

Skin Care and Hand Washing: Revisiting the Basics



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Skin Care and Hand Washing: Revisiting the Basics

Study Guide #7

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Description of Study Guide Topic

The importance of proper skin care is often minimized as many healthcare professionals consider skin care to be very basic. However, compliance to handwashing and a thorough understanding of handwashing products and practices is still lacking in healthcare environments today. This study guide provides information on skin anatomy, the chain of infection, handwashing products and practices and certain skin problems, while highlighting the critical importance of appropriate handwashing and skin care.

Overall Purpose of the Study Guide

To revisit the basics of skin care and handwashing.

Objectives

Upon completion of this study guide program, the participant should be able to:

1. Describe the role of skin as a protective barrier.
2. Discuss the hand washing process, including hand washing product selection and the steps of appropriate handwashing.
3. List skin problems and their characteristics.

Intended Audience

This study guide is a self-study program intended for use by perioperative nurses, surgical technologists, central service staff members, endoscopy suite nurses, endoscopy staff members, infection prevention nurses, general duty nurses and other healthcare professionals interested in this topic.

Skin - The Versatile Organ

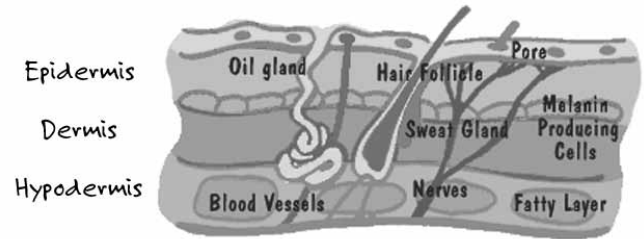
“There is no magician’s mantle to compare with the skin in its diverse roles of waterproof, overcoat, sunshade, suit of armour and refrigerator, sensitive to the touch of a feather, to temperature and to pain, withstanding the wear and tear of three score years and ten and executing its own running repairs. This vital organ of the body, 16-20 square feet in extent (the child at birth has three times the area relative to the body weight), holds the mirror to age and health even revealing general conditions such as fever, jaundice, syphilis, deficiency diseases and poisons” (Lockhart, 1965).

Anatomy of the Skin

The skin is an amazing structure of the body representing the integumentary system. It offers protection from the environment or pathogenic invasion, provides temperature regulation and fluid control, responds to changes in the external environment and reflects changes in the internal environment. Skin is durable and varies in thickness, from the thin skin on the eyelid to the thick skin on the sole of the foot. Skin comes in a variety of textures, from the smooth skin on a baby’s buttocks to the wrinkled skin of an elderly face. Some skin is intensely sensitive, like the fingertips or inside aspect of the lower arm, while some skin is not very responsive to external stimuli like the soles of the feet. Some skin contains hair follicles (arm, leg) while some skin does not (sole of foot). Skin is very self-repairing, but can also become quite altered with emotional or general health stressors. Skin has the ability to reveal the signs of a wide-variety of disorders or diseases.

Skin, even though quite simple, can be a very complex organ of the human body. Healthy skin provides a critical barrier to possible abrasion, chemical irritants, ultraviolet radiation and most importantly, infectious agents. On the other hand, skin can be the vehicle of transmission of pathogenic microorganisms if not cared for appropriately.

Even though skin is very diverse with many variations, it has some common anatomical characteristics. Skin is composed of three main layers: the epidermis, dermis and the subcutaneous tissues.



Epidermis

The epidermis is avascular with an outer, dead cornified portion and a deeper, living, cellular structure. The epidermis is divided into several layers consisting mostly of keratinocytes (cells that produce keratin). Epidermal cells slowly move outward to the skin surface while going through a change process during this migration until they are sloughed as cornified flakes. These transitional layers are (starting from the most inner aspect of the epidermis) the basal cell layer, the prickle cell layer, the granular layer, the clear cell layer and the cornified layer. Together, these layers measure approximately 0.5 to 1.1mm in thickness (Mosby, 1994). Pigment-containing cells (melanin and carotene) are found in the epithelial layer and are responsible for the skin color.

Formed by the communication with the underlying dermis are the epidermal appendages including: hair, nails, eccrine sweat glands, apocrine sweat glands and sebaceous glands. The hair and nails are actually keratinized appendages and have no real function in human beings. Hair ascends from an ingrowth of epidermal cells or follicle that pushes itself down into the dermis during development. Nails are an epidermal structure that consist of specialized, hardened keratin protein. Care of the fingernails focuses on the nail bed (the pink background behind the nail), the base of the nail (the junction site of the skin and the exposed fingernail) and the area under the exposed tip of the fingernail (Rodgers, 1998).

The eccrine sweat glands are found in many areas and are responsible for dissipating body heat when sweat is produced and evaporates. The apocrine sweat glands are mostly found in the axilla and in some general areas and may open into the hair follicles. The sweat that these glands produce decomposes when contaminated by bacteria, which is responsible for the characteristic body odor. The sebaceous glands usually emanate from hair follicles and produce sebum which lubricates the hardened outer layer of the epidermis to help resist dehydration.

Dermis

The dermis, which is underneath the epidermis, makes up the bulk of the skin. It consists of tough connective tissue with lymphatics, glands, sensory receptors and related nerves and blood vessels. The dermis not only supports the epidermis, but it nourishes it.

Subcutaneous layer or Hypodermis

The subcutaneous layer lies immediately under the dermis and is characterized by its fat storage. This subcutaneous layer is instrumental in temperature insulation.

Transient vs. Resident Organisms

Microorganisms can be found on almost everyone's hands. Depending on the site and the method of sampling, human skin may contain between 4,000 to 400,000 microorganisms per square centimeter, but human skin is not considered to be totally covered with infectious microorganisms. There are two types of flora found on human skin:

- > Resident microorganisms
- > Transient microorganisms

Resident flora (also known as colonizing flora) are microorganisms that are considered permanent residents of the skin and not readily removed by mechanical friction. These microorganisms can be consistently isolated from the skin of most persons. An example of a microbe that resides without harm on the skin surface and is considered normal is *Staphylococcus epidermidis*.

When flora is not normally present at a given site but is suddenly found there, this flora is termed transient. Transient flora (also termed contaminating or noncolonizing flora) are microorganisms found on the skin, but are not demonstrated to be consistently present in a majority of persons. Transient microorganisms can accumulate easily on the hands of healthcare workers after patient contact and patient care activities. They must be removed by mechanical friction with soap and water, or destroyed by the application of an antiseptic handrub (alcohol, for instance). If adequate and proper hand washing is not performed, the chance of pathogenic transmission to other persons (patients or co-workers) can occur.

Chain of Infection

Healthcare professionals must understand the chain of infection so that practices can be implemented to control the transmission of pathogens, such as handwashing. The three main components in this chain of infection are the agent, route of transmission and the host (AAMI, 1996).

The causative agent of infection can be a bacterium, virus, fungus, parasite, or prion. This pathogen must be virulent, invasive, infective and have the appropriate reservoir to survive and transmit disease as described below:

- > Virulence is the degree of pathogenicity or the ability of a microorganism to cause disease. As a microorganism becomes more virulent, the resulting disease becomes more severe and communicable
- > The invading organism must be able to penetrate the host's defensive barriers (invasive) to cause disease
- > An infective dose of the pathogen must be present, which is the number of organisms needed to cause an infection. This number varies with the organism and the host
- > An appropriate reservoir must be present to allow the organism to metabolize and multiply. Different microorganisms require different reservoirs which may be animate or inanimate.

The route of transmission of an organism can be through direct contact (blood transfusions, direct contact with body fluids, sexual contact), vectors (insects that can transmit disease), or indirect contact (exposure to contaminated food, water, air, surgical instruments).

The host must be susceptible to the infective pathogen for disease to occur. Factors, such as age, physical condition and nutrition can affect the host's susceptibility.

In summary, the chain of infection requires a causative agent that multiplies in a reservoir. A portal of exit allows the pathogen to escape and to be transmitted to a susceptible host through a portal of entry. This is how disease is transmitted.

Healthcare-Associated Infections (HAIs)

There is a constant competition between microorganisms that infect patients and the drugs (antibiotics) used to treat the infections. Antibiotic resistance actually began with the development of one of the first antibiotics, penicillin. In the 1950s, there were reports from Canada and Australia about penicillin-resistant *Staphylococcus aureus* infections that included skin lesions, sepsis and pneumonia in children and young adults. In the same time period, the United

States reported penicillin-resistant *Staphylococcus aureus* infections in newborns, obstetrical and surgical patient populations. One study demonstrated that approximately 25% of newborns in the United States developed pyodermas with the resistant *Staphylococcus aureus* (Siegel, 2006).

Even though HAIs are healthcare facility-acquired infections, they may not be apparent until after the patient has been discharged. The source of these infections may be endogenous (from one's own tissues, self-infection) or exogenous (from objects or other persons, cross-infection). HAIs can proliferate in healthcare environments due to the population of susceptible hosts, presence of infective agents and the existence of various modes of transmission.

Multiple drug-resistant organisms (MDROs) have become challenging agents of HAIs today. Many infectious diseases were dreaded, life threatening, or maiming events until antibiotics were first introduced more than 50 years ago. The value of chemical antimicrobial therapy can not be overestimated, but with the introduction of each new drug also comes problems such as the emergence of resistant strains of a bacteria.

The resistant organisms causing HAIs that have caused a great deal of concern among healthcare workers are MRSA (Methicillin-resistant *Staphylococcus aureus*), MRSE (Methicillin resistant *Staphylococcus epidermidis*) and VRE (Vancomycin-resistant enterococci). To illustrate how dangerous these resistant organisms can be, VRE is discussed in more detail.

Enterococci is the leading cause of blood infections in hospitalized patients. Although this bacteria tends to attack only the sickest patients, this disease constitutes a serious threat in healthy patients as well. In the past, most infected patients were successfully treated with an antibiotic called vancomycin. Through years of exposure to vancomycin, some enterococci have been able to alter their genetic structure, thus rendering the vancomycin powerless to destroy the bacteria. The rate of isolated enterococci becoming more resistant to vancomycin has increased tremendously in the past decade. Transmission of VRE can occur two ways: directly via patient-to-patient contact, or indirectly from the hands of healthcare workers or contaminated environmental surfaces.

With respect to handwashing and multiple drug-resistant organisms (MDROs), the CDC recommends that healthcare workers wash their hands immediately with an antiseptic soap preparation after performing patient care duties. Hands can become contaminated through glove leaks or during glove removal.

Handwashing and Surgical Scrubbing

Handwashing is generally accepted to be the single most important procedure for preventing HAIs, as it removes loose bacteria and dead skin cells that can harbor bacteria. Unfortunately, it is also a fact that handwashing is done far too infrequently and haphazardly. The primary challenge in getting healthcare professionals to practice effective hand hygiene is not due to a lack of handwashing facilities or solutions. There is an array of excellent products available to suit all handwashing needs. Poor compliance to performing adequate handwashing has been identified as the major problem. Healthcare professionals identify three contributing factors that have led to decreased handwashing compliance:

- > Too busy
- > Perceive a minimal risk of exposure to infectious organisms
- > Frequent handwashing will damage the skin

The APIC (Association for Professionals in Infection Control and Epidemiology) 2002 Guidelines for Handwashing and Hand Antisepsis in Healthcare Settings states that:

Handwashing associated with general patient care occurs in approximately half of the instances in which it is indicated and usually is of shorter duration than recommended. Variations in handwashing practice have been reported by type of unit (pediatric personnel have been shown to have higher frequency of handwashing) and professionals, (in general nurses wash more often than physicians, although physicians have been shown to wash more thoroughly).

Governmental and professional organizations

Government agencies and professional organizations have issued guidelines and regulations on handwashing practices and issues. Government and professional agencies involved include:

- > FDA (Food and Drug Administration)
- > CDC (Centers for Disease Control and Prevention)
- > OSHA (Occupational Safety and Health Administration)
- > Joint Commission (JC)
- > AORN (Association of perioperative Registered Nurses)
- > APIC (Association for Professionals in Infection Control and Epidemiology)

Levels of handwashing

Different levels of decontamination are required for different situations in the healthcare environment. With regard to handwashing, the levels of decontamination include:

- > Routine handwashing
- > High-risk handwashing
 - Healthcare professional handwashing
 - Surgical scrubbing

Routine handwash products remove transient organisms, but they do not typically contain an antimicrobial agent and they do not have to go through FDA testing. The chemical agent used for high-risk handwashing determines which organisms are killed and how quickly they are eliminated. Since antimicrobial or antiseptic soaps are classified as drugs because they kill microorganisms, the FDA regulates them. The FDA dictates the specific testing that must be done on the products to ensure their safety and efficacy (the ability of the product to perform as it claims). Product labels then reflect these claims. For example, testing and label claims allow a company to label its product a “healthcare personnel handwash” or a “surgical scrub,” which are the two types of high-risk handwashing products.

According to the FDA classification, some soaps, such as antimicrobial soaps, must be evaluated using both *in vitro* and *in vivo* testing to prove that they kill microorganisms or inhibit their growth on the skin. This means that the product has been tested in the laboratory or in a test tube (*in vitro*) and used on human hands or in real-life situations (*in vivo*) after contamination with a test organism. (Hint: An easy way to remember the difference between *in vitro* and *in vivo* is to consider the “t” in “*in vitro*” as standing for test tube.) The results obtained from testing a product in a test tube under ideal conditions may differ greatly from the results obtained in a real-life situation.

The FDA has created different definitions and requirements to explicitly categorize different handwash products. These definitions and requirements (APIC, 2002) include:

- > Antimicrobial soap contains an ingredient with demonstrated *in vitro* and *in vivo* activity against skin flora. Antimicrobial soaps are considered OTC

(over the counter) drugs and are intended to kill or inhibit microorganisms on skin when the soaps are present in certain concentrations

- > Healthcare personnel handwash is a broad spectrum antimicrobial preparation that reduces the number of transient flora to a baseline level. It is fast-acting, nonirritating and designed for frequent uses. A healthcare personnel handwash is designed primarily to reduce transient organisms. Acceptable support data must include both *in vitro* and *in vivo* tests
- > Surgical handscrub is a broad spectrum antimicrobial preparation that significantly reduces the number of microorganisms on intact skin. It is fast-acting and nonirritating. A surgical handscrub is similar to that of the healthcare personnel handwash except that persistence data for up to six hours must be demonstrated. The characteristic of persistence (also called substantivity or residual activity) means that the product has continued antimicrobial activity for up to six hours. Many resident organisms live in the deeper layers of the skin, therefore persistence of a surgical scrub is required. This can be a real advantage during a prolonged surgical procedure when a surgeon can not continually stop the operation to degerm his or her hands

Handwash products

A key healthcare professional in the decision of handwashing products is usually the hospital Infection Control Practitioner (ICP). The ICP usually considers the “Guidelines for Hand Washing” developed by APIC to be the final word on handwashing protocol as this document is often referenced by many professionals.

Some general considerations about handwash products must be reviewed when determining which agent is to be used. Handwash products must be able to decrease transient and sometimes even resident flora. Hand soaps work by emulsifying lipids, which in turn, remove dirt, oil, grease and disrupt the lipid components of some bacterial and viral cells (Rodgers, 1996).

The choice of handwashing product depends on the degree of hand contamination, the need to mechanically remove the transient flora and the need to reduce and maintain minimal counts of residual flora (APIC, 2002).

There are a variety of antimicrobial ingredients available for handwashing, surgical scrub, or hand antisepsis. The choices of handwashing products available include plain soap, antiseptic soap, or antiseptic handrub. To provide a knowledgeable decision about which agent to use, the following factors (APIC, 2002) must be considered:

- > Characteristics of the antimicrobial agent (e.g., persistence, absence of skin absorption, spectrum of activity, rapid reduction of flora)
- > Results of tests that show evidence of safety and efficacy
- > Personnel acceptance of the product and costs

Two types of high-risk handwash products are available, those that require water for use and those that can be used without water. Waterless products are often referred to as hand rinses or antiseptic handrubs. When waterless products are used after exposure to blood or body fluids, the hands must be washed with soap and water as soon as possible.

Below is a listing of the most common nonantimicrobial and antimicrobial ingredients used to kill or arrest the growth of pathogens in handwash products.

Plain Soap

Plain or nonantimicrobial soaps are detergent-based cleaners in any form (bar, liquid or powder) used for the primary purpose of physical removal of dirt and contaminating microorganisms. Such soaps work principally by mechanical action and have no bactericidal activity. Although some soaps contain low concentrations of antimicrobial ingredients, these are only used as preservatives so bacterial growth will not occur in the soap containers.

Plain soaps can be natural, synthetic, or blended.

- > **Natural soaps** are generally made of vegetable fats, such as coconut or palm oils. The pH is generally a little less than 10.2. Extra fats are added along with emollients. These ingredients help to overcome the higher pH and make the product less irritating than synthetic soaps
- > **Synthetic soaps** or detergents have a pH of 4 to 7, which is close to the pH of the skin. These products have greater wetting, penetration and degreasing properties than natural soaps. As a result, synthetic soaps can be very drying. This is generally overcome by the addition of emollients (skin conditioners and softeners) to the formula. Detergents produce a rich lather that many people prefer because they associate the suds with better cleaning properties
- > **Blended soaps** are a blend of the best properties of both synthetic and natural soaps. They have a pH of approximately 8, which varies slightly depending on the blend. These products also contain emollients, which make them very gentle on the hands

In evaluating plain soaps, healthcare workers often consider the following factors:

- > How gentle the product is to the skin
- > How well the product lathers and cleans
- > How the product smells
- > How easily the product rinses off the hands
- > What is the cost of the product

A plain soap and water handwash is sufficient in non-critical care units and when exposure to microorganisms is minimal. Plain soap and water only remove transient organisms. Routine handwashing may not remove all organisms from heavily contaminated hands and does not kill microorganisms.

In 1985, CDC guidelines stated that “Plain soap should be used for handwashing unless otherwise indicated” (Garner, 1985). Since then, infection control practitioners have recommended the use of antimicrobial agents that provide pathogenic kill. The increased incidence of HAIs coupled with the rise in HAIs have justified the change to the use of antimicrobial agents throughout healthcare facilities.

Alcohols

Alcohols provide an antimicrobial effect by denaturing proteins.

They are bactericidal against most vegetative gram-positive and gram-negative bacteria and tubercle bacillus. Even though alcohols are not sporicidal, they are effective against many viruses and fungi.

Alcohols are characterized by providing a very rapid reduction in microbial counts on the skin. Rubbing the skin with alcohol for a short 15-second-period has been shown to be effective in preventing hand transmission of gram-negative bacteria (APIC, 1995). Research has also shown that rubbing the skin with alcohol for three minutes is just as effective as a 20-minute scrub (APIC, 1995).

The three alcohols used for skin antiseptics are ethanol, n-propyl and isopropyl. The formulation of sanitizers is much more important than the type and concentration of alcohol in determining the effectiveness of a preparation. Alcohol solutions or gels must be diluted with water to denature protein. Alcohol concentrations of 60% to 90% by weight appear to be the most effective for antiseptics. Generally, a concentration of less than 70% is more desirable because higher concentrations cause more skin drying and are more expensive (APIC, 1995).

Solutions, foams and gels with 60% to 70% ethanol or isopropyl alcohols have been combined with emollients to minimize skin drying and reduce evaporation time. These preparations can be used as waterless cleaners and have become very popular today because they are convenient, easy to use, cause less drying and also promote regular hand asepsis. Leading healthcare organizations, such as the National American Red Cross, CDC/NIOSH, the Association for Practitioners in Infection Control and Epidemiology and the American Society of Microbiologists, all agree that the data regarding alcohol waterless products support their efficacy.

OSHA guidelines state that alcohol-based, waterless preparations may be used when there is no contact with blood, body fluids (excretions and secretions), mucous membranes, or when there are no handwashing facilities available. Medication administration and instances involving minimal patient contact are examples where alcohol hand degerming may be used. Alcohol preparations may provide a viable alternative when handwashing facilities are not available, but they are not to be a substitute for handwashing. These products may be regarded as an effective adjunct to handwashing in high-risk areas.

Chlorhexidine gluconate (CHG)

CHG’s antimicrobial effect is achieved by causing microbial cell membranes to disrupt, leading to precipitation of the cellular contents. CHG is effective against gram-negative and gram-positive bacteria, but is less effective against tubercle bacillus and fungi.

CHG is nontoxic and minimally absorbed by the skin. The antibacterial action is less rapid than alcohol and the speed of kill is classified as intermediate. An important characteristic of CHG is its persistence. With its strong affinity for the skin, CHG will remain chemically active for at least six hours (APIC, 2002) unless inactivated by incompatible lotions or alcohol gels. CHG is pH-dependent and can be influenced by each individual’s skin pH differences, skin secretions and moisture levels (APIC, 2002).

CHG is most commonly prepared in a 4% concentration in a detergent base or the 2% aqueous formulation. CHG is also available as an alcohol-based handrinse (approximately 0.5% CHG), which combines the rapid antiseptic effect of the alcohol with the persistence of the CHG.

Often, healthcare professionals will use a handwash product containing CHG and then apply personal lotions to treat dry skin. The personal lotions can cancel the persistence activity that is the desired characteristic of the CHG product. Special lotions are available that are compatible with CHG handwash products so that the persistence will not be altered. This is also true for other handwash products that provide persistence.

Para-chloro-meta-xyleneol (PCMX or chloroxylenol)

PCMX provides microbial kill by disrupting the cellular membrane and inactivating cellular enzymes. Even though PCMX is less active than CHG, it is still effective against gram-positive bacteria, but less effective against gram-negative organisms. PCMX is fairly active against tubercle bacillus, some fungi and viruses.

Skin sensitivity from PCMX is low even though it penetrates the skin. PCMX is classified as having an intermediate rate of speed with a persistent effect lasting over a few hours (APIC, 2002). PCMX is currently found in a variety of handwashing products in concentrations of 0.5% to 3.75%.

Triclosan

Triclosan is thought to achieve microbial kill by disrupting the organism's cell wall. Its broad spectrum activity works well against gram-positive and most gram-negative bacteria, but appears to be weakly effective against fungi. More information is needed to determine its action against viruses. Even though triclosan is absorbed through the skin, allergies and mutagenic effects have not been proven with short-term use. The rate of kill of organisms is intermediate.

Triclosan is often used in over-the-counter soaps in concentrations up to 1% to reduce body odor by inhibiting the growth of skin bacteria.

High-risk handwash products vs. routine handwash products

Recently, many hospitals have begun to consider using high-risk handwash products throughout the hospital, even in non-critical areas where routine handwash products were previously considered adequate. There are several reasons for this approach:

- > Nowadays, only the sickest of patients remain in the hospital for any longer than a few days; the rest are being discharged to home care and nursing homes as soon as they are no longer considered critical. Sicker patients mean more pathogenic organisms and a greater chance that these organisms can spread and cause HAIs. Critically ill patients in hospitals today are more susceptible to HAIs than they used to be
- > Although routine handwashing is considered appropriate for general patient care, hospitals are starting to explore what general patient care really involves. With the increased incidence of nosocomial infection and the rise in microbial resistance, healthcare professionals cannot readily identify who is infected. Many hospitals are providing an antimicrobial product for all departments just to minimize the potential for transmission of pathogens
- > Patients and healthcare workers are concerned about AIDS and tuberculosis (TB), MRSA and VRE. With an increase in the incidence in these diseases, coupled with a concern expressed by healthcare workers, high-risk handwashing products are becoming more preferred to control pathogenic spread
- > Some strains of bacteria are beginning to develop resistance to the antibiotics traditionally used to treat them
- > The 1995 APIC guidelines recommend the use of healthcare personnel handwashes after contact with body fluids and substances, even if gloves are worn as recommended in Standard Precautions. Therefore, anytime gloves are worn for any type of procedure, a high-risk

handwashing product should be used prior to donning the gloves and immediately upon the removal of those gloves

- > Hospitals also may be motivated to use only high-risk handwash products because doing so helps streamline inventory. Since the majority of the patients in the hospital today are seriously ill, having routine handwash products in some areas and high-risk products in others does not make much sense. Having only one product to stock, inventory and use is much easier. With the onset of MDROs, a high-risk soap used facility-wide is a more-effective alternative.
- > A high-risk handwash product will most likely cost more than a routine handwash product, but if the use of that product prevents even one HAI, it has paid for itself many times over. Therefore, the high-risk handwash product is often more cost-effective in the long run.

Log reduction of microorganisms

Healthcare workers need to be aware of the critical importance of understanding log reductions. Most handwash product laboratory reports deal with log reductions to show the efficacy of a product in removing and killing microorganisms. An understanding of log reduction of pathogenic microorganisms must be realized so that appropriate handwash products can be chosen.

Log is short for logarithm. The logarithm of a number is the exponent to which 10 must be raised to produce that number. For example, the logarithm of 100 is 2 because 10 must be raised to the second power to produce 100. The logarithm of 1,000 is 3 because 10 must be raised to the third power. This is illustrated below:

$$2 \text{ logs} = 10^2 = 10 \times 10 = 100$$

$$3 \text{ logs} = 10^3 = 10 \times 10 \times 10 = 1,000$$

$$4 \text{ logs} = 10^4 = 10 \times 10 \times 10 \times 10 = 10,000$$

$$5 \text{ logs} = 10^5 = 10 \times 10 \times 10 \times 10 \times 10 = 100,000$$

$$6 \text{ logs} = 10^6 = 10 \times 10 \times 10 \times 10 \times 10 \times 10 = 1,000,000$$

$$7 \text{ logs} = 10^7 = 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 = 10,000,000$$

$$8 \text{ logs} = 10^8 = 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 = 100,000,000$$

Large numbers of microorganisms are considered when performing antimicrobial tests. To eliminate large, unwieldy numerical expressions, large numbers are expressed as logs (of bacteria). For example, instead of writing 1,000,000 bacteria, the expression would be 6 logs of bacteria ($1,000,000 = 10^6$). The following examples demonstrate log reductions.

Example 1:

An inoculum of 6 logs of bacteria (1,000,000) is exposed to antimicrobial agent A for two minutes. The amount of bacteria that is left after the exposure is measured. The result is that 2 logs of bacteria survive. Therefore, the log reduction was 4 logs (6 logs minus 4 logs = 2 logs remaining). The number of bacteria left is 100.

Example 2:

An inoculum of 6 logs of bacteria (1,000,000) is exposed to antimicrobial agent B for two minutes. The amount of bacteria that is left after the exposure is measured. The result is that 1 log of bacteria survive. Therefore, the log reduction was 5 logs (6 logs minus 5 logs = 1 log remaining).

Without any more information, antimicrobial agent B has been shown to be more effective than antimicrobial agent A because it produced a greater log reduction. When comparing log reductions of two products, the healthcare professional should ensure that the two

products were evaluated using the same test conditions and the same initial inoculum of bacteria.

Products within different classifications should not be compared directly. One product in a healthcare personnel handwash test should not be compared to another product's surgical scrub test. Two products using the same test protocol, but different inoculums of bacteria, should not be compared.

Handwashing Processes

According to APIC and CDC guidelines (APIC, 2002), the decision for handwashing to occur depends on:

- > The intensity of contact with patients or fomites
- > The degree of contamination that may occur with that contact
- > The susceptibility of patients to infection
- > The procedure to be performed

The practice of handwashing has been categorized into two general groups: routine handwashing and high-risk handwashing. These groups are discussed in more detail.

Routine Handwashing

Routine handwashing is the mechanical removal of soil and transient organisms from the surface of the hands. As previously mentioned, transient organisms are those that are recently acquired and survive only a limited amount of time. When handwashing is performed with plain soap and water, microorganisms are suspended with the soap and rinsed off under running water.

The protocol for routine handwashing includes:

1. Wet hands with warm water.
2. Dispense soap onto wet hands and work it into a lather.
3. Rub lather briskly over all surfaces of the hands for at least 10 seconds, paying special attention to the areas around the fingernails and between the fingers.
4. Rinse hands well under a stream of water.
5. Dry hands thoroughly with paper towel.
6. Turn off the faucet using a paper towel.

Routine handwashing is performed:

- > Before and after patient contact
- > Beginning and end of the work day
- > Before and after using gloves
- > Before eating, smoking, or handling medications
- > After using the toilet
- > After wiping the nose or touching the face
- > After touching contaminated surfaces

High-Risk Handwashing

According to APIC guidelines, there are two types of high-risk situations in which patients are considered compromised and a maximum reduction in bacterial counts on the healthcare provider's hands is thought to be desirable:

- > During the performance of invasive procedures, such as surgery or the placement and care of intravascular catheters, indwelling urinary catheters, or other such invasive devices
- > Before contact with patients who have immune defects resulting in alterations in cellular immunity;

those with burns, pressure ulcers and other wounds; and extremely elderly patients

Within these high-risk situations, high-risk handwashing is recommended. A subcategory of high-risk handwashing is known as "healthcare personnel handwash" and is recommended:

- > Before and after patient contact
- > After contact with a source of microorganisms (body fluid and substances, mucous membranes, nonintact skin and inanimate objects that are likely to be contaminated)
- > After removing gloves

The protocol for the subcategory of healthcare professional handwash is the same as for routine handwashing:

1. Wet hands with warm water.
2. Dispense soap onto wet hands and work it into a lather.
3. Rub lather briskly over all surfaces of the hands, paying special attention to the areas around the fingernails and between the fingers. (This step should last at least 10-15 seconds.)
4. Rinse hands completely.
5. Dry hands thoroughly with paper towel.
6. Turn off the faucet using a paper towel.

The other subcategory of high-risk handwashing is known as a surgical scrub that is designed to significantly reduce the number of microorganisms on intact skin. The purpose of a surgical handscrub is threefold:

- > To remove debris and transient flora from the nails, hands and forearms
- > To reduce the resident microbial count to a minimum
- > To inhibit rapid rebound growth of microorganisms

A surgical scrub is recommended:

- > Before the performance of invasive procedures, such as surgery or the placement of intravascular catheters, indwelling urinary catheters, or other invasive devices
- > When persistent antimicrobial activity on the hands is desired
- > When reducing the numbers of resident skin flora in addition to transient microorganisms

The protocol for performing a surgical handscrub should include the following steps:

1. Wash hands and forearms thoroughly.
2. Clean finger nails with a nail cleaner.
3. Rinse thoroughly.
4. Apply an antimicrobial agent to wet hands and forearms with friction (usually using a brush); maintain the friction for at least 120 seconds (two minutes). Some antimicrobial agents require a rinse and repeat application.
5. If an alcohol-based preparation is selected for use, wash hands and arms, clean fingernails thoroughly, dry completely and follow the manufacturer's recommendations for application. Generally, the application should take at least 20 seconds.

AORN has published recommended practices for surgical handscrubs that are intended as guidelines for a variety of different practice settings, such as surgery units, endoscopy suites, physician's offices, cardiac catheter labs and all other areas where operative procedures may be performed. These recommendations include: (AORN, 2002)

- > All personnel should be in surgical attire before beginning the surgical handscrub
- > An effective antimicrobial surgical handscrub agent approved by the facility's infection control committee should be used for all surgical handscrubs
- > The surgical handscrub procedure should be standardized for all personnel according to institutional policy and procedure
- > Policies and procedures for surgical handscrubs should be developed, reviewed periodically and be readily available in the practice setting

Skin Problems

Irritant dermatitis and skin dryness are detrimental effects that handwashing may have on the skin. Some of these effects occur regardless of the product used. Contrary to popular opinion, antimicrobial preparations do not necessarily cause greater damage to the skin than plain soap.

Irritant dermatitis is a non-allergic response from mechanical or thermal irritation. Usually, this type of dermatitis is localized to the area of contact and may present with redness, itching, dryness, or crusted lesions. There may be an immediate onset that worsens with continued contact. Glove powders can have an abrasive effect on the hands that may be complicated with frequent handwashing and strong surgical scrub agents, soaps, or detergents.

As glove use has increased in the healthcare industry, the frequency of irritation appears also to be rising. A number of additional factors for this trend should be considered. Many workers wear gloves for prolonged periods of time, which can lead to macerated skin as well as reactions to perspiration in those individuals who are allergic to their own perspiration. Failure to wash hands after glove removal allows continued exposure to whatever irritant is present.

Dry skin on the hands is also a common problem for healthcare professionals and is caused by many factors. In winter, extreme temperatures and low humidity can cause drying. Other factors contributing to dry skin include: the number of hand washes performed, the amount of product used, the degree of rinsing, the method of drying and skin integrity. Lotions are often recommended to ease the dryness resulting from frequent handwashing and more recently, to prevent dermatitis resulting from glove use.

Methods to help alleviate dryness and irritation that may be caused by frequent handwashing include:

- > Always wet the hands with tepid water (hot water can dry/irritate the skin) before applying a handwash product
- > Dispense the appropriate amount of handwash product, usually 1 cc per pair of hands
- > Rinse thoroughly to remove powder residue, irritants, soil and the handwash product
- > Rinse the hands and wrists well and also rinse between the fingers and under jewelry if it can not be removed
- > Dry hands thoroughly. White, individually dispensed paper towels are less irritating and more absorptive than the bulk brown pulp-paper rolls. Pat hands dry rather than rubbing them
- > Turn off the faucet with the paper towel and discard in the designated receptacle after washing and rinsing is complete
- > Apply lotion or hand cream and rub into all surfaces of wrists, hands and fingers. Use a compatible/recommended lotion that will not destroy the effectiveness of the handwash product

When hand soaps are used appropriately on healthy skin, minimal changes usually occur. When frequent handwashing is performed, skin can become dry and abraded through rigorous scrubbing. Soaps can also change the pH of the skin (making it more alkaline), causing an increase in the ability of chemicals and other allergens to penetrate into the epidermis, thus increasing damage to the skin. The overuse of harsh soaps can irritate and damage the epidermal layer, facilitate bacterial growth and increase the incidence of HAIs. These potential negative effects should not be used as an excuse to reduce or stop adequate handwashing.

Chemical allergies - Delayed or Type IV hypersensitivity

Chemicals used to manufacture gloves, particularly accelerators and antioxidants, can cause symptoms of an allergic response. This chemical allergy is also known as delayed or Type IV hypersensitivity. Skin symptoms are localized, but may spread. Redness, irritation, eczema, swelling, blistering and urticaria (hives) may present as signs and symptoms of this reaction. Even though the symptoms may be similar to irritant dermatitis, they usually appear much later, around 48-72 hours after contact with the allergen. Moreover, these delayed symptoms may not appear until six days after the contact. A significant discomfort is felt by the patient or healthcare worker with this type of sensitivity. The delayed skin reaction that appears after touching poison ivy is an example of a Type IV hypersensitivity reaction.

The specific allergen causing the reaction must be determined so that it can be removed or avoided. Allergy testing is available to assist with ascertaining the cause of the reaction. When an individual is sensitized to an allergen, clinical symptoms may appear after a few exposures, after repeated exposures, or the individual may never experience a reaction.

Latex allergies - Immediate or Type I hypersensitivity

A Type I reaction is the most severe and least common type of allergic response to latex products. A Type I reaction is a systemic allergic reaction (that is, a reaction that can affect more than one system in the body), but may also present with immediate skin changes only. Healthcare workers and patients can show symptoms of latex allergies shortly after contact.

With a latex allergy, there is an immediate onset of symptoms including: urticaria (hives), rhinitis (hay fever-type symptoms), asthma (resulting in difficulty breathing) and sometimes even anaphylaxis (characterized by contraction of the smooth muscles and dilation of the capillaries). Persons who are allergic to latex usually have allergies to other things such as food products. Latex allergy symptoms can range from mild to severe. A latex-sensitive person must avoid all contact with items containing latex as a mild reaction may develop into a severe reaction.

There are many different contributing factors that have increased the incidence of latex allergies today. These include:

- > An enormous increase in glove use
- > Increase in awareness and reporting
- > Changes in latex manufacturing techniques and latex agriculture (because of the increased latex needs, new rubber plants have been introduced through cloning to produce a maximum yield)

Latex allergies can be treated by detecting the symptoms early, decreasing exposure to latex and understanding the condition to prevent long-term health problems or acute episodes. The following steps can be used to protect against latex exposure in the workplace:

- > Nonlatex gloves should be used by persons allergic to latex (vinyl, nitrile, or neoprene)
- > Powder-free gloves are recommended
- > Oil-based creams or lotions are not recommended
- > Appropriate work practices should be implemented to reduce the chance of latex exposures and reactions
- > After removing latex gloves, wash hands with a mild soap, rinse well and dry thoroughly
- > Frequently clean areas and equipment that may be contaminated with latex-containing dust
- > Become familiar with the early signs and symptoms of latex allergy reactions
- > Create a latex-free cart in surgery that includes products not made with latex
- > Identify patients who are latex sensitive and do not use any latex products in their care
- > Identify healthcare workers who are latex sensitive and do not expose them to latex products
- > Schedule latex-sensitive patients as the first procedure of the day when the lowest aerosolized latex levels are present

Glossary

Antimicrobial

Antimicrobial refers to a substance that is destructive to some microorganisms. It is not specific in terms of its effectiveness on different types of organisms. There are no regulatory restrictions on this term; therefore, hand care products with drug preservatives could be considered "antimicrobial."

Antibacterial

Antibacterial is similar to antimicrobial, except that it is specific in referring to its destructive effects on bacteria. Like antimicrobial, there are no regulatory restrictions on the use of this term.

Antiseptic

An antiseptic is a chemical that destroys or inhibits the growth of disease-causing bacteria and other microorganisms. It is sufficiently nontoxic so it can be applied to the skin or mucous membranes to cleanse wounds or control infection.

Bactericidal

Bactericidal refers to a substance that kills bacteria. A handwashing product ordinarily would not be described as a bactericide because it doesn't kill 100% of the organisms. However, a handwashing product can be described as having bactericidal activity.

Bacteriostatic

Bacteriostatic refers to a product that inhibits the growth of bacteria, but does not necessarily kill them. This is of importance when one considers the tremendous rate at which bacteria can multiply. Often antimicrobial activities of some handwash products will leave enough of a residue behind to render the hands bacteriostatic. That is, the residual product will be sufficient to inhibit the growth of those organisms left on the hands.

Healthcare Personnel Handwash

This definition is given by the FDA as an antimicrobial high-risk handwash product containing a broad spectrum, fast acting, non-irritating handwashing agent designed for frequent use. A healthcare personnel handwash is designed primarily to reduce transient organisms. Acceptable support data includes both in vitro and in vivo tests.

In vitro

Testing done in a laboratory or in a test tube.

In vivo

Testing done on human hands or in real-life situations.

MDRO

Multiple drug-resistant organisms; these are organisms (like *Staphylococcus aureus*) that are resistant to one or more antibiotics (such as Methicillin-based drugs).

Persistence

Persistence refers to the prolonged activity of an antimicrobial agent after application. This persistence may be as bactericidal action or bacteriostatic action. A healthcare personnel handwash product may optionally show persistence. A surgical scrub must show persistence.

Surgical Scrub

The definition by the FDA is similar to that for healthcare personnel handwash except persistence data for up to six hours must be demonstrated. In addition, surgical scrubs are designed to remove and control resident skin organisms. The test procedure for evaluating surgical scrubs is the glove juice procedure. Other tests, both in vitro and in vivo, may be used to support activity against specific organisms.

References and Suggested Readings

APIC. (2002) "APIC Hand Hygiene Guidelines" Association for Professionals in Infection Control and Epidemiology, Washington, D.C.

AAMI. (1996), "Safe handling and biological decontamination of medical devices in health care facilities and in nonclinical settings." ANSI/AAMI ST35, Arlington, VA, Association for the Advancement of Medical Instrumentation.

Association of peri Operative Room Nurses. (2002) "Recommended Practices for Surgical Hand Scrubs." Denver, CO, AORN.

Boyce, JM, Pitter, D, and the HICPAC, SHEA, APIC, IDSA Hand Hygiene Task Force. Guideline for Hand Hygiene in Health-Care Settings. MMWR 2002; 51 (RR-16); 1-45.

Garner JS, Favero MS. (1986) "CDC Guideline for Hand Washing and Hospital Environmental Control." Infection Control, 7:231-5.

Lockhart RD, Hamilton GF, and Fyfe FW. (1965) Anatomy of the Human Body, 2nd edition, London, Faber and Faber.

Mosby. (1994) Mosby's Medical, Nursing, and Allied Health Dictionary, 4th edition. St. Louis, Mosby-Yearbook, Inc.

Rodgers PA, Sullivan KM, Hamann CP. (1998) "Skin care: Maintaining your best defense." Infection Control Today, June 1998, pp. 20-24.

Siegel JD, Rhinehart E, Jackson M, Chiarello L and the Healthcare Infection Control Practices Advisory Committee. "Management of multidrug-resistant organisms in healthcare settings, 2006." Available at: <http://www.cdc.gov/ncidod/dhqp/pdf/ar/mdroGuideline2006.pdf>. 2006.

Yoffe E. (1999) "Doctors are reminded, Wash Up!" The New York Times Science, November 9, 1999.

Review Questions

- The greatest obstacle in trying to reduce the spread of HAIs through handwashing is:
 - Too many products from which to choose
 - Compliance among healthcare workers
 - Skin irritation
 - Not enough handwashing sinks
- The specific organisms that a handwash product will kill and how quickly these organisms will be killed, is partly dependent on:
 - The chelating ability of the product
 - The antimicrobial or antiseptic ingredient in the product
 - How much product is used
 - The pH of the product
- The hospital Infection Control Practitioner will usually reference the handwashing guidelines published by:
 - FDA
 - APIC
 - AORN
 - OSHA
- The government agency that oversees efficacy testing for antimicrobial handwashing products is the:
 - CDC
 - OSHA
 - FDA
 - EPA
- Flora that is not normally present on the skin are called:
 - Resident
 - Commensal
 - Transient
 - Bacteria
- The active ingredient that provides a characteristic rapid reduction in microbial counts on the skin is:
 - CHG
 - Alcohol
 - PCMX
 - Triclosan
- In vivo testing is done:
 - In the laboratory
 - In a real-life use situation, such as on human hands
 - Only on animals
 - In a test tube
- A surgical scrub product is different from a routine handwash product in that it must go through tests to prove:
 - Persistence
 - Ease of rinsing
 - Irritation to skin
 - Lathering ability
- What reasons might a hospital have to convert from routine handwash products to high-risk handwash products throughout the hospital?
 - Sicker patients in the hospital
 - An increase in the number of patients afflicted with AIDS, TB, MRSA and VRE
 - An opportunity to streamline inventory
 - All of the above
- Latex allergies can cause not only a localized reaction, but a systemic reaction that may be life-threatening.
 - True
 - False

- | | | |
|-----|---|---|
| 1. | B | (Hand Washing and Surgical Scrubbing) |
| 2. | B | (Hand Washing and Surgical Scrubbing) |
| 3. | B | (Hand Wash Products) |
| 4. | C | (Levels of Hand Washing) |
| 5. | C | (Transient vs. Resident Organisms) |
| 6. | B | (Alcohol) |
| 7. | B | (Levels of Hand Washing) |
| 8. | A | (Levels of Hand Washing) |
| 9. | D | (High-Risk Hand Wash Products vs. Routine Hand Wash Products) |
| 10. | A | (Latex Allergies - Immediate or Type I Hypersensitivity) |

Answers to Review Questions & Section Sources:

Evaluation Form

Study Guide 7: Skin Care and Hand Washing: Revisiting the Basics

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To what extent did the study guide meet the 3 stated objectives below?

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| 2. Review the handwashing process, including handwashing product selection and the steps of appropriate handwashing. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. List skin problems and their characteristics. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 4. To what extent is this learning method easy-to-use? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
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