

Infection Prevention – Is it in Our Hands?

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📁 Nursing

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Objectives

1. Discuss the importance of handwashing and its effect on the transmission of nosocomial infections.
2. Explain the significance of fingernails (artificial or natural) and their potential role in transmitting infection.
3. Describe the Center's for Disease Control's and other national group's recommendations regarding hand hygiene.

Article

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Author: Colleen Symanski-Sanders, RN, Forensic Nurse Specialist

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Introduction

What makes the Healing Art divine? The blazoned truth we hold so dear: To guard is better than to heal, the shield is nobler than the spear." (Dr. Oliver Wendell Holmes)

In an age where preventive health care has been deemed valuable, Dr. Holmes' words are as current now as they were in the 1800's. Each year, nearly 2 million people in the United States get an infection as a result of receiving health care in a hospital and 88,000 die as a direct or indirect result of these infections. Hand-transmission is a major factor in the spread of bacteria, viruses, and other pathogens that cause disease, foodborne illnesses, and nosocomial infections. Everyone is vulnerable, but the elderly, young children, pregnant women, and those with a compromised immune system are at the highest risk. In 1855, Holmes republished his paper in the American Journal of the Medical Sciences and this time he received the support of his colleagues. Holmes considered nosocomial infections as "professional homicide" and believed that ignoring this issue in medicine should not be acceptable. It is hard to image that in nearly 150 years the "homicide" that Holmes referred to still remains a threat to recipients of health care.

Bacterial Flora

Normal bacterial flora lives on external body surfaces and in the gastrointestinal tract. The composition of the normal flora varies from individual to individual. To understand the importance of handwashing and the different hand cleansing procedures, knowledge of normal bacterial skin flora is essential. Bacterial floras are categorized as either transient or resident.

- Transient floras colonize the superficial layers of the skin and are more susceptible to removal by routine handwashing. Healthcare workers often acquire them during direct patient contact or from contact with contaminated environmental surfaces. Transient floras are the organisms most frequently associated with healthcare related infections.
- Resident floras attach to deeper layers of the skin and are more resistant to removal than transient floras. Hands can be colonized with pathogenic flora like *Staphylococcus aureus*, gram-negative bacilli, or yeast.

Normal flora does have some important benefits, one of which is preventing some pathogenic microorganisms from access to body surfaces. Normal flora may also produce essential nutrients, such as vitamin K, which is manufactured by intestinal flora and some species have medicinal value by producing antibiotics.

The administration of broad-spectrum antibiotics, however, alters the body's normal flora and can result in colonization with antibiotic-resistant organisms. This disruption of the normal flora can lead to fungal infections, such as Candidiasis. In addition, some bacteria that are usually part of the normal flora or are common in the environment may become pathogenic following continual exposure to these antibiotics, an example of which is certain strains of *E. coli* that cause urinary tract infections or meningitis. If the superficial normal flora contains *Staphylococcus aureus*, a serious infection can occur if it gains access to the deep tissues via trauma, surgery, and/or insertion of intravascular lines.

Hand Transmission of Pathogens

There is substantial scientific evidence that the area around the subungual region of the hands (subungual means below the nail) has the highest concentrations of bacteria and other pathogens. Though invisible to the naked eye, pathogens can be transmitted from one patient to another via the hands of healthcare personnel, which is a leading cause of transmission of nosocomial infection. The CDC has identified the following sequence of events as modes of transmission:

1. Organisms present on a patient's skin, or that have been shed onto inanimate objects in close proximity to a patient, must be transferred to the hands of healthcare workers. These organisms must then be capable of surviving for at least several minutes.
2. Next, hand washing or hand antisepsis by the worker must be inadequate or omitted entirely, or the agent used for hand hygiene must be inappropriate.
3. Finally, the contaminated hands of the caregiver must come in direct contact with another patient, or with an inanimate object that will come into direct contact with another patient.

Fingernails and Artificial Nails = Bacteria

Conclusive evidence is needed whether or not artificial nails contribute to transmission of infections, but healthcare personnel who wear artificial nails are more likely to harbor gram-negative pathogens on their fingertips than are those who have natural nails, both before and after handwashing. Whether the length of natural or artificial nails is a substantial risk factor remains debatable. The fingernail plate is attached to the skin that lies directly underneath (the subungual skin). As the fingernail grows out, it will eventually extend to a point that is no longer attached to this skin. The majority of bacterial growth occurs at our fingertips adjacent to this area where the fingernail and subungual skin are no longer attached. Long nails, both natural and artificial, can facilitate the colonization of bacteria on the hands by making handwashing less effective and the use of gloves less practical. The longer the nail the more likely it is that bacteria can reside under its free edge. A few reports have implied that nurses who wear acrylic fingernails may become colonized with *Candida* and, thus, become a possible risk to susceptible patients. Personnel wearing artificial nails have been epidemiologically implicated in several outbreaks of infection caused by gram-negative bacilli and yeast.

Researchers from an Oklahoma City Hospital determined that out of 439 infants admitted to the neonatal intensive care unit (NICU) during a 15-month study, 46 (11%) acquired a *Pseudomonas aeruginosa* infection and 16 (35%) of those infected died. Molecular typing confirmed that the genotypes isolated from the hands of two nurses were the same as those found in 90% of their case patients and that these genotypes differed from those found in patients in other parts of the hospital or in those who arrived in the NICU after the study period. They further assessed 92 of the 104 healthcare professionals for fingernail length and presence of artificial nails. The researchers found that those with short or medium length nails had a low risk of *Pseudomonas aeruginosa* colonization (1 in 80), whereas those with long natural or artificial nails had a much higher risk of 1 in 6 (a rate that was 13 times higher).

The Association of Operating Room Nurses (AORN) has issued a practice statement on artificial nails. Their website posted response on the acceptance of fake nails is "Artificial nails of any type should not be worn in the perioperative setting. It does not matter whether the person is scrubbed or circulating, artificial nails are not acceptable in the operating room". The AORN "Recommended practices for surgical hand scrubs" and "Recommended practices for surgical attire" in the *Standards, Recommended Practices, and Guidelines* state, "Artificial nails should not be worn. Rationale: It has not been proven that artificial or acrylic nails on healthy hands increase the risk of surgical infection. Artificial nails, however, may harbor organisms and prevent effective hand washing. Higher numbers of gram-negative microorganisms have been cultured from the fingertips of personnel wearing artificial nails than from personnel with natural nails..." Whether it is the scrub person or the circulator, AORN believes that artificial nails should not be worn."

Bacterial and fungal infections frequently result from artificial nails. A bump to a long artificial nail can cause it to lift from the natural nail at the base leaving a tiny opening for the collection of dirt. If the nail is reglued without proper cleaning, bacteria or fungi can grow between the nails and spread onto the natural nail. In addition, as the natural nail grows, a space develops between the natural nail and artificial nail and if this space is not regularly filled in, it increases the chance for infection.

Physiology of Normal Skin and Fingernails

The skin is a dynamic structure that has the ability to act as a barrier under a homeostatic environment. The primary function of the skin is to reduce water loss, provide protection against abrasive action and microorganisms, and act as a permeability barrier to the environment. The basic structure of skin includes the epidermis, the dermis, and the subcutaneous layer. The epidermis is the tougher, protective outer layer and it contains three special types of cells:

- **Melanocytes**, which produce **melanin**, the pigment that gives skin its color;
- **Keratinocytes**, which produce **keratin**, the basic component of nails; and
- **Langerhans cells**, which help protect the body against infection.

Underneath, the dermis layer nourishes the epidermis. It consists of blood vessels, nerve endings, and connective tissue. The outer portion of the dermis has tiny projections called **papillae** that are sensitive to touch. They are especially numerous on the palms, soles, and fingertips. The dermis is also the layer that is patterned and provides a person's unique set of fingerprints and footprints. The third layer, the subcutaneous tissue, is made up of connective tissue, blood vessels, and cells that store fat. This layer provides protection from injuries and helps the body retain body heat. Nails are a type of modified skin. They are formed from the epidermis and consist of hardened skin cells that contain keratin.

Antiseptic Product Categories

The FDA Tentative Final Monograph for Health-Care Antiseptic Drug Products approves and monitors antiseptic hand washes and patient preoperative skin preps. Products are divided into three categories as follows.

1. **Antiseptic handwash or healthcare worker handwash.** An antiseptic-containing preparation designed for frequent use; it reduces the number of microorganisms on intact skin to an initial baseline level after adequate washing, rinsing, and drying; it is broad-spectrum, fast-acting, and if possible, persistent.
2. **Surgical hand scrub.** An antiseptic-containing preparation that substantially reduces the number of microorganisms on intact skin; it is broad-spectrum, fast-acting, and persistent.
3. **Patient preoperative skin preparation.** A fast-acting, broad-spectrum, and persistent antiseptic-containing preparation that substantially reduces the number of microorganisms on intact skin.

The Centers for Disease Control (CDC) Hand Hygiene Guidelines

The hand hygiene guidelines were developed by the CDC's Healthcare Infection Control Practices Advisory Committee (HICPAC), in collaboration with the Society for Healthcare Epidemiology of America (SHEA), the Association of Professionals in Infection Control and Epidemiology (APIC), and the Infectious Disease Society of America (IDSA). The hand hygiene guidelines are part of an overall CDC strategy to reduce infections in healthcare settings and to promote patient safety.

In this guideline, washing hands with soap and water is replaced by rubbing hands with an alcohol hand rub as the primary means of hand hygiene to be used by healthcare personnel involved in routine patient care. The rationale behind this is the documented increased antimicrobial efficacy of alcohol hand rubs over washing hands with either plain soap and water or an antimicrobial soap. In addition, there is the potential for increased compliance with hand hygiene because hand rubbing requires less time, results in less skin irritation, and does not require proximity to a sink. The only qualification is that the hands must be free from visible soiling prior to the use of an alcohol hand rub.

The CDC/HICPAC system for categorizing recommendations is as follows and is found at the end of each recommendation statement that is discussed below.

- **Category IA.** Strongly recommended for implementation and strongly supported by well-designed experimental, clinical, or epidemiological studies.

- **Category IB.** Strongly recommended for implementation and supported by certain experimental, clinical, or epidemiological studies and a strong theoretical rationale.
- **Category IC.** Required for implementation, as mandated by federal or state regulation or standard.
- **Category II.** Suggested for implementation and supported by suggestive clinical or epidemiological studies or a theoretical rationale.
- **No recommendation.** Unresolved issue. Practices for which insufficient evidence or no consensus regarding efficacy exist.

1. Indications for handwashing and hand antisepsis

- When hands are visibly dirty or contaminated with proteinaceous material or are visibly soiled with blood or other body fluids, wash hands with either a non-antimicrobial soap and water or an antimicrobial soap and water (IA).
- If hands are not visibly soiled, use an alcohol-based hand rub for routinely decontaminating hands or alternatively, wash hands with an antimicrobial soap and water (IB).
- Decontaminate hands before having direct contact with patients (IB).
- Decontaminate hands before donning sterile gloves when inserting a central intravascular catheter (IB).
- Decontaminate hands before inserting indwelling urinary catheters, peripheral vascular catheters, or other invasive devices that do not require a surgical procedure (IB).
- Decontaminate hands after contact with a patient's intact skin (i.e. when taking a pulse, a blood pressure, or lifting a patient) (IB).
- Decontaminate hands after contact with body fluids or excretions, mucous membranes, non-intact skin, and wound dressings (IA).
- Decontaminate hands if moving from a contaminated-body site to a clean-body site during patient care (II).
- Decontaminate hands after contact with inanimate objects (including medical equipment) in the immediate vicinity of the patient (II).
- Decontaminate hands after removing gloves (IB).
- Before eating and after using a restroom, wash hands with a non-antimicrobial soap and water or with an antimicrobial soap and water (IB).
- Antimicrobial-impregnated wipes (i.e. towelettes) may be considered as an alternative to washing hands with non-antimicrobial soap and water. However, because they are not as effective as alcohol-based hand rubs or washing hands with an antimicrobial soap and water for reducing bacterial counts, they are not a substitute for using an alcohol-based hand rub or antimicrobial soap (IB).
- Wash hands with non-antimicrobial soap and water or with antimicrobial soap and water if exposure to *Bacillus anthracis* is suspected or proven. The physical action of washing and rinsing the hands under such circumstances is recommended because alcohols, chlorhexidine, iodophors, and other antiseptic agents have poor activity against anthrax spores (II).
- No recommendation can be made regarding the routine use of nonalcohol-based hand rubs for hand hygiene in healthcare settings. Unresolved issue.

2. Hand-hygiene technique

- When decontaminating hands with an alcohol-based hand rub, apply product to palm of one hand and rub hands together, covering all surfaces of hands and fingers, until hands are dry (IB). Follow the manufacturer's recommendations regarding the volume of product to use.
- When washing hands with soap and water, wet hands first with water, apply an amount of product recommended by the manufacturer to hands, and 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 the towel to turn off the faucet (IB). Avoid using hot water, because repeated exposure to hot water might increase the risk of dermatitis (IB).
- Liquid, bar, leaflet or powdered forms of plain soap are acceptable when washing hands with a non-antimicrobial soap and water. When bar soap is used, a soap rack that facilitates drainage and small bars of soap should be used (II).
- Multiple-use cloth towels of the hanging or roll type are not recommended for use in healthcare settings (II).

3. Surgical hand antisepsis

- Remove rings, watches, and bracelets before beginning the surgical hand scrub (II).
- Remove debris from underneath fingernails using a nail cleaner under running water (II).
- Surgical hand antisepsis using either an antimicrobial soap or an alcohol-based hand rub with persistent activity is recommended before donning sterile gloves when performing surgical procedures (IB).
- When performing surgical hand antisepsis using an antimicrobial soap, scrub hands and forearms for the length of time recommended by the manufacturer, usually 2 to 6 minutes. Long scrub times (i.e. 10 minutes) are not necessary (IB).
- When using an alcohol-based surgical hand-scrub product with persistent activity, follow the manufacturer's instructions.

Before applying the alcohol solution, prewash hands and forearms with a non-antimicrobial soap and dry hands and forearms completely. After application of the alcohol-based product as recommended, allow hands and forearms to dry thoroughly before donning sterile gloves (IB).

4. Other Aspects of Hand Hygiene

- Do not wear artificial fingernails or extenders when having direct contact with patients at high risk (i.e. those in intensive-care units or operating rooms) (IA).
- Keep natural nail tips less than 1/4-inch long (II).
- Wear gloves when contact with blood or other potentially infectious materials, mucous membranes, and nonintact skin could occur (IC).
- Remove gloves after caring for a patient. Do not wear the same pair of gloves for the care of more than one patient, and do not wash gloves between uses with different patients (IB).
- Change gloves during patient care if moving from a contaminated body site to a clean body site (II).
- No recommendation can be made regarding the wearing of rings in healthcare settings. Unresolved issue.

5. Healthcare worker educational and motivational programs

- As part of an overall program to improve hand-hygiene practices of healthcare workers, educate personnel regarding the types of patient-care activities that can result in hand contamination and the advantages and disadvantages of various methods used to clean their hands (II).
- Monitor the adherence to recommended hand-hygiene practices and provide personnel with information regarding their performance (IA).
- Encourage patients and their families to remind healthcare workers to decontaminate their hands (II).

Are you a Risk Factor?

1. Are you a physician or a nursing assistant?
2. Is your gender male?
3. Are you often too busy, lacking sufficient time due to understaffing/overcrowding?
4. Do you work in an intensive-care unit?
5. Do you work during the week versus the weekend?
6. Do you perform activities with a high risk of cross-transmission?
7. Do you believe wearing gowns/gloves obviates the need for hand hygiene?
8. Do you believe you are at low risk of acquiring infection from patients?
9. Are sinks inconveniently located?
10. Is there a lack of soap and paper towels where you work?
11. Do hand-washing agents cause irritation and dryness?

If you answered "yes" to any of the risk factors above, you are not alone. In fact, the CDC cites the above risk factors as contributors (based on information provided by healthcare workers) to poor adherence to hand-washing practices. They also cite a lack of knowledge of guidelines/protocols, not thinking about it/forgetfulness, and no role model from colleagues or superiors. Hopefully, the following fact statements from the CDC Hand Hygiene Fact Sheet will assist in promoting handwashing.

- Improved adherence to hand hygiene (i.e. hand washing or use of alcohol-based hand rubs) has been shown to terminate outbreaks in health care facilities, to reduce transmission of antimicrobial resistant organisms (e.g. methicillin resistant staphylococcus aureus) and reduce overall infection rates.
- In addition to traditional handwashing with soap and water, the CDC is recommending the use of alcohol-based hand rubs by healthcare personnel for patient care because they address some of the obstacles that healthcare professionals face when taking care of patients.
- Handwashing with soap and water remains a sensible strategy for hand hygiene in non-health care settings and is recommended by the CDC and other experts.
- The use of gloves does not eliminate the need for hand hygiene. Likewise, the use of hand hygiene does not eliminate the need for gloves. Gloves reduce hand contamination by 70% to 80%, prevent cross-contamination, and protect patients and health care personnel from infection. Hand rubs should be used before and after each patient just as gloves should be changed before and after each patient.
- When evaluating hand hygiene products for potential use in healthcare facilities, administrators or product selection committees should consider the relative efficacy of antiseptic agents against various pathogens and the acceptability of hand hygiene products by personnel. Characteristics of a product that can affect acceptance and therefore usage include its smell, consistency, color, and the effect of dryness on hands.

- As part of these recommendations, the CDC is asking healthcare facilities to develop and implement a system for measuring improvements in adherence to these hand hygiene recommendations. Some of the suggested performance indicators include: periodic monitoring of hand hygiene adherence and providing feedback to personnel regarding their performance; monitoring the volume of alcohol-based hand rub used/1000 patient days; monitoring adherence to policies dealing with the wearing of artificial nails; and perform a focused assessment when outbreaks of infection occur.
- Allergic contact dermatitis due to alcohol hand rubs is very uncommon. However, with increasing use of such products by health care personnel, it is likely that true allergic reactions to such products will occasionally be encountered.
- Alcohol-based hand rubs take less time to use than traditional hand washing. In an eight-hour shift, an estimated one hour of an ICU nurse's time will be saved by using an alcohol-based hand rub.

Conclusion

Regardless of one's profession in health care there is an expectation from the public regarding a patient's health and safety. Ethically, clinicians are obligated "to do no harm" and are responsible and accountable for their actions or lack of action. Establishing, maintaining, and improving healthcare environments is also part of providing care and services. Diligence with handwashing and maintenance of short nails promotes prevention of nosocomial infections. Prevention is more invigorating than illness and the power of prevention is in our hands.

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Colleen has been an author of educational material for St. Petersburg College, St. Petersburg, Florida. She has also lectured on a variety of topics at numerous nursing symposiums and conferences across the country. She is on the Editorial Board for "Home Health Aide Digest" and "Private Duty Homecare" publications.

