Hand Hygiene for Healthcare Professionals

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Hand washing dates back to biblical times and the early days of medicine. This simple task is the most important way to prevent infection resulting from pathogenic microorganisms found in all healthcare environments. Not only does hand washing prevent the spread of potentially deadly nosocomial infection, it also saves money. Hospital acquired infections may result in millions of dollars in costs to the healthcare facility. This text provides the healthcare professional (HCP) with guidelines for hand washing published by the Center for Disease Control (CDC), as well as information about the common pathogens that can be transmitted as the result of poorly groomed hands.

In biblical times, God told Moses to build a basin for Aaron, the religious leader of their group, and his sons in which to wash their hands and feet. He told Moses that they should wash their hands and feet so that they would not die (Exodus 30:17-21, New International Version). This ritual was to be performed each time they entered the tent of worship and before they approached the altar to give offerings to God. Today, the ritual of hand cleansing before approaching the altar is still practiced in many religions. It is thought that hand washing represents the cleansing of sins thus allowing the person to stand in the presence of God to deliver his message or offer any sacrifices free of impurities ("Handwashing", n.d.).

In 1847, Kolletschka, a friend of Dr. Ignaz Semmelweis (1818-1865) cut his finger while performing an autopsy on a woman who had succumbed to puerperal (child birth) fever. Shortly after cutting his hand, Kolletschka exhibited symptoms similar to those of puerperal fever and died shortly thereafter. Later, Dr. Semmelweis linked puerperal fever to the unclean hands of students he was teaching in Vienna. This led Dr. Semmelweis to develop a policy that required the washing of hands with a chlorinated lime solution before moving from the dissection room to the delivery room. Following the implementation of this policy, the mortality rate from childbirth fever dropped from 9.9% to 0.39% (Clark, 1961).

Semmelweis kept his findings to himself until a friend published two papers describing his methods, which led physicians and co-workers to turn against Semmelweis because of disagreement with his findings. Years later, Semmelweis wrote a book describing his work that was highly criticized by many of his peers. This criticism caused Semmelweis to become very angry and frustrated, and eventually he suffered a mental breakdown. As a result, Semmelweis’s friends committed him to a psychiatric hospital. Ironically, he died in 1865, at the age of 47, from an infection similar to puerperal fever (Lienhard, n.d.).

Later that year Joseph Lister (1827-1912), a British surgeon, discovered a connection between a theory of Louis Pasteur and wound sepsis. Pasteur suggested that decay was caused by living organisms in the air. Lister hypothesized that microbes in the air were likely causing the putrefaction and had to be destroyed before they entered wounds. Lister began using a solution of carbolic and phenic acid to clean and dress wounds; an idea he derived from methods being used to treat sewage and fields for parasites at that time (Brock, 1999). Two years later at a medical meeting, he was able to announce that his wards had been infection free for nine months. At first Lister’s theory was rejected, but the medical community gradually embraced his idea. In one publication, Lister gave all of the credit to Semmelweis ("Joseph Lister & Antiseptic Surgery", n.d.).

In October 2002, the Centers for Disease Control and Prevention (CDC) released “Guideline for Hand Hygiene in the Health-Care Setting” (Boyce & Pittet, 2002). It is from this document that healthcare facilities today adopt their policy on hand washing. The established guidelines recommend the following routine for properly disinfecting the hands:

1. Use anti-microbial soap and warm water.
2. Rub hands together vigorously for 15 seconds; concentrating mainly on the palms of the hands, under fingernails, and wrists covering all surfaces of the hands with soap.
3. Rinse hands thoroughly with warm water and dry completely with a disposable towel.

There is no substitute for soap and water when it comes to ridding the hands of pathogens. The CDC recommends using antimicrobial soap instead of plain (non-antimicrobial) soap when washing hands in the healthcare setting where bacteria and other pathogens are present. Plain soap is a detergent-based product that contains esterified fatty acids and sodium or potassium hydroxide as the main ingredient, and is limited to the removal of dirt, soil, and many organic substances from the hands. However, plain soap has not been found to remove much of the resident flora or many of the pathogens from the hands of healthcare practitioners. Plain soap may become contaminated with gram-negative bacilli, leading to the colonization of gram-negative rods on the
hands of healthcare practitioners, therefore creating a possible hazard in the healthcare setting (Boyce & Pittet, 2002).

Antimicrobial soap is recommended for healthcare professionals by the CDC. The antimicrobial agents most commonly added to soap and hand rubs are triclosan, chlorhexidine, and alcohols. While these soaps have good antimicrobial activity, they have minimal activity toward spore forming bacteria. Triclosan has very good antimicrobial activity towards gram-positive bacteria, but very poor activity toward gram-negative bacilli, particularly *Pseudomonas aeruginosa*. This chemical has excellent activity against methicillin-resistant *Staphylococcus aureus* (MRSA), which is a known tyrant in healthcare institutions. Its mechanism of action involves affecting the cytoplasmic membrane and interfering with the synthesis of RNA, fatty acids, and proteins. Chlorhexidine gluconate has effective antimicrobial activity against gram-positive bacteria, but has less activity against gram-negative bacteria and fungi, while tubercle bacilli are minimally influenced. This antimicrobial agent is not sporicidal; therefore, it has poor activity against spore-forming bacteria such as the bacillus species and *Clostridium difficile*, the organism responsible for healthcare-associated diarrhea. The mechanism of action for chlorhexidine involves the disruption of the cytoplasmic membrane, which results in the spilling out of the contents from within the cell (Boyce & Pittet, 2002).

The most commonly used agent in hand rubs is alcohol which has antimicrobial activity against gram-positive and gram-negative vegetative bacteria, MRSA, and the emerging drug-resistant bacteria known as vancomycin-resistant *Enterococcus* (VRE). Alcoholic hand rubs are also effective against certain enveloped viruses but have very poor activity toward some non-enveloped viruses. The drawback to using alcohol as a hand rub is that it provides no residual antimicrobial activity (Boyce & Pittet, 2002).

Antimicrobial hand rubs are popular among busy healthcare professionals because they are convenient, inexpensive, and effective. The most valuable aspects of using hand rubs are they save time and decrease the rate of nosocomial infections spread by unwashed hands (Rouchon-Edouard et al., 2004). Antimicrobial rubs cannot be used when hands are visibly soiled with blood and body fluids. Hand rubs should be used in conjunction with soap and water (Kaye & Sexton, 2002).

According to CDC guidelines, “Studies have documented that subungual areas of the hand harbor high concentrations of bacteria, most frequently coagulase-negative staphylococci, gram-negative rods (including *Pseudomonas* species), *Corynebacteria*, and yeasts. Freshly applied nail polish does not increase the number of bacteria recovered from perungual skin; but, chipped nail polish may support the growth of larger numbers of organisms on fingernails. Even after careful hand washing or the use of surgical scrubs, personnel often harbor substantial numbers of potential pathogens in subungual spaces (Boyce & Pittet, 2002). Many hospitals have policies which require healthcare workers who are involved in patient care to keep their fingernails properly groomed so that the length of the nail does not extend past the tip of the finger. Hospital policies also often prohibit acrylic fingernails, nail wraps, and jewelry, since these are known to harbor deadly pathogens. The CDC recommends that the healthcare worker pay particular attention to the crevices around and underneath the nail (Boyce and Pittet, 2002).

Gloves are essential to a healthcare professional who handles any type of body secretions or works directly with patients. Latex gloves are the most economical and widely used gloves in healthcare. However, some healthcare workers are sensitive to latex and use vinyl gloves as an alternative. Signs of a latex sensitivity include itching and redness after the use of latex gloves. Latex sensitivity can lead to more serious problems such as anaphylaxis if not properly addressed.

Many healthcare professionals feel that gloves are a security blanket, and in many ways they are. They afford limited protection against pathogens by forming a barrier between the healthcare professional and the patient or body fluid being handled. When properly worn, gloves provide protection from blood-borne pathogens, but there are also disadvantages to wearing gloves. Susan Marino, an infection control practitioner (ICP), says that workers can be lulled into thinking latex gloves offer enough protection. However, if the healthcare professional inadvertently touches the contaminated gloves while removing them, germs end up on their hands, and they need to wash their hands again (DeMarko, 2004). When healthcare professionals remove their gloves improperly and don’t wash their hands, the next time that they reach into a box of clean gloves they can contaminate the whole box. Failure to cleanse hands after glove use can result in the healthcare professional infecting themselves, their co-workers, and their patients. It has been demonstrated that significant numbers of bacterial pathogens can still be recovered from the hands of hospital personnel after contaminated gloves have been removed (Kaye & Sexton, 2002). Healthcare workers often say that they forget to wash their hands because sometimes they are just too busy. Multiple other excuses may be given for failure to follow proper hand hygiene.

Lee George, MT, MPH, PhD, CIC, ICP at Fort Sanders Regional Medical Center in Knoxville, TN stated that she documented an increased rate of nosocomial infection when a ward in her hospital did not have sufficient supplies of soap and water (“Semmelweis’s Revenge”, 2003). In many cases, hand washing
is skipped all together if soap and water are not available and hand rubs are used alone. This process may lead to the colonization of bacteria that are resistant to hand rubs on the hands of healthcare practitioners.

Pathogens, which often colonize on the hands of healthcare professionals, are usually bacteria, viruses, and fungi. In most cases, if proper hand washing is performed, the pathogens are harmless to a healthy person. In the hospital, many patients are immunocompromised and therefore are at high risk for nosocomial infection. Healthcare professionals must be very careful in the various environments where patients are located within the healthcare facility (Boyce and Pittet, 2002).

Some bacteria are environmentally-selective, while others are capable of growing almost anywhere. In the healthcare facility, the bacteria of most concern to the infection control practitioners are methicillin-resistant *Staphylococcus aureus* (MRSA), vancomycin-resistant *Enterococcus* (VRE), and *Pseudomonas aeruginosa*. Staphylococcus is a part of the normal bacterial flora found on the skin and is an opportunistic pathogen that can cause problems for the unhealthy patient if given the opportunity. *Pseudomonas* is found in the gut of approximately 10% of healthy individuals, and it is readily available to cause nosocomial infections (Soner, n.d.). When patients are immunocompromised, these bacteria can be deadly. The emergence of antibiotic-resistant strains of these bacteria make the nosocomial infection a more deadly factor, and thus presents itself as a major concern for the infection control practitioner and healthcare professional.

Methicillin-resistant *Staphylococcus aureus* is a gram-positive, catalase-positive and coagulase-positive bacteria that is resistant to methicillin type antibiotics. All other staphylococci are catalase negative. Staphylococci are responsible for cutaneous infections such as folliculitis, boils, carbuncles, impetigo, and wound infections. It can also cause bacteremia, endocarditis, and septic infections. Clinical laboratory testing methods for the identification of MRSA include growth on culture media, coagulase test, and DNase testing. When growing cultures of *S. aureus*, the media of choice are blood agar, colistin-nalidixic acid agar (CNA), and mannitol salt agar (MSA). Appearance on culture media varies in the various environments where patients are located within the healthcare facility (Boyce and Pittet, 2002).

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Vancomycin-resistant *Enterococcus*, a gram-positive coccus that is catalase negative, is an emerging pathogen of concern. It can cause nosocomial infection resulting in urinary tract infections, bacteremia, wound infections, and subacute bacterial endocarditis (Rollins & Joseph, n.d.). VRE is bile-esculin positive and can grow in 6.5% sodium chloride broth. *Enterococcus* is cultured on sheep blood agar on which the colonies may exhibit alpha, beta, or no hemolysis while appearing small and exhibiting a gray color. The 6.5% broth test is performed in conjunction with culturing *Enterococcus*. A positive 6.5% broth test is indicated by the presence of turbulence in the test tube (Delost, 1997).

*Pseudomonas aeruginosa* is associated with most fingernails. It is a deadly gram negative, motile pathogen that is responsible for the deaths of many neonates in the neonatal intensive care unit. Risk factors for colonization of the hands with *P. aeruginosa* include the presence of false fingernails, nail jewelry, nail polish, and cracked or inflamed nail beds (Fosca et al., 2000). This opportunistic pathogen is the most frequently isolated non-fermenter. *P. aeruginosa* is oxidase positive, fluoresces under a fluorescent light, and exhibits a “grape-like” or “tortilla-like” odor. It can be cultured on McConkey agar and eosin methylene blue agar (EMB) and is a non-lactose fermenter. On blood agar, the colonies appear large, grayish with a feathered edge, and exhibit beta hemolysis. This pathogen is of significant concern among infection control practitioners because it is resistant to most antibiotics for gram-negative infections. Patients with burns, wounds and cystic fibrosis are most susceptible (Delost, 1997).

Many viruses, such as influenza, can spread by way of contaminated hands. Influenza is a virus of major concern and, in some cases, can result in the death of a patient. “Among certain persons, influenza can exacerbate underlying medical conditions, lead to secondary bacterial pneumonia or primary influenza viral pneumonia, or occur as part of a co-infection with other viral or bacterial pathogens” (Center for Disease Control, n.d.). The flu virus is spread through bodily secretions by way of coughing or the blowing of ones nose.

Hand washing is the most cost effective method that a healthcare facility can employ to prevent the spread of nosocomial infection. Non-compliance by healthcare workers is a major obstacle that healthcare facilities face. The infection control experts at the University of Geneva Hospitals found a 50% reduction in the rate of hospital-acquired infections in their
patients after modest handwashing by healthcare workers. According to statistics, approximately 5-10% of patients in U.S. hospitals acquire a nosocomial infection. That is two million infections per year resulting in 90,000 deaths at a price of 4.5 billion dollars per year (DeMarco, 2004). More attention needs to be focused on stricter protocol implementation and monitoring to ensure compliance of the healthcare practitioners in performing this simple, yet critical, task.

References
Questions for STEP Participants

Answer questions only on the official STEP answer sheet. If you do not have the official STEP answer sheet, a year's supply can be obtained (at no cost), simply by writing to: STEP Program Answer Sheets. American Medical Technologists, 710 Higgins Road, Park Ridge, IL 60068-5765.

In addition to marking your answers, be sure to include all the required information on the answer sheet and a processing fee of $3.00 per article. In the following, choose the one best answer for each question.

1. The earliest recorded references to the importance of handwashing are found in the writings of:
   A. Bible
   B. Lister
   C. Kolletschka
   D. Semmelweis

2. Which of the following scientists linked puerperal fever to unclean hands?
   A. Lister
   B. Delost
   C. Kolletschka
   D. Semmelweis

3. When washing hands in the healthcare setting where microbial pathogens are present, the CDC recommends the use of plain soap.
   A. True
   B. False

4. Which of the following is NOT an antimicrobial routinely added to soaps and hand rubs?
   A. Alcohol
   B. Triclosan
   C. Chlorhexidine
   D. Phenolic acid

5. The MOST commonly used agent in hand-rubs is:
   A. Alcohol
   B. Triclosan
   C. Chlorhexidine
   D. Phenolic acid

6. Which of the following patients would be LEAST susceptible to nosocomial infection?
   A. A baby in the neonatal intensive care unit
   B. A leukemia patient undergoing chemotherapy
   C. A 55-year-old male admitted for knee replacement surgery
   D. A 85-year-old female admitted for repair to a broken hip

7. Which of the following organisms would cause the least concern to infection control practitioners?
   A. Enterrococcus
   B. Staphylococcus aureus
   C. Pseudomonas aeruginosa
   D. Staphylococcus epidermidis

8. The most effective way to prevent spread of nosocomial infections is through the use of:
   A. Latex gloves
   B. Non-latex gloves
   C. Proper handwashing techniques
   D. Immunization of healthcare workers

9. Appropriate handwashing techniques would NOT include the use of:
   A. Cold water rinse
   B. Rinsing hands thoroughly
   C. Rubbing hands together vigorously
   D. Drying completely with disposable towel

10. Many hospital hand hygiene policies prohibit each of the following EXCEPT:
    A. Nail wraps
    B. Nail jewelry
    C. Acrylic fingernails
    D. Manicured fingernails