is considered to be the single most important technique in the prevention of cross-infection. Soap and water alone moves bacteria but is not effective at killing organisms. However, several respondents (7%) in the survey in table 1 believe this is more than adequate before performing a regional technique. In contrast, full surgical scrub was believed necessary by 42% of respondents, with 48% suggesting that this should be performed with an antiseptic solution. Antiseptic solutions with an alcohol component or alcoholic solutions alone provide superior disinfection when compared with nonalcoholic antiseptic (povidone iodine, 4% chlorhexidine, hexachlorophene, and triclosan) or standard nonantimicrobial soaps. For example, a 1-minute hand rub with 60% isopropanol by volunteers who then put on surgical gloves has an immediate bacterial reduction lasting 3 hours, which is significantly greater than that resulting from the use of nonalchololic antiseptics. Alcohols are rapidly germicidal when applied to the skin but have very little persistent activity. However, when combined with other antiseptic compounds, bacterial regrowth occurs at a significantly slower rate. Extended antimicrobial activity appears to be greatest for alcohol-based solutions containing 2% or 4% chlorhexidine gluconate, followed by hexachlorophene, triclosan, and the iodophors. Because hexachlorophene is absorbed into the blood after repeated use, it is seldom used as a surgical scrub. Of note, antiseptic solutions containing 60% to 95% alcohol appear to be most effective, with higher concentration being less potent because protein denaturization requires the presence of water.

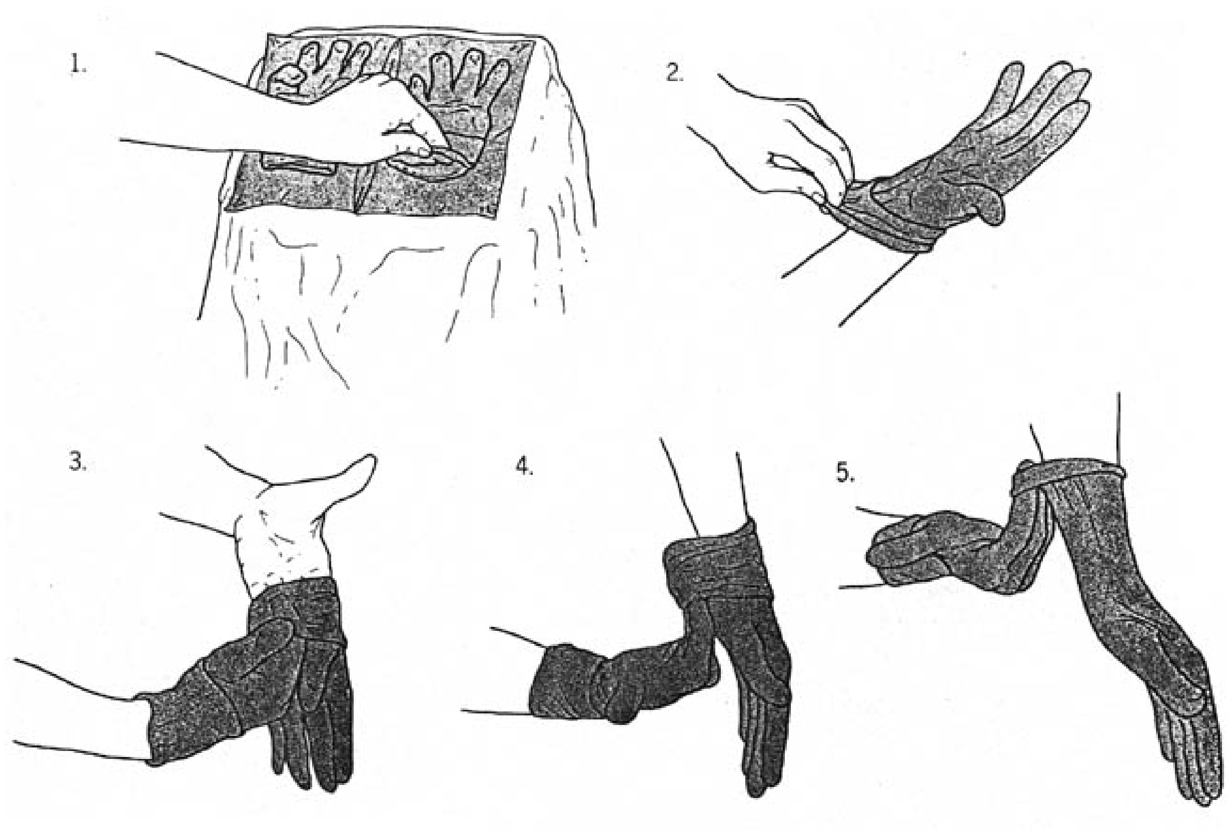
Currently, in 2012, it is unclear whether or not the use of artificial nails or the length of natural fingernails contributes to an increased risk of hospital-related infections. Heatlh care workers with artificial nails are more likely to harbor gram-negative pathogens on their hands and fingertips both before and after hand washing when compared with health care workers with natural fingernails alone. Studies have shown that the subungual region of the hand harbors high concentration of bacteria primarily coagulase negative staphylococcus, gram-negative rods, corynebacteria, and yeast. At present, nail length does not appear to be a significant risk factor for either infectious complication or cross-contamination because the majority of bacterial growth occurs along the proximal 1 mm of nail adjacent to the subungual skin. The application of nail polish to artificial or natural-borne fingernails does not increase the number of bacteria recovered from the periungual region. However, chipped or poorly maintained nail polish may increase the number of transient microorganisms present.

The majority of respondents in the survey by Sellors et al (86%) indicated that removing wristwatches was essential, a view held by many infection-control experts. However, there was less agreement on the removal of rings, an issue that nearly divided the respondents equally. Higher microbial counts after hand washing have been bound in health care workers who prefer not to remove rings. Bertha suggested that this practice may place patients at higher risk for nosocomial infections. Finally, it is important to emphasize that proper hand washing techniques or other interventional procedures nut throughout the patient's entire preoperative experience.

Although gloves may be considered a useful and important component of asepsis, they should only be regarded as a supplement to, not replacement for, hand washing, For example, Olsen and colleagues report possible microbial contamination of hands and transmission of infection despite gloves being worn. In this prospective investigation, quantitative hand cultures were obtained from 137 health care workers before and after contaminated patient care procedures (endotracheal tube care, digital rectal examinations, and routine dental examinations). All health care workers wore single-use, nonsterile disposable latex vinyl gloves. External glove surfaces were also quantitatively cultures after each patient contact. Used gloves were then tested for leaks by using the American Society for Testing Materil's watertight test. Eighty-six of the 135 glove cultures (64%) had gram-negative rods or enterococci on the external surface after use and were therefore sources of potential hand contamination. Microbial contamination of the health care workers' hand occurred in 11 (13%) of theses 86 events and was more frequent with vinyl (24%) versus latex gloves (2 %,). Although appropriate glove use prevented hand contamination in the vast majority of cases, 23% of hands were found to be contaminated after patient care when a glove leak occurs. The authors concluded that latex gloves, and to a lesser extent vinyl gloves, provide substantial protection to heath care workers during hand contact with contaminated mucosal membranes. However, nonsterile gloves cannot reliably provide an impenetrable barrier between patient and health care provider and must therefore always be considered potential extrinsic infectious foci. At present, no investigation has examined the risk of microbial contamination or glove leaking with sterile surgical latex or neoprene gloves, Single –use sterile or disposable gloves should never be washed, resterilized, or disinfected, with new gloves being worn during each patient encounter.

Gowns are generally considered a means of preventing cross-contamination between patients by preventing infectious materials form coming into contact with the clothes of health care providers. Recent investigations have shown that the use of gowns did not reduce patient colonization, infection, or mortality rates in neonatal intensive care units. Furthermore, the universal use of gloves and gowns was found to be no better that the use of gloves alone in preventing colonization of vancomycin-resistant enterococci in medical intensive care units. However, there is currently insufficient data to make a definitive recommendation with regard to routine gown use within the operating room environment during regional blocks.

Donning sterile gloves requires specific technique so that the outer glove is not touched by the hand. A large cuff exposing the inner glove is created so that the glove may be grasped during donning. It is essential to avoid touching nonsterile items once sterile gloves are applied; the hands may be kept interlaced to avoid inadvertent contamination. Any break in the glove or touching the glove to a nonsterile surface requires immediate removal and application of new gloves.



Asepsis in the operating room or for other invasive procedures is also maintained by creating sterile surgical fields with drapes. Sterile drapes are sterilized linens placed on the patient or around the field to delineate sterile areas. Drapes or wrapped kits of equipment are opened in such a way that the contents do not touch non-sterile items or surfaces. Aspects of this method include opening the furthest areas of a package first, avoiding leaning over the contents, and preventing opened flaps from falling back onto contents.

The issue of wearing surgical masks during regional techniques has also received a tremendous amount of attention and controversy. Several clinicians contended that surgical masks are critical component of asepsis, whereas others argue their use in not based on definitive scientific evidence. A British survey reports that 51% of practitioners do not routinely wear masks when performing central neuraxial block. This practice is supported by the work of Schweizer, who showed that surgical masks may significantly increase the amount of wound contamination. It is postulated that under these conditions, skin friction with the mask may release skin scales that carry a significant amount of bacterial contaminants. These findings were also confirmed by Orr, who reported a 50% decrease in would infections when surgical face masks were not worn during procedures. However, this investigation is often criticized for its lack of controls. Tunevall subsequently performed a prospective, randomized investigation to examine whether or not face significantly increase the amount of bacterial “fall-out” into the surgical wounds of 3,088 patients undergoing a variety of general surgical procedures. Postoperative infections were identified in

73 of 1,537 (4.7%) patients in which face masks were used and in 55 of 1,551 (3.5%) patients in which no surgical face masks were worn, showing no added benefit of wearing masks during surgery. As a result, Tunevall suggested that the routine use of face masks be reconsidered if the intent is to protect the patient. However, he goes on to recommend that surgical masks may be worn if the intent is to protect operating room personnel against blood droplets or airborne infections originating from patient encounters.

In contrast to the investigations noted earlier, Pholops and colleagues showed that wearing a face mask results in a marked reduction in the bacterial contamination of a surface in close proximity to the upper airway. Bacterial colonies grew on more than 50% of agar plates 30cm away from providers who were speaking without a mask. A fresh mask barely abolished contamination, whereas a small increase did occur after 15 minutes of wear. Although this increase was statistically insignificant, it is advisable to wear a new face mask for each procedure or patient encounter. It should be kept in mind that organisms grow in the upper airway are of low pathogenicity and virulence. Therefore, the likelihood of causing a wound infection in a patient with an intact immune system is extremely small.

Equipment and supplies also need careful attention. Medical equipment such as surgical instrumentation can be sterilized by chemical treatment, radiation, gas, or heat. Personnel can take steps to ensure sterility by assessing that sterile packages are dry and intact and checking sterility indicators such as dates or colored tape that changes color when sterile.

In the operating room, staff has assignments so that those who have undergone surgical scrub and donning of sterile garb are positioned closer to the patient. Only scrubbed personnel are allowed into the sterile field. Arms of scrubbed staff are to remain within the field at all times, and reaching below that level of the patient or turning away from the sterile field are considered breaches in asepsis.

Other “unscrubbed” staff members are assigned to the perimeter and remain on hand to obtain supplies, acquire assistance, and facilitate communication with outside personnel. Unscrubbed personnel may relay equipment to scrubbed personnel only in a way that preserves the sterile field. For example, an unscrubbed nurse may open a package of forceps in a sterile fashion so that he or she never touches the sterilized inside portion, the scrubbed staff, or the sterile field. The uncontaminated item may either be picked up by a scrubbed staff member or carefully placed on to the sterile field.

The environment contains potential hazards that may spread pathogens through movement, touch, or proximity. Interventions such as restricting traffic in the operating room, maintaining positive-pressure airflow (to prevent air from contaminated areas from entering the operating room), or using low-particle generating garb to help minimize environment hazards.

When beginning a surgically aseptic procedure, the nurse follows certain principles to ensure maintenance of asepsis. Failure to follow these principles places patients at risk for infection. The following principles are important:

1. A sterile object remains sterile only when touched by another sterile object. This principle guides the

nurse in placement of sterile objects and how to handle them.

  a. Sterile touching sterile remains sterile; for example, sterile gloves or sterile forceps are used to handle objects on a sterile field.
  b. Sterile touching clean becomes contaminated; for example, if the tip of a syringe or other sterile object touches the surface of a clean disposable glove, the object is contaminated.
  c. Sterile touching contaminated becomes contaminated; for example, when the nurse touches a sterile object with an ungloved hand, the object is contaminated.
  d. Sterile state is questionable, for example, when you find a tear or break in the covering of a sterile object. Discard it regardless of whether the object itself appears untouched.

2. Only sterile objects may be placed on a sterile field. All items are properly sterilized before use. Sterile objects are kept in clean, dry storage areas. The package or container holding a sterile object must be intact and dry. A package that is torn, punctured, wet, or open is considered unsterile.

3. A sterile object or field

Other principles that are applied to maintain asepsis in the operating room include:

- All items in a sterile field must be sterile
- Sterile packages or fields are opened or created as close as possible to time of actual use.
- Moist areas are not considered sterile.
- Contaminated items must be removed immediately from the sterile field.
- Only areas that can be seen by the clinician are considered sterile (i.e., the back of the clinician is not sterile).
- Gowns are considered sterile only in the front, from chest to waist and from the hands to slightly above the elbow.
- Tables are considered sterile only at or above the level of the table.
- Nonsterile items should not cross above a sterile field.
- There should be no talking, laughing, coughing, or sneezing across a sterile field.

- Personnel with colds should avoid working while ill or apply a double mask.
- Edges of sterile areas or fields (generally the outer inch) are not considered sterile.
- When in doubt about sterility, discard the potentially contaminated item and begin again.
- A safe space or margin of safety is maintained between sterile and nonsterile objects and areas.
- When pouring fluids, onto the lip and inner cap of the pouring container is considered sterile; the pouring container should not touch the receiving container, and splashing should be avoided.
- Tears in barriers and expired sterilization dates are considered breaks in sterility.

A key difference between the operating room and other clinical environments is that the operating area has high standards of asepsis at all times, while most other settings are not designed to meet such standards. While clinical areas outside of the operating room generally do not allow for the same strict level of asepsis, avoiding potential infection remains the goal in every clinical setting. Observation of medical aseptic practices will help to avoid nosocomial infections. The application of aseptic technique in such settings is termed medical asepsis or clean technique (rather than surgical asepsis or sterile technique required in the operating room).

Specific situations outside of the operating room require a strict application of aseptic technique. Some of these situations include:

- Wound care
- Drain removal and drain care
- Intravascular procedures
- Vaginal exams during labor
- Insertion of urinary catheters
- Respiratory suction

For example, a surgical dressing change at the bedside, though in a much less controlled environment than the operating room, will still involve thorough hand washing, use of gloves and other protective garb, creation of a sterile field, opening and introducing packages and fluids in such a way as to avoid contamination, and constant avoidance of contact with nonsterile items.

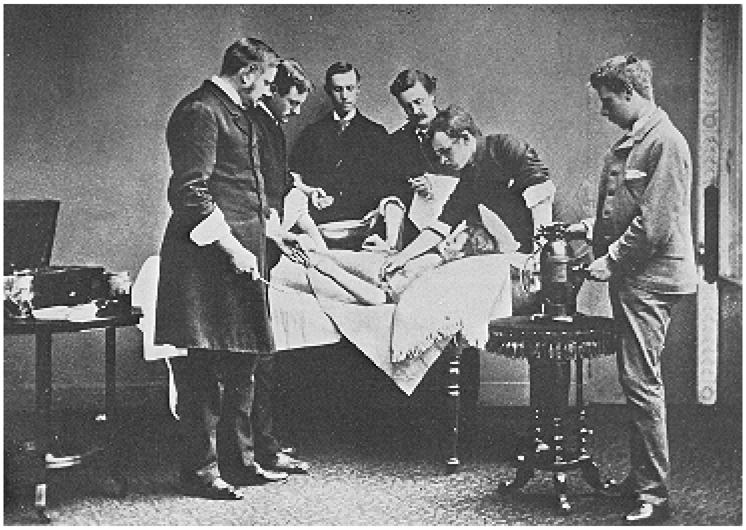
General habits that help to preserve a clean medical environment include:

- Safe removal of hazardous waste, i.e., prompt disposal of contaminated needles or blood-soaked bandages to containers reserved for such purposes
- Prevention of accumulation of bodily fluid drainage, i.e., regular checks and emptying of receptacles such as surgical drains or nosogastric suction containers
- Avoidance of backward drainage flow toward patient, i.e., keeping drainage tubing below patient level at all times
- Immediate clean-up of soiled or moist areas
- Labeling of all fluid containers with date, time, and timely disposal per institutional policy
- Maintaining seals on all fluids when not in use

The isolation unit is another clinical setting that requires a high level of attention to aseptic technique. Isolation is the use of physical separation and strict aseptic technique for a patient who either has a contagious disease or is immunocompromised. For the patient with a contagious disease, the goal of isolation is to prevent the spread of infection to others. In the case of respiratory infections (i.e., tuberculosis), the isolation room is especially designed with a negative pressure system that prevents airborne flow of pathogens outside the room. The severely immunocompromised patient is placed in reverse isolation, where the goal is to avoid introducing any microorganisms to the patient. In these cases, attention to aseptic technique is especially important to avoid spread of infection in the hospital or injury of the patient unprotected by sufficient immune defenses. Entry and exit from the isolation unit involves careful hand washing, use of protective barriers like gowns and gloves, and care not to introduce or remove potentially contaminated items. Institutions supply specific guidelines that direct practices for different types of isolation, i.e., respiratory versus body fluid isolation precautions.

In a multidisciplinary setting, all personnel must constantly monitor their own movements and practices, those of others, and the status of the overall field to prevent inadvertent breaks in sterile or clean technique. It is expected that personnel will alert other staff when the field or objects are potentially contaminated. Health care workers can also promote asepsis by evaluating, creating, and periodically updating policies and procedures that relate to this principle.

History of Aseptic Technique



Ancient records show that antiseptics date far back into history; the ancient Chinese, Persians, and Egyptians had methods for water sanitation and antisepsis for wounds. The ancient Greeks and Romans used silver vessels to store fresh liquids and wine. Settlers in the Australian outback put silverware and Pioneers of the American West put silver and copper coins in drinking water to keep it fresh and prevent algae; settlers in the Australian outback put silverware in drinking water for the same purpose. Mercuric chloride was used to prevent sepsis in wounds by Arabian physicians in the middle Ages. Hypochlorite and iodine were introduced as a treatment for open wounds in 1825 and 1839, respectively.

In 1861, Louis Pasteur proved that microorganisms cause spoilage and could be transported via the air. He placed broth in flasks with long S-shaped necks, then boiled the broth and observed that no microorganisms grew in the flasks. These experiments were the basis for the development of aseptic techniques. Pasteur showed that heat could kill microorganisms; this process was later named pasteurization.

Using the knowledge gained from Louis Pasteur, a scientist named Dr. Ignaz Semmelweis reduced the number of postpartum infections (puerperal sepsis) in the wards of Vienna’s lying-in hospitals by urging doctors to wash their hands between patients.

By the mid-nineteenth century, post-operative sepsis infection accounted for the death of almost half the patients who underwent major surgery. Later in the 1860s, an English surgeon named Joseph Lister heard about Pasteur’s work. He began soaking his surgical dressings in carbolic acid (phenol) because he had heard the previous year that carbolic acid had been used to treat sewage in Carlise and the fields that had been treated were now free of parasite-causing disease. This led to a dramatic decrease in the number of post-operational infections. Before the discovery of antisepsis by Lister, about 80% of surgical patients contracted gangrene. In 1870, Lister's antiseptic methods were used by Germany during the Franco-Prussian war, where they saved the lives of many Prussian soldiers. Although Germany and several other countries followed Lister's procedure of sterilization, England and America were still in opposition to his "germ theory". The turning point for Lister came on October 26, 1877, when he had the opportunity to perform a simple knee operation (wiring a fractured kneecap, which entailed deliberate conversation of a simple fracture into a compound fracture), which often resulted in generalized infection and death. News of this operation was widely publicized; its success forced people to accept that his methods greatly added to the safety of operative surgery. The culmination of his emphasis on the principle of preventative medicine was the opening of the Institute of Preventative Medicine in 1891. These are a few of the reasons why Joseph Lister is often referred to as the "father of antiseptic surgery."

Paul Ehrlich, a German scientist, later advanced the idea of using chemicals to kill microorganisms by testing many more compounds. He eventually found a chemical that was successful against syphilis.

Another scientist that had a significant impact on the field of sterilization was Ernst von Bergmann. He is credited with introducing steam sterilization under pressure for testing instruments and all other medical equipment used for a surgical patient.

A famous surgeon from John Hopkins, William Stewart Halsted, introduced sterile rubber gloves to the field of medicine when his fiancée's hands became irritated from constant washings and antiseptics.

The key elements of perioperative practice are caring, conscience, discipline, and technique. Optimal patient care requires an inherent surgical conscience, selflessness, self-discipline, and the application of principles of asepsis and sterile technique. All are inseparably related.

The concept of a surgical conscience may be stated simply as a surgical Golden Rule: Do unto the patient as you would have others do unto you. The caregiver should consider each patient as himself or herself or as a loved one. Once an individual develops a surgical conscience, it remains inherent thereafter. Florence Nightingale summarized what is, in essence, its meaning when she said, “The nurse should keep a high sense of duty in her own mind, must aim at perfection in her care, and must be consistent always in herself.”

A surgical conscience involves self-inspection coupled with moral obligation. Involving both scientific and intellectual honesty, it is self-regulation in practice according to a deep personal commitment to the highest values. It incorporates the caregiver’s values and attitudes at a conscious level and monitors behavior and decision making in relation to those values. In short, a surgical conscience is the inner voice for conscientious practice of aseptic and sterile technique at all times. This conscientiousness applies to every activity and intervention, as well as to personal hygiene and health. An aseptic body image includes an awareness of body, hair, makeup, jewelry, fingernails, and attire. A team member with an infectious process, such as influenza, a cold, or an open skin lesion, clearly cannot work in the perioperative environment. Professional responsibility requires that patient's safety is not compromised.

Correct practice of asepsis provides a foundation for development of a mature conscience- mastery of personal integrity and discipline. Development of this conscience incorporates knowledge of aseptic principles, perpetual attention to detail, and experience. All are facets of responsibility that involves trust. A surgical conscience does not permit a person to excuse an error but rather to admit and rectify one readily. It becomes so much an automatic part of the caregiver that he or she can see at a glance or instinctively know if a break in technique or violation of a principle has occurred. Conscience dictates that appropriate action be taken, whether the person is with others or is alone and unobserved. A surgical conscience therefore is the foundation for the professional accomplishments, as well as an inner confidence that the patient is receiving the highest level of care.

A very important aspect in assisting the development of a surgical conscience in others is communication skills. A team member should not be criticized for an error; that person should be given credit for admitting the error and should be helped to correct the violation. Fear of criticism is the primary deterrent in admission of fault. No one should be reluctant to admit a frank or questionable break in technique.

There is no compromise with sterility. In clinical practice, an item is considered either sterile or unsterile. Team members should always be as certain of sterility as possible. That certainty rests on the fact that the necessary conditions have been met and that all factors in the sterilization process have been observed. Obviously it is impossible to prove that every package is free from bacteria, but a single break in technique can compromise the life of a patient.

OR personnel must maintain the high standards of sterile technique they know are essential. Every individual is accountable for his or her own role in infection control. The patient should be considered an extension of the caregiver’s own body. The patient completely trusts the team to provide safe care and protection from infection.

Assuring Aseptic technique at all times is our solemn obligation, with moral implications!

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