U S Chemical

Providing Exceptional Quality Since 1962

The Science of Handwashing

Table of Contents

INTRODUCTION

While commonly understood to be a critical part of controlling the spread of microorganisms and disease, handwashing is widely under-performed. Surveys repeatedly demonstrate that people have the information needed to understand when and how they should wash their hands. Actual compliance however, documented through surveillance studies, demonstrates that overall compliance is very low. This has led several experts to conclude that it is only a matter of time before major litigation occurs because of poor handwashing.

Healthcare specialists generally cite handwashing as the single best way to prevent the spread of disease. Skin is the first line of defense against microbial invasion of the body. The goal of effective handwashing is to remove transient microorganisms from the hands and thus prevent their transfer to susceptible patients. Antimicrobial hand soaps seek to both mechanically remove transient organisms and to reduce to acceptably low levels microorganisms left on the skin while providing a bacteriostatic chemical residual on the skin to control the future growth of microorganisms.

Wirthlin Worldwide conducted a national survey and found that 94% of respondents say they always wash their hands after using the bathroom, yet direct observation of people in major metropolitan areas during the study found that only 68% of adults did so. Women washed their hands more than men (74% versus 61%) did. Studies have indicated that up to 99% of all infectious diseases are spread by germs on our hands. Infectious diseases are the leading cause of death and disease worldwide.

In United States hospitals, transmission of germs from patient to patient via the hands of hospital personnel probably occurs thousands of times per day. Many, if not most, occurrences of transmission can be prevented by simply having the health care staff wash their hands more frequently. This brochure discusses the technical aspects of handwashing and proposes strategies to aid in compliance.

GLOSSARY OF TERMS

This section provides a quick reference of some of the medical terms used in this brochure. While efforts were made to explain terms as they appear, this list is a complete reference.

Antisepsis – Preventing infection by inhibiting the growth of pathogenic microorganisms.
Dermatitis – Inflammation of the skin often characterized by reddening, cracking or scaling of the skin.
Dermis – The inner layer of skin.
Desquamation – Shedding of skin scales.
Dorsum – The back of the hands.
Epidermis – The outer layer of skin, composed of 5 layers.
Flora – The population of bacteria inhabiting the internal and external surfaces of healthy people.
Fomites – Objects, such as clothing and surfaces, capable of harboring and transmitting pathogens.
Glove Juice – The fluid, usually bacteria laden, that accumulates in gloves from hand perspiration.
Gram Negative Bacteria – Bacteria that turn pink when stained using the Gram Method.
Gram Positive Bacteria – Bacteria that turn violet when stained using the Gram Method.
Immunocompromised – A person with a weakened or nonfunctioning immune system.
Interdigital Spaces – Webs between the fingers.
Keratinizing – The hardening of skin cells in the epidermis which makes them strong and rigid.
Lipids – Fat soluble liquids secreted by the sebaceous glands.
Mitosis – Cell reproduction and/or division.
MRSA – Methicillin resistant staphylococcus aureus, staphylococcus aureus that cannot be killed by methicillin.
Nail Fold – Skin around the fingernails.
Nosocomial – A background infection that a patient was not carrying at the time of hospitalization, such as becoming infected with MRSA while being treated for a broken leg.
Other Than Hand Operated – Any device capable of being operated by the knee, back of wrist, elbow, or other body part to prevent the potential for contamination the can occur through hand operation.
Pathogenic – Microorganisms capable of causing disease in humans.

Perforation – A puncture or tear in a glove.
Resident Bacteria – Those naturally occurring bacteria on the human body.
Sebaceous Glands – Glands within the dermis that usually open into hair follicles that secrete sebum and lipids to promote skin health.
Sebum – Oils secreted by the sebaceous glands.
Stratum Corneum – The outermost layer of the epidermis which is in direct contact with the environment.
Subungal – Underneath the fingernail.
Transient Bacteria – Those contaminating bacteria not normally found on the human body.
VISA – Vancomycin intermediate resistant staphylococcus aureus, staphylococcus aureus resistant to methicillin and vancomycin.
VRE – Vancomycin resistant enterococcus that cannot be killed by the antibiotic vancomycin.

HISTORY

In the 11th century Moses ben Miamonides, a Jewish physician, rabbi and philosopher, was the first to formally advocate handwashing. Yet even in the 16th century, handwashing was not routinely practiced, because the understanding of the disease process did not include the concept of germs. In the 16th century, Girolamo Fracastoro, an Italian physician, poet, astronomer and geologist, was the first to postulate that germs caused infections. It remained for the German pathologist, Friedrich Henle, in 1840, to postulate that living microorganisms cause disease before the concept started to gain acceptance.

In 1847, Dr. Ignaz Semmelweis, who worked in a hospital in Vienna, observed that his maternity patients died at such an alarming rate that they begged him to be allowed to go home. Most of the patients who died were being treated by student physicians. At the time, the importance of handwashing was unrecognized, so it was common for the students to perform autopsies early in the day and then spend the rest of the day treating patients. This was often done with no handwashing at all. Pathogenic bacteria from the cadavers were transmitted to the mothers via the students' hands. The result was a death rate of 22% for mothers who delivered their babies in the hospital, compared to a 3% mortality rate for mothers who delivered their babies at home. This observation was the beginning of the science of infection control. After instituting mandatory handwashing, which was considered "quaint" at the time, the death rates in Semmelweis's Vienna hospital fell from 18.8% to 1.2% in three months. Despite these results, it took 50 years for handwashing as a preventative measure to be widely accepted by the medical profession in hospitals and general patient care.

During the 1930s, skin antisepsis (preventing infection by inhibiting the growth of pathogenic microorganisms) was being defined by a host of investigators. Dr. Carl Walter, working at the Harvard Medical School, first demonstrated that bacteria lived in the deep layers of the skin and that these bacteria reached the skin surface as sweat and oils were secreted. Walter also demonstrated that 30% of surgical gloves (at the time) became perforated (punctured) during use, leading to experiments demonstrating the high levels of bacteria from the sweat inside a surgical glove (glove juice). He also showed that dermatitis or skin abrasions caused by excess scrubbing could not be made totally free of bacteria by any antiseptic agent.

Infection control reached prominence in the 1950s after epidemics of nosocomial (hospital acquired) staphyloccocal infections were documented in several US hospitals. The Communicable Diseases Center (CDC) (renamed the Centers for Disease Control and Prevention in 1970) in Atlanta sponsored a meeting in 1958 to address this issue. By 1960 the first textbook on nosocomial infections was published and the modern era of infection control was born. As hospitals started developing infection control programs (ICP), the first attempts were often poorly organized, underfunded and misunderstood. In some cases, ICP's were formed only to comply with the Joint Commission of Accreditation of Healthcare Organizations (JCAHO) standards.

In 1970, JCAHO formally required hospitals to have ongoing infection control programs for accreditation. During the 1970s and 1980's the Hospital Infection Program (HIP) of the CDC directed the course of surveillance and control programs. Over a ten-year period, from 1974 through 1983, the National Nosocomial Infections Surveillance system (NNIS) gathered data for the CDC on hospital nosocomial infections as part of the Study on the Efficacy of Nosocomial Infection Control (SENIC). SENIC demonstrated conclusively that hospitals with the lowest nosocomial infection rates had the strongest programs for surveillance, prevention and control of nosocomial infections.

In 1987, as a response to the growing prevalence of AIDS, the CDC introduced the concept of “Universal Precautions”. Universal Precautions were a formal set of procedures and practices that health care workers were required to follow to minimize their risk of exposure to bloodborne pathogens. The Hospital Infection Control Practices Advisory Committee (HICPAC) was established in 1991 to advise the CDC regarding infection control and the prevention of nosocomial infections. In 1996 the CDC and HICPAC issued a new guideline, which included recommendations on handwashing with a two-tier approach to precautions: standard precautions and transmission based precautions. Standard precautions combined the major features of Universal Precautions and body substance isolation policies by recommending handwashing before and after patient contact, the use of gloves, gowns and eye protection where exposure to body secretions is possible, and safe disposal of sharps and soiled linens. Transmission based precautions are more stringent and were recommended on a case by case basis for care of patients with a suspected or confirmed diagnosis of a specific transmissible infection. These precautions were divided into airborne, droplet and contact precautions.

Handwashing can be divided into three categories. When plain soaps or detergents are used, the soap emulsifies and suspends the soil and microorganisms allowing them to be rinsed away. This is often referred to as the mechanical removal of microorganisms. If handwashing employs the use of an antimicrobial soap to kill or inhibit the growth of microorganisms, this process is referred to as the chemical removal of microorganisms. A special subgroup of chemical removal is a surgical scrub, which is more rigorous and thorough than the standard chemical removal handwashing procedure. To understand the requirements of these different categories of handwashing, it is helpful to have an understanding of how the skin protects the body. Skin is the first line of defense against microbial invasion.

SCIENCE OF THE SKIN

People outside the medical community are often surprised that skin is considered an organ. In fact, skin is the largest organ of the body. It comprises between 16 and 18% of the body’s weight. The average person has 1.8 m^2 (about 2 square yards) of skin. Skin is composed of two primary layers. The outer primary layer of cells is called the epidermis. These cells are in various stages of keratinization (hardening). This outer layer of skin provides protection for the body from the environment. It is the epidermis that provides the body’s wall of protection from transient infectious organisms. The epidermis is composed of five layers. The outermost layer, called the stratum corneum, is the layer that is in constant contact with the environment. The stratum corneum and to a lesser extent the next layer, called the stratum lucidum, are thick, hard (keratinized) layers of dead cells that are constantly being shed. The other three layers of the epidermis (continuing in order) are the stratum granulosum, stratum spinosum and the stratum basale. These three layers are composed of primarily living cells, which are starting to die and keratinize.

The secondary inner layer of skin, called the dermis, is composed of connective tissues, blood and lymphatic vessels. The dermis is made of fibers that give the skin strength and also provides nutrients for the epidermis. The sweat glands, hair follicles and sebaceous glands pierce the epidermis and dermis connecting to vessels below the skin.

Skin cells in the bottom layers of the epidermis and throughout the dermis constantly undergo mitosis (cell reproduction), which produces the new cells to replace the stratum corneum (outer layer of skin) as it is shed. After mitosis, the skin cells migrate towards the surface and stop reproducing. They then lose their nuclei and cytoplasmic organelles (internal structures). Once this occurs, the cells start to harden (keratinize), which prepares them for their part in forming the hard stratum corneum.

Despite skin being uniformly spread over the body, the environment of the skin is composed of three very different environments. The “oily” area includes the head, trunk and upper back. The “wet” area includes the axilla (armpits), anterior nares (nostrils), groin and intertrigenous areas (between the buttocks and beneath female breasts). The “dry” areas include the hands and limbs. The skin cells of the stratum corneum are constantly being shed throughout the day and an adult sheds approximately 300 million skin cells each day. Approximately once every four days we lose the entire outer layer of skin cells in the stratum corneum. Usually these cells are shed at unequal rates, so the shedding is inconsistent.

A thin emulsion of lipids (fat soluble liquids) or sebum (oils) cover the entire surface of the skin. The sebaceous glands secrete the sebum/lipids, usually from within a hair follicle. Sebum is a complex mixture of chemicals and is composed of 57.5% triglycerides, 26% wax esters, 12% squalene (a hydrocarbon used in the production of cholesterol), 3% cholesterol esters and

1.5% cholesterol. It is produced at a rate of 0.48 mg per 10 cm^2 of skin each hour. Once produced in the sebaceous glands, sebum is secreted slowly over an eight day period. Sebum plays a role in keeping skin flexible, regulating moisture content of the skin and inhibiting the growth of pathogenic bacteria and fungi. Sweat emulsifies the sebum to aid in spreading it more readily over moist areas of the skin.

The concentration of sebaceous glands varies considerably over the body. The back of the hands (dorsum) contains less than 100 glands/cm^2, while the forehead has 400 to 900 glands/cm^2 and the palms of the hands have no sebaceous glands. Most fats on the palm and fingertips either are secreted in small concentrations with sweat, are transferred from oily parts of the body or from the application of creams and lotions. The palms of the hands sweat more responding to emotional stimuli rather than thermal stimuli. Unlike other areas of the body, the sweat glands on the palms and soles of the feet are continuously secreting.

The population of microorganisms inhabiting the internal and external surfaces of healthy people is called its “flora” and consists of several types of bacteria. The microbial flora of the skin consists of resident and transient bacteria. Resident bacteria survive, reproduce on the skin and can be repeatedly cultured, but generally do not cause disease in the host. Transient microbial flora are contaminants that can only live for a short period of time. Most resident microorganisms are only found in superficial skin layers, but about 10-20% inhabit the deep epidermal layers of the skin. Handwashing with plain soap is effective in removing many of the transient flora but may not remove the resident flora. Resident flora may not be removed by handwashing with plain soaps, but can usually be killed or inhibited by handwashing with products that contain antimicrobial chemicals. The complex structure of the stratum corneum prevents any chemical or antiseptic agent from sterilizing the skin, because the antiseptic simply cannot reach all of the bacteria.

There are five main types of microorganisms that can cause disease; although, we will primarily focus on just bacteria and viruses in this discussion. The first type bacteria, are single celled organisms with a double cell wall that protect the bacteria from the body’s defenses. Bacteria that turn violet when stained using the Gram stain method are “gram-positive”. Those that turn pink are “gram-negative”. The Gram stain method is used to aid in identifying bacteria. The staining process colorizes structures that would otherwise be invisible under the microscope. Bacteria can be further classified by their need for oxygen (aerobic or anaerobic) and their shape (cocci, spheres, rod-shaped and spiral shaped). Examples of strains of bacteria include staphylococcus, salmonella, streptococci and escherichia coli. Viruses (examples are Rhinoviruses, AIDS and poliovirus) are subcellular organisms with a protein coat. They are the smallest known organisms and are parasitic, meaning they cannot exist without a host. Fungi (an example is Candida albicans, which causes Athlete’s Foot) have rigid walls and nuclei. They occur as yeasts and molds and gain their nutrients from dead organic matter. Protozoa (examples are Giardia lamblia, Cryptosporidium and Toxoplasms gondii) are much larger than bacteria but are still single celled organisms. Their cells have membranes instead of walls. Parasites (examples are pinworms and tapeworms) are multicellular organisms that rely on a host to survive. They usually do not kill their hosts but take only the nutrients they need to survive.

Resident flora found in all skin areas include staphylococcus epidermidis and diphtheroids (bacteria resembling corynebacterium diphtheriae). Anaerobic diphtheroids, such as proprionobacterium acnes are mainly found in oily areas of the body such as the face which produce large amounts of sebum. In most areas of the body, gram-positive bacteria are much more common than gram-negative bacteria; although, in moist areas, such as the armpits (axilla) and groin, acinetobacter, which is gram-negative, may be part of the resident flora. The hair, face, groin and axilla (armpits) have the highest populations of resident flora. The arms and hands generally have far fewer resident bacteria than the moist areas. On hands, the highest numbers of bacteria are found near and under the fingernails. On average, the skin has more than 10,000 microorganisms per cm^2. Scrapings from the mouth show millions of organisms per mg of tissue.

While the skin flora varies between people, it is very consistent for an individual, even in the absence of bathing. There are approximately 15 layers of skin cells in the stratum corneum, with a new layer of cells being formed every day. The entire stratum corneum layer of skin is replaced about every two weeks but is shed at uneven rates, so some areas of skin are replaced more frequently. Of the 300 million skin cells shed each day, approximately 1 million cells are shed which contain viable resident bacteria.

While the typical resident skin flora does not cause infections (except for skin infections) these resident organisms can cause infections when allowed to enter deep tissues, such as through surgery or other invasive procedures. One patient's resident flora can be pathogenic (disease causing) to another patient or health care personnel.

The transient flora on the hands of health care personnel frequently are pathogenic (disease causing) and may cause nosocomial infections. Whether handwashing is required typically depends on the type, intensity, duration and sequence of activity. Generally most health care facilities do not require their employees to wash their hands before and after brief superficial contact with a source not suspected of being contaminated, such as taking a patient's blood pressure reading or pulse rate, despite the 1996 CDC recommendations. Any prolonged intense patient contact should always be preceded and followed with handwashing. Whenever there is a question, always wash the hands.

Moisture is essential for maintaining the flexibility and strength of the skin. Water is the plasticizer that holds the lipids and keratin together. 10% to 20% water is needed for healthy skin. The sweat glands and the keratinization process maintain this concentration. The amino acids and other materials produced during keratinization also help maintain the acidic pH of the skin. The availability of moisture is the most important factor in determining skin flora. Cornyebacterium and propionibacterium (typical resident bacteria) compose about 60% of the resident microorganisms on the skin. Some coryneforms grow better in the presence of more lipids, some grow better in less, but most strains of resident bacteria grow better in the moist regions of the body than in the dry regions. The majority of the hand flora resides under the fingernails or in the nail folds (skin surrounding the fingernails).

There is a tendency for hospital patients to acquire a skin flora that is different from that of the general population because of the variety of strains of bacteria found in a hospital. These bacteria may also be more antibiotic resistant than those of healthy adults in the general population. Gross et. al. (1979) demonstrated that contaminants, especially gram-negative bacteria such as staphylococcus, may be carried for weeks or months by hospital staff. Wearing rings increases the carriage rate for bacteria as they can be trapped under the rings and protected from removal during handwashing.

HANDS

The bacterial flora of the hands is similar to other skin sites. Coryneform and coagulase-negative staphylococci are the most common. Some bacteria, such as staphylococcus epidermidis, produce a chemical that kills other bacteria. This is part of the body's defense system to control the growth of transient microorganisms. The hands are unique in that the various parts of the hand, the interdigital spaces (webs between fingers), nail folds (skin around the fingernail) and palms can each support different types of bacteria due to the differences in the environment in these places. They are constantly coming in contact with environmental surfaces. The hands can carry many different types and populations of transient and potentially pathogenic microorganisms. Gram-negative bacteria, while only comprising about 10% of the total bacteria population on the skin, often reside and proliferate at high numbers on the hands of health care workers. Due to regular handwashing and the application of creams and lotions, the flora on the hands frequently changes. The bacteria population on other parts of the body remains fairly constant. In one experiment, subjects refrained from bathing for five to seven days. The bacteria populations on the backs and shoulders increased just slightly. This was not true of the hands. Bacterial density on the hands was shown to be directly related to the frequency of handwashing; although, there is a minimum number that can be achieved. With very high levels of handwashing, some bacterial levels, such as staphylococcus aureus, actually increase. This is probably due to the removal of the lipid/sebum layer during washing, which helps control the environment of the skin for the resident microorganisms. Anything that interferes with the body's ability to regulate the resident flora can inadvertently allow pathogenic bacteria to thrive. This is not to suggest that handwashing is in any way contraindicated however.

Handwashing removes skin lipids and sebum and decreases both acidity and the moisture content of the hands. Various experiments have demonstrated that handwashing for 30 seconds or more with ordinary soap increased the skin pH by 0.6 to 1.8 units, with the pH increasing as high as 8. A change in pH of the skin may make it harder for resident bacteria to survive but may make it easier for transient bacteria to thrive. The skin took between 25 minutes to three hours to return to the normal pH of 5 to 6.

The dorsum (backs) of the hands will replace the lipids removed during handwashing at a rate of 20% after one hour and 50% after three hours. Other lab experiments confirm that after thoroughly removing all of the sebum from the hands it takes the body three hours to replace 50% of the sebum on the hands. The sebum helps control the pH and moisture of the hands, which controls the population of resident organisms. Removal of all of the sebum makes it easier for transient microorganisms to thrive on the hands. Naturally occurring fatty acids in the stratum corneum have fungicidal and bactericidal activity, which is critical in regulating the skin flora.

During handwashing, friction is applied to the skin of the hands to remove the lipids/sebum, soils and microorganisms present. This is accomplished in the presence of water and soap. Handwashing also removes the first several cell layers of the stratum corneum and usually lowers the number of bacteria on the skin surface, but does not remove all of the bacteria from the hands. During subsequent handwashing, which removes more skin cells and bacteria, the bacteria numbers remain the same. This again indicates that bacteria is located in the deeper skin layers, hair follicles and sebaceous glands.

Handwashing with plain soap can physically remove a certain level of microorganisms, but soap with an antimicrobial agent is needed to kill or inhibit microorganisms and reduce the numbers of bacteria further. If the soap is antimicrobial, it will kill microorganisms not removed by the mechanical washing process. It could potentially leave a residual effect on the hands to prevent later bacterial growth by binding to the stratum corneum, resulting in a persistent activity on the skin, which keeps the numbers of bacteria low up to several hours.

In the presence of a heavy contamination of transient microorganisms, handwashing with plain soap may fail to remove all of the transient organisms. Hands that have been heavily contaminated need to be washed with an antiseptic soap. In one study, frequent washing with an antimicrobial soap increased the number of organisms being spread on nurses' hands. This was attributed to an overall decline in skin health rather than any failure of the antimicrobial soap or the washing process.

Lilly and Lowbury (1978) demonstrated that soap and water did not effectively reduce counts of artificially applied bacteria when the microorganisms were rubbed into the hands. Using an antimicrobial alcohol gel hand rub, however, did kill the organisms. Lilly et al. (1979) also concluded that even when an antimicrobial is used, there is a maximum reduction in the bacterial population, which is less than 100%, that can be achieved.

Frequent handwashing with plain soap can damage the skin that can result in an increase in shedding of more resident organisms into the environment. Overall skin health is at least as important as using an antimicrobial soap in controlling microorganism populations. Studies of showering and bathing demonstrated that these activities also resulted in an increase in the number of bacteria being shed into the air. This seems to be caused by breaking up the skin surface and bacteria then contaminating surrounding surface skin cells which are shed following showering and bathing.

While drying the skin is a necessary mechanism to promote the "self-sterilization" of the skin, (fewer bacteria will be found on dry skin than wet skin) dryness is partially a result of the loss of lipids, which causes a loss of water in the skin. Drying of the stratum corneum (outer layer of skin) below a 10% water content causes cracks in the skin, destroying the integrity of the skin. In performing a handwashing experiment, Doctors Meers and Yeo found a 17 fold increase in the number of particles carrying viable bacteria released from the skin after handwashing with bar soap. This shedding of bacteria was notably decreased after using an antibacterial soap instead of the bar soap. The scrubbed hands appear to react to the removal of bacteria during handwashing by replacing them and quickly increasing the population of resident bacteria on the surface of the skin.

Lilly and Lowbury showed that rubbing hands with an alcohol gel sanitizer reduced bacterial counts by 99.7%. However, if the clean hands were subsequently washed with plain soap, there was a sharp increase in bacterial counts which was contributed to increased shedding of viable resident bacteria with the additional trauma to the stratum corneum epidermis (outer layers of skin). This finding contributed to the discovery that there is an irreducible minimum in bacterial counts of the hands that can be achieved. It has been known for years that prolonged handwashing with plain soap can increase bacterial counts. But unlike soaps, antiseptics bind to the stratum corneum epidermis, causing a lasting chemical activity on the skin, even when gloved. These studies demonstrate that handwashing programs in which employees alternate between the use of plain soaps and antiseptics will result in widely fluctuating bacterial counts on the employees' hands. Handwashing without using an antiseptic/antibacterial soap removes transient bacteria but also aids the body in replenishing the resident bacteria on the skin. Handwashing with an antiseptic/antibacterial hand soap kills or removes both resident and transient bacteria and suppresses the natural regeneration of resident bacteria because of the residual effect left on hands, making it easier for transient bacteria to flourish. Even for health care workers, routine handwashing with antimicrobial soaps may not be desirable, since repeated washings will suppress their population of normal flora on the hands, thus making it easier for transient flora to flourish.

Plain soaps are adequate for routine handwashing, but bar soap should not be used. Gram-negative bacteria have been isolated from the sludge in bar soap dishes. While there is some evidence that this does not result in the transmission of microorganisms, it is far from conclusive and thus as a sensible precaution should be avoided.

DERMATITIS OF THE HANDS

Hand soaps and cleaning detergents rank second behind solvents in causing occupationally acquired dermatitis. Dermatitis is inflammation of the skin often characterized by reddening, cracking or scaling of the skin. Klauder attributed almost 25% of occupational dermatitis in a 20 year study to hand soap and cleaning detergents. Soaps and detergents solubilize keratin and skin lipids, removing lipids and soil from the hands and changing the skin pH from acidic to alkaline. If the soap has abrasive agents, such as is found in mechanics hand soaps, it not only removes soils but also strips away the superficial layers of stratum corneum to which the soils have adhered. Dermatitis is caused by the removal of lipids from the skin (delipidization) and destruction of skin tissue cell walls.

When it occurs, dermatitis is almost always caused by direct skin irritation, known as contact dermatitis, rather than a chemical allergy. Allergic contact dermatitis from hand soap and cleaning detergents is relatively rare. Trace chemicals present in the detergent base or the perfumes used in the hand soaps are often the cause of allergic dermatitis. True contact allergy caused by the cleaning detergent base or hand soap almost never occurs. Mechanical friction, cutaneous trauma and the temperature of the wash solution all influence how irritating a cleaning detergent or hand soap is to the hands. Even if a cleaning detergent or hand soap does not cause inflammation following a single or a few exposures, repetitive low concentration exposures to the cleaning detergent or hand soap can cause increasing amounts of inflammation. Excessively high concentrations of some cleaning detergents can cause inflammation, even with just one exposure. A “typical” person washing their hands three to four times per day seldom develops contact dermatitis. Workers washing their hands frequently, 10 to 20 times per day, may develop dermatitis through skin irritation. Once skin has become inflamed, it is even more susceptible to additional irritation. Irritant skin reactions can take up to 17 days before the skin is completely repaired. With a high frequency (>25 times/day) of handwashing, an increase in bacterial counts on the hands of health care workers is likely to occur, due to dermatitic inflammation.

Repeated or excessive handwashing may cause excessive dryness, cracking and dermatitis. Bacterial counts on dermatitic skin cannot be reduced appreciably even with antiseptic hand soaps, because the bacteria get into the crevices of the skin and cannot be killed. Effective handwashing programs strive to prevent this condition, as will be discussed later. Accumulated surveys report that irritant contact dermatitis caused by frequent handwashing occurs in between 10% and 45% of all health care workers. Damaged skin often harbors increased numbers of potential pathogens. As the hands become irritated, the skin develops cracks or fissures which allows microorganisms to penetrate the skin’s barrier and reproduce in larger numbers in these reservoirs. Washing damaged skin with either a plain or antiseptic soap is less effective in reducing the number of bacteria present than on healthy skin. The damaged skin no longer provides the protective barrier needed to control the growth of microorganisms and the soap cannot penetrate into all of the reservoirs to remove or kill the bacteria.

Personnel with dermatitis, which may be caused by frequent handwashing, may be a greater risk to patients than other personnel. Colonization by pathogenic organisms on dermatitic skin is common and handwashing will not appreciably reduce the bacteria counts. Efforts should be made to control dermatitis through the use of creams and lotions. However, if the creams and lotions are contaminated, they can also be the source of nosocomial outbreaks as has happened several times. Food service workers should not use creams and lotions during their shifts to avoid the potential for contamination of food with the cream or lotion.

If the dispenser of the cream or lotion is not equipped with a positive break, such as the Personal Hygiene System, the creams and lotions should only be applied while at home or during other nonworking hours. A positive break is a method of dispensing hand care products that prevents the accidental contamination of the dispenser, which in turn could contaminate the product reservoir, by means of a gap through which discharged product falls before touching the employee's hands. Instances of product contamination have occurred which resulted in employees washing their hands and becoming contaminated with high levels of bacteria.

NOSOCOMIAL INFECTION AND HANDWASHING RATES

In acute care hospitals, approximately two million nosocomial (hospital acquired) infections are reported annually in the United States. Approximately one-third of the nosocomial infections that occur could be prevented by having a surveillance and control program which includes effective handwashing. Nosocomial infections generate costs in excess of $4.5 billion each year. In this era of managed costs, infection control programs often are underfunded, despite the fact that infection control programs have been demonstrated to be cost effective and to reduce overall costs. Intensive Care Unit (ICU) patients are as much as five to ten times more at risk than patients in general medical wards. The CDC estimates that nosocomial infections are the 11th leading cause of death in the United States, directly causing 30,000 deaths each year and contributing to another 70,000 deaths.

Nosocomial infections are hospital-acquired infections, which prolong hospital stays, injure patients and consume hospital resources. Despite copious amount of evidence of its importance, studies routinely confirm that healthcare workers often fail to wash their hands as would be appropriate based on their duties. Bartzokas, et. al., observed senior doctors, who washed their hands only twice during 21 hours of ward rounds despite frequent patient contacts. Doctors surveyed to estimate their own handwashing rate perceived that they washed their hands 73% of the time, indicating that self-reporting dramatically over-estimates compliance. Pritchard and Raper reported their astonishment that "doctors can be so extraordinarily self-delusional about their behavior". Among other reported observations, Larson and Larson reported that junior doctors washed their hands more often when consultants set an example, but their compliance was still less than 50%. Junior staff members handwashing rates dropped when more senior ward staff did not, despite the junior staff members having been taught to do so. Several other studies show that most (95%) physicians and (90%) nurses believe that they wash their hands correctly. Broughall et al. (1984) observed that nurses typically wash their hands between five and ten times per shift but claimed to do so more frequently when asked to rate their handwashing frequency.

The bacteria most responsible for nosocomial infections are gram-negative rod bacteria and certain strains of gram-positive bacteria, such as Staphylococcus aureus. Gram-negative bacteria are of concern to infection control personnel because they have the tendency to develop resistance to antibiotics. Gram-negative rods generally die upon drying and can be controlled by a clean dry environment, but Staphylococcus aureus resists drying and can survive for hours on a dry surface, which is certainly easier to clean and disinfect than hands. Studies of both surgical and medical wards showed that handwashing technique is inadequate and often not carried out at all after some nursing procedures. Larson (1985) reported that organisms, such as Klebsiella, commonly found in respiratory, intestinal and urogenital (genitourinary, or urinary and reproductive) tracts of people can survive for 20 to 150 minutes on the hands or other environmental surfaces making transmission possible. Since Klebsiella can survive for up to 150 minutes on nurses' hands, handwashing is critical in its control even when performing routine duties. Pathogenic bacteria can be found on a variety of common equipment in a hospital, even without visible contamination. It is readily apparent that the bacteria live long enough for cross-contamination to occur.

In one study, Fox and colleagues demonstrated that over a 90 hour period, only 7% of nurses washed their hands after potentially contaminating activities. Using a similar study, Taylor found a compliance rate of 52.2% after performing contaminating activities. He concluded that the nurses believed if their hands were not visibly contaminated or dirty, then no infection can occur. Other studies clearly refute this erroneous belief. Casewell and Phillips demonstrated that minimal contact with patients colonized with Klebsiella resulted in between 100 and 1000 colonies transferred to the nurses hands after touching the patient's hand, taking an oral temperature, taking a blood pressure or pulse or lifting the patient. Typically these activities would be considered "clean" under the CDC guidelines and would not be followed by a handwashing requirement. It is virtually impossible for health care workers to know with any degree of certainty whether heavy contamination of the hands has occurred or whether subsequent contact with environmental surfaces is likely to result in the transmission of microorganisms. Esherichia coli, Pseudomonas, Serratia, Staphylococcus aureus and enterococci are frequently found on health care workers hands following "clean" activities, such as making beds, handling clothing, touching furniture and touching curtains.

Although health care staff can easily identify practices or procedures and patients with the highest risk of infection, they cannot always know when they have become contaminated by pathogenic organisms. Personnel may expect to have only minimal contact with a patient, but unforeseen complications may require additional extensive contact, running the risk of passing transient organisms from their hands to the patient. Therefore, handwashing should be observed before and after all patient contacts. Casewell and Phillips (1977) demonstrated that such "clean" activities as pulse taking can result in the transfer of 1,000 CFU's (colony forming units) to nurses' hands. This would likely be an infective dose for many patients, especially anyone immunocompromised.

In a typical British hospital, about 9% of the patients will have a nosocomial infection at any given time. These infections are typically 23% urinary tract, 22% lower respiratory tract, 10% surgical wound, 9% skin infections and 36% other. Other studies in the United States put the percentages at 40% urinary, 20% surgical wounds, 15% lower respiratory, 5% bacteremia (infection of the bloodstream) and 20% other. Fomites, which are objects capable of harboring disease and transmitting germs, can be just about any environmental surface. Medical equipment, shaving brushes and holy water have all been implicated as a common source of nosocomial infection. Methicillin Resistant Staphylococcus Aureus (MRSA, which causes many nosocomial infections and is difficult to treat with antibiotics) from infected patients may be readily detected on the hands of nurses for a considerable time following contact. MRSA has been isolated from the remotes of television sets, paper towel holders, cushions, computer keyboards, and even consultants' pens. MRSA can also be transmitted on doctors' stethoscopes, clothing and hands. Many strains of staphylococcus can withstand desiccation (drying) and are commonly found in dust, surviving for up to 175 days under desiccating conditions. In some cases health care personnel become persistent carriers of bacteria, such as MRSA, and become re-exposed to MRSA by contact with their contaminated home furniture.

Organizations that monitor nosocomial infections in the United States and who actively collect data include the American Hospital Association (AHA), the American Society for Microbiology (ASM), the Association for Practitioners in Infection Control (APIC), the Joint Commission on Accreditation of Healthcare Organizations (JCAHO), the Society of Hospital Epidemiologists of America (SHEA), the Surgical Infection Society and the Centers for Disease Control and Prevention (CDC).

Tests have shown that healthcare workers who wore rings had a higher bacterial count on their hands than those who did not, both prior to and after washing hands. The wearing of rings should be limited to wedding bands if allowed at all. Although plain wedding bands can still harbor high numbers of organisms, they can easily be manipulated during handwashing, to allow for the removal of organisms, whereas rings with stones or edges can harbor microorganisms that will not be removed by handwashing.

Bacteria that can form a hard protective coating are called spore formers. When these bacteria form the hard protective coating, they are said to be in a spore form, which is a form of protected hibernation and are very difficult to kill. Hospital grade disinfectants, such as the ones used for mopping floors, do not kill spores. Spores will survive for months if left undisturbed. In one study, a spore forming bacteria was able to survive for 157 days on a piece of glass. Air currents, even thermal currents from radiators, can be enough to spread spores. Vacuuming up dust from floors is probably the best and simplest method of removing spores from the environment. In some facilities, clean linens are placed on the floor during the bed making process, thus contaminating the linens. In general, antimicrobial hand soaps are ineffective in killing spores; although, the mechanical action of proper handwashing may remove them.

Viruses can also be easily spread in a hospital. Even a patient vomiting in a room may be enough to transmit infection to an entire ward, because the aerosol/droplets from the vomit can spread the virus into the air, where it can travel large distances and eventually fall onto environmental surfaces in other areas. Some viruses can remain active/viable for many hours, which is long enough for them to be spread and infect other patients.

THE CHAIN OF INFECTION

Infections, especially nosocomial infections, are transferred through a "chain of infection". This process follows the infecting organism from site to site as it is transferred to the patient who ultimately becomes infected. The start of the chain may be a patient who is infected with an organism. The patient may or may not have developed a disease from carrying the organism. Through some mechanism, including coughing, sneezing, touching a surface, etc, the organism is transferred to an environmental surface, either directly or by first contacting the patient's hair, hands or skin. Nurses or other staff then pick up the organism from the patient or the environmental surface that has been contaminated and transport the organism to another patient on their hands or arms. The nurse or staff may directly contaminate the receiving patient or may contaminate a surface in the receiving patient's environment, which in turn, infects the receiving patient. Ultimately, the receiving patient becomes infected with the organism despite no direct contact with the primary patient.

The chain of infection has six vital links (adapted from Springhouse, 1998).

A. Causative Agent – any microorganism capable of causing disease.
B. Infectious Reservoir – the environment in which the microorganisms can survive, such as environmental surfaces, people and animals.
C. Portal of Exit from the Reservoir – Can include body fluids and secretions. This is how the microbe leaves its reservoir.
D. Mode of Transmission – Includes contact (direct and indirect), airborne (microbes suspended in the air), vehicle (water, blood, and food, among many) and vector-borne (fleas and mosquitoes among others).
E. Portal of Entry into the Host – Path by which microbes invade a susceptible host.
F. Susceptible Host – Human body.

Eliminating any one link breaks the chain and stops the spread of infection. The easiest way to stop infection is by controlling the mode of transmission, which is usually the weakest link in the chain. This is where handwashing can play its critical role.

HANDWASHING COMPLIANCE

The key to increasing handwashing compliance among health care workers appears to be attitude. As long as handwashing is perceived to be damaging to the hands and statistics of nosocomial infections are not widely distributed to the employees, compliance will be poor even when expensive in-service training is run. As an example, hard paper towels, not designed for frequent (20+ times daily) hand drying, may lead to skin irritation and chapped hands. This leads to a reduction in handwashing frequency. Williams and Buckles concluded that lack of motivation, not lack of knowledge is the biggest factor in low compliance rates. They found that although the knowledge level was increased through training, the initial enthusiasm for the program faded within six months. Antiseptic/antimicrobial soaps are generally harsher on the hands than plain soaps. Norton recommended both educating patients on the importance of handwashing and encouraging patients to confront health care personnel about any lack of handwashing that they witness. Wenzel and Pfaller (1991) demonstrated that this resulted in higher compliance rates as it became impossible for a health care worker in good conscience to refuse a request from a patient that they wash their hands.

In some hospitals nurses are prevented from performing the basics of infection control due to a lack of resources, such as soap and paper towels. Larson and Killen demonstrated that handwashing declined when resources were unavailable or disliked. While an alcohol rub, usually found in gel form, is not always effective in the presence of organic matter, it is generally acceptable to offer alcohol rubs in areas where handwashing sinks are not available. The two factors most influencing handwashing compliance are how harsh the handwashing is on the hands, such as from soaps that dry the skin, and whether their peers frequently wash their hands. Part of a handwashing compliance program should be monitoring the acceptance of the protocol by the staff and the hand trauma the staff incurs.

Larson compiled handwashing compliance rates and found that they vary widely from 17% to 75% with physicians being some of the worst offenders. Even in periods where control measures should be at their maximum because of MRSA or VRE outbreaks, compliance for handwashing and barrier protocols varied from 28% to 79%. The spread of MRSA and VRE must be blamed, at least in part, on the failure of medical professionals to wash their hands properly. This can be due to low frequency, duration or poor technique of handwashing. Even when handwashing is performed, it is often done poorly. Taylor (1978) concluded that as much as 89% of the hand surface was often missed. The areas most frequently missed were the fingertips, webs between the fingers, palms and the thumbs. Proper handwashing technique will be discussed later in this brochure.

GLOVES

Gloves are often used both in health care and in food preparation. They are designed to protect the hands of the employee and prevent the employee from either becoming sick or spreading germs they may be carrying to other people or surfaces. However, even if gloves are worn, this does not eliminate risks. Gloves can become perforated or tear during use, which can contaminate the employee or the surfaces the employee touches. While wearing gloves, bacteria can multiply rapidly on hands. Whitehorse (1998) concluded that the dirtiest your hands ever are is when you take off a pair of gloves. Additionally, Doebbeling showed that hands are routinely contaminated during glove removal. Rather than being less important because of wearing gloves, handwashing after removing gloves is more important.

Because the hands naturally perspire inside gloves, the skin is moist. This causes a softening of the stratum corneum, allowing resident organisms to exude (slowly come to the surface) and rapidly multiply. Studies of the fluid inside gloves, called glove juice, have confirmed that bacteria multiply rapidly inside gloves. If the hands have dermatitis, they will tend to be much more heavily colonized. Several studies have reported glove puncture or tear rates happen between 5% and 60% during surgical operations. When gloves tear during a procedure, any “glove juice”accumulated in the glove can leak into the patient. Cruse and Foord reported that the clean wound infection rate was three times higher when a glove tear occurred during an operation than when a glove tear did not occur. This makes it necessary to use an antibacterial soap that leaves a strong residual activity on the skin when performing a surgical scrub.

Gloves should not be used to replace handwashing. They are an adjunct to handwashing to further protect the glove wearer. Gloves should be used for potentially hand contaminating activities and should be removed and hands washed after the activity is complete. They should be discarded after the activity, between patients, when glove integrity is in doubt, when moving from one procedure to another on the same patient or in many phases of food preparation. Disposable gloves should not be washed and reused, they should be used once and discarded. OSHA, through its Bloodborne Pathogen Standard, prohibits the reuse of disposable gloves. Studies have shown that despite friction during washing, a cleansing agent and drying, not all of the organisms are removed from a glove and the integrity of the glove is decreased. Adams et all. (1992) demonstrated that disposable (single use) gloves cannot be disinfected between patients and that the glove punctures climbed alarmingly upon repeat usage.

Gloves can be made from a variety of natural and synthetic materials. Natural latex is the most common in health care, but gloves made from other materials are also used. People who wear latex gloves for extended period of time can develop an allergy to the latex. This has accelerated the search for synthetic materials suitable for glove construction. Synthetic rubber materials include butyl rubber, chloroprene, fluoro rubber, nitrile rubber, styrene-butadiene and styrene-ethylene-butadiene. Plastic polymeric materials include ethylene-methyl acrylate (EMA), polyethylene, polythene, polyvinyl chloride (PVC) and PE/EVAL/PE laminates. Gloves are classified either as protective or medical use, but some can be used for both purposes. The labeling on the gloves indicates the acceptable uses. One common problem with using gloves is that cheaper gloves are sometimes substituted for more expensive gloves. If the cheaper gloves are not approved for the intended application, this can lead to safety and cross-contamination issues. Klein et all. (1990) reported that polyethylene (PE) and polyvinyl chloride (PVC) gloves were ineffective barriers to viruses of the same size as the hepatitis B virus in 40% of the cases.

Handwashing after glove use is critical because neither vinyl (PVC) nor latex gloves are completely impermeable. Olson, et al (1993), tested vinyl and latex nonsterile examination gloves in a nursing home setting and found that in procedures where gram-negative bacteria and enterococci were present, 13% of the time the gloves allowed microorganisms to contaminate the health care workers hands. This occurred with 24% of the vinyl gloves and 2% of the latex gloves. Vinyl gloves were five times more likely to leak, especially near the thumb and index finger, than were latex gloves. In another study, Wright, et al, (1993) reported glove tears in 11% of the cases. In other studies, glove leakage occurred between 4% to 63% of vinyl gloves and 3% to 52% of latex gloves. Olson (1993) also concluded that the workers were generally not aware that their gloves had leaked. Because of the high potential for glove leakage, not changing gloves when moving from patient to patient can be just as bad as the failure to wash hands when not wearing gloves. They further found that only 16% of the time did the workers change their gloves when needed. Double gloving was shown to have little additional benefit for latex gloves. Gloves frequently become damaged during surgical procedures. This combination increases the risk of surgical wound infection. A residual activity on the skin, such as is provided by chlorhexidine (CHG, discussed later), can decrease this risk since the alternative, rewashing hands, is not practical in long surgical procedures. Lowenfels, et al. (1989), surveyed 301 surgeons. 86% reported a glove puncture at some time in the previous year.

ANTIBIOTIC RESISTANT BACTERIA

Antibiotic resistant bacteria are bacteria that have developed a resistance to the standard antibiotics used to treat them. Methicillin resistant staphylococcus aureus (MRSA) and VRE are the most common ARI's. The resistance of certain strains of bacteria has paralleled the rise in use of antibiotics. Where antibiotic usage is high, resistant strains of bacteria are very common. Hospital patients infected with resistant strains of bacteria are more likely to have received or be receiving antibiotics while in the hospital when they become infected. The use of antibiotics increases the risk of infection with antibiotic resistant bacteria. Departments in a hospital that have the highest rate of use of antibiotics also have the highest prevalence of antibiotic resistant bacteria. The longer a patient is exposed to antibiotics, such as in a prolonged hospital stay, the greater is the patient's likelihood of colonization with antibiotic resistant bacteria.

There has been some confusion over whether bacteria can develop resistance to an antiseptic/antimicrobial hand soap. Several studies have demonstrated that over multiple months, bacteria did not develop a resistance to an antiseptic hand soap. Antiseptics rely on multiple, nonspecific modes of action to destroy the bacteria, usually involving destruction of the bacterial cell wall. Thus, bacteria are not likely to develop a resistance to them any more than a person could become resistant to injury by being shot with a gun. In contrast, antibiotics work by a "lock and key" approach where the antibiotic inactivates a portion of the bacteria, such as through gene manipulation, either rendering it sterile or interrupting other intracellular functions. Bacteria can develop a resistance to this type of gene manipulation, rendering the antibiotic useless against the bacteria.

Vancomycin resistant enterococci (VRE) is comprised largely of Enterococcus faecium and Enterococcus faecalis, which belong to the group known as D streptococci. Resistant strains first started appearing in the late 1960's. Between 1992 and 1995, the data shows an increase in nosocomial infections from 11 to 29 infections per 100,000 admissions. Resistance does not arise through genetic mutation, as previously thought, but through the use of antibiotics. VRE strains are generally resistant to the top three antibiotics used to treat them – gentamicin, ampicillin and vancomycin. Because the primary mode of transmission is via the hands of health care workers, proper handwashing is the key to prevention and control of VRE. VRE is a highly resistant microorganism, not easily killed by drying. It can survive for 60 minutes on a gloved or ungloved hand. Control measures for VRE are also cost effective.

When bacteria lands on environmental surfaces in a health care facility, disinfectants are needed to kill them. Standard hospital grade disinfectants require a ten-minute contact time to be effective in killing organisms. VRE can be killed on an environmental surface by disinfectants as long as the surface remains wet for 10 minutes. Byers et al found that 16% of environmental surfaces (60 of 376) were positive for VRE after spraying the surfaces with a quaternary disinfectant and quickly wiping the surfaces. This procedure does not allow the thorough wetting or contact time necessary to kill microorganisms. Repeating this procedure only slightly increased the kill rates. Only after thoroughly wetting the surfaces for ten minutes did the cultures all become negative.

Note: The proper use of chemical agents on hard surfaces is regulated by the Environmental Protection Agency (EPA). When using chemical disinfectants to kill germs, such as VRE and MRSA, the EPA specifies the product concentration and contact time to be used. Not following these rules is not only unsafe, but also illegal. The EPA and Food and Drug Administration (FDA) have jointly agreed that the FDA would maintain regulatory control over antimicrobial handwashing products as "over the counter" drugs intended for direct human contact.

The main mode of transmission of methicillin resistant staphylococcus aureus (MRSA) is via hands, usually from healthcare workers, who transiently carry MRSA on their hands (and fail to observe proper handwashing), first to an environmental surface, and then to the patient. Direct transmission of MRSA from a healthcare worker to a patient occurs, but is less common. In one case study, an infected food handler passed the infection to a patient in a hematology unit.

MRSA was first identified in 1968. Approximately 20 – 25% of S. aureus infections of patients hospitalized in the United States are methicillin resistant. The nosocomial infection rates range up to 13.7 infections per 1000 hospital admissions, with an average of 2.8 infections per 1,000 hospital admissions. MRSA infection rates reflect the effectiveness of the infection control program in a facility. MRSA does not squeeze out standard S. aureus strains. Once MRSA is introduced in a hospital, the overall incidence of nosocomial staphylococcal infections usually increases as well. A hospital with a high rate of infection of both

MRSA and VRE can develop ARIs, vancomycin intermediate resistant staphylococcus aureus (VISA) and vancomycin intermediate resistant MRSA. These bacteria are very difficult to control and also tend to be at least partially resistant to other antibiotics, such as rifampin, cotrimoxazole and mupirocin.

Standard precautions to prevent the spread of MRSA include thorough handwashing, gloving and masking (when necessary). Handwashing should be done immediately after touching any secretion (whether or not gloves are worn), after gloves are removed, between patient contacts and other times when indicated. It may be necessary to wash hands between tasks and procedures on the same patient to prevent cross-contamination of different sites on the patient. Clean, non-sterile gloves are generally adequate for standard and contact precautions. Gloves should be removed promptly after use, before touching non-contaminated items or other environmental surfaces and before going to another patient. When dealing with a patient that has MRSA or an antibiotic resistant infection, antibacterial hand soap should always be used.

FOOD RELATED ILLNESS

The FDA estimates that foodborne illness, much of which is caused by a lack of handwashing, results in 9,000 deaths and 81 million illnesses each year. Food related disease in the United States costs $10 billion in health care costs and productivity losses.

The FDA publishes a recommended Food Code every two years. States have the option of how much or little of the code they adopt. The FDA currently prohibits bare hand contact with ready-to-eat food. Some states, such as Kansas, have adopted this as a regulation (Kansas Food Code 3-301.11) and aggressively enforce it. There is a growing recognition that employees, through failing to observe proper handwashing, spread much of the foodborne illness that occurs. For example, food handlers in restaurants can easily contaminate their hands by working with raw foods. If proper handwashing isn't practiced, the food handlers can contaminate other food or surfaces.

DAY CARE

The US Department of Education estimates that 60% of children under the age of six, approximately 13 million, attend daycare outside their homes. Infected children are likely to spread their diseases to other people, such as their families, other children and other people in the community. Children attending daycare are 30% more likely to develop diarrhea than children cared for at home. Diarrhea outbreaks can be reduced by 50% by requiring the staff to wash their hands and the child's hands after changing diapers. Even when only engaging in routine activities, children's hands should be washed frequently throughout the day.

Some of the most common ways for disease causing germs to be transmitted by hands in a day care setting are listed below:

A. Hands to food. Lack of handwashing allows a food preparer who hasn't washed his hands to pass germs into the food.
B. Infected infant to hands to other children. During diaper changing, hands may become contaminated. If the adult changing the diapers doesn't wash his hands before touching another child, that child can become infected.
C. Food to hands to food. Germs are transmitted from raw uncooked food to the hands of the preparer and then to another food because of a lack of handwashing.
D. Food to hands to infants. Germs from raw uncooked food are transmitted to hands and then to an infant by touching the infant because of lack of handwashing.
E. Nose, mouth or eyes to hands to others. Germs can be spread to the hands by sneezing, coughing, rubbing the eyes, or nose blowing. These germs can then be spread to other family members and friends.

ROUTES OF INFECTION

When should you wash your hands? Before you:

1. Eat or prepare food, or when switching between potentially hazardous food types, such as cutting poultry and then switching to beef.
2. Touch a cut or wound, or touch someone who is sick.
3. Insert or remove a contact lens.
4. Perform invasive procedures (surgery).
5. Attend to patients, especially particularly susceptible patients, such as newborns or those immunocompromised.

When should you wash your hands? After you:

1. Use the bathroom/toilet.
2. Help a child use the bathroom/toilet.
3. Handle uncooked foods, particularly potentially hazardous foods, such as meat, poultry, fish and eggs.
4. Change a diaper. Wash the baby's hands also.
5. Touch a cut or wound.
6. Blow your nose, cough or sneeze.
7. Touch a pet.
8. Handle garbage.
9. Touch a patient, anyone sick or injured or anything that a sick or injured person touched.
10. Come in contact with body fluids, such as blood, vomit, saliva or nasal discharges (even when gloves are worn).
11. Touch inanimate objects likely to be contaminated.
12. Handle patient linens, including personal clothes.
13. Eat your own meals.
14. Following personal hygiene, such as combing your hair, blowing your nose or using the restroom.

SKIN CLEANSERS

Skin cleaners, soap and detergents, help reduce bacterial counts through the friction of washing and the detergency of the soap. These products do not have any germ killing properties. Skin antiseptics (antimicrobials) have germ killing properties and often have a residual effect on the skin after handwashing. The major types of antimicrobials are described below. When using antimicrobial hand soaps, it may be necessary to use as much as 3-5 mL to achieve the desired antimicrobial action, which is a significantly higher amount than the typical 0.5 – 1.5 mL of plain soap used for routine handwashing.

Alcohol – Sold as 60% or 70% gels, alcohol shows excellent activity against most vegetative gram-positive and gram-negative bacteria, including the tubercule bacillus, but are not sporicidal. Alcohol also shows activity against many fungi and viruses including cytomegalovirus and HIV. The main drawbacks are the tendency for alcohols to dry the skin (alcohol rubs have the tendency to cause drying, cracking and irritation of the skin) and because it is not a detergent used to wash the hands, it cannot remove soils on the skin. This is a problem because organic materials, such as blood, mucus, etc. reduce the effectiveness of alcohol. Hands must be clean to apply alcohol. Despite this, repeated studies demonstrate that in proper concentrations, alcohols product the most rapid and greatest reduction in bacterial counts on clean skin. A one-minute immersion or scrub with alcohol was shown to be the most effective method for hand antisepsis and it is as effective as a four to seven minute scrub with other antiseptics. Washing with alcohol for three minutes was shown to be as effective as 20 minutes of scrubbing with other antiseptics. The rapid drying of alcohol prevents it from leaving a lasting antiseptic effect on the skin, such as CHG does. Meers and Yeo reported that both a surgical scrub and using alcohol rubs reduced the bacterial counts on the hand to satisfactory numbers, but the alcohol rubs did not increase skin shedding as scrubbing did. Although it does not bind to the skin, such as CHG does, bacterial counts of hands rubbed with alcohol remain low and continue to decrease for several hours when gloves are worn. This is caused by the gradual death of bacteria damaged by the initial alcohol application.

Chlorhexidine Gluconate – Chlorhexidine gluconate (CHG) is a cationic bisbiguanide that is somewhat more effective against gram-positive than gram-negative bacteria, but shows a broad spectrum of activity. It is a good fungicide but has only moderate activity against the tubercule bacillus and is a poor virucide. Even when used on the intact skin of newborns, it has an extremely low toxicity. Compared to alcohols its activity is not as rapid, but the chemical remains active for five to six hours longer than any other skin antiseptic. CHG still maintains its antimicrobial activity in the presence of blood and organic material, giving it an advantage over alcohol. However, its activity is pH dependent (5.5 – 7.0) and can be inactivated by tap water with a pH above 7.0. It can also be inactivated by natural soaps or the anionic surfactants present in many synthetic soaps. CHG's residual activity is also neutralized by the use of anionic surfactants and some nonionic surfactants, which are commonly found in hand lotions. Its residual activity lasts for a minimum of six hours. After a few days of using CHG based products, the bacterial yield from the hands after scrubbing with CHG is as low as after use of alcohol based products.

PCMX – Chloroxylenol or ParaChloro-Meta-Xylenol. PCMX is a halogenated phenolic, which has good activity against gram-positive bacteria, but slightly less activity than CHG against gram-negative bacteria. It has decent activity against the tubercule bacillus, fungi and viruses. Overall, it is slightly less effective than iodine based (iodophor) products or CHG and is only minimally affected by organic matter. PCMX at 0.6% has a cumulative residual effect without being irritating. At higher concentrations, the skin can be irritated, but hand soaps with less than 0.6% PCMX are not expected to be irritating.

Iodophors – Solutions which have elemental iodine bound chemically to a carrier molecule, such as polyvinylpyrrolidone, are called iodophors. They have a wide range of activity against gram-positive and gram-negative bacteria, tubercule bacillus, fungi, viruses and in some cases, spores. They are excellent at killing germs, but iodine can cause staining and excessive drying of the hands.

HANDWASHING TECHNIQUE

In cleansing the hands, we can consider three separate procedures.

1. Handwashing is a process for the removal of soil and transient microorganisms from the hands.
2. Hand Antisepsis is a process for the removal of soil and the removal or destruction of transient organisms.
3. Surgical Hand Scrub is a process to remove or destroy transient microorganisms and reduce resident flora.

Because the goals for each process are different, the type of soap used and the cleaning technique vary between the processes. The choice of which process and which type of soap to use should be based on the degree of hand contamination and whether it is important to reduce and maintain minimal counts of resident flora as well as removing the transient flora on the hands of health care providers or food handlers.

The Centers for Disease Control and Prevention recommends, "vigorous scrubbing with warm, soapy water for at least 10 seconds with 15 seconds being described as "ideal". The CDC recommendation is both a food safety and health care guideline. There are no specifics given for washing technique. Noting that if hands are visibly soiled, more time may be required, the CDC concludes that plain soap should be used for handwashing unless otherwise indicated.

The Food and Drug Administration recommends washing hands for a minimum of 20 seconds (FDA Model Food Code 2-301.12), and also does not recommend a handwashing technique. It is interesting to note that the time recommended for handwashing for food handlers is longer than the time recommended for nurses in health care. The FDA also recommends using a nailbrush. This practice has been largely eliminated for routine handwashing in health care, because if the bristles cause minor abrasions, this creates openings for microorganisms. Thus it may be less hygienic to use a nailbrush than to not use one. Also, brushes used in health care are often not cleaned and become a potential source of cross-contamination. In health care, if a nailbrush is to be used, such as for surgical scrubs, an antiseptic soap is used and the brush should be sterile or single use. A better alternative for routine handwashing is simply to require that all employees keep their nails short and clean. The FDA also prohibits the wearing of any jewelry on the hands and arms except a simple wedding band.

A variety of handwashing "techniques" are available. Several are listed for comparison and to note their differences. The American Society for Microbiology recommends the following procedure without specifying the target audience:

1. Use soap and warm, running water.
2. Lather hands thoroughly, including wrists, palms, back of hands, fingers and under fingernails for 20 seconds.
3. Dry hands thoroughly with a clean paper or cloth towel or air dry.
4. Apply hand lotion if desired to help prevent chapping or soothe dry skin.

Larson (1985) recommends:

1. Removal of jewelry. Jewelry with ridges and stones should not be worn at all by health care workers.
2. Use continuous running water and soap.
3. Use of friction over all surfaces of both hands.
4. Avoiding contamination by splashing of clothing, other skin surfaces or other items.
5. Rinsing under running water.
6. Use paper towels to dry hands and to turn off faucet.
7. A washing time of 10 – 15 seconds.

The handwashing technique recommended by Mikos-Schild (1998) is as follows. Always use soap and warm water. Hot water is not necessary, as it is the friction that helps to remove the germs. Water hot enough to kill germs would burn the skin.

1. Wet all surfaces of hands up to the wrist.
2. Apply one dose of soap. Too much soap makes it hard to rinse off, but does not get the hands any cleaner.
3. Rub all surfaces of your hands, including all sides of fingers, thumbs and wrists.
4. Rinse with fingers pointing down, so that dirty water falls from the fingertips, not towards the elbows.
5. Leave the water running.
6. Use a paper towel to dry hands.
7. Use a paper towel to cover faucet handles when turning off the water.

Parker recommends the following for 10 – 15 seconds:

1. Remove rings (better to avoid wearing jewelry).
2. Keep nails short.
3. Turn on water and wet hands before applying handwashing agent.
4. Rub palm to palm, fingers not interlocked.
5. Rub the back of each hand, hands at a 90° angle.
6. Rub palm to palm with the fingers interlocked.
7. Rub backs of interlaced fingers.
8. Wash both thumbs. Rotational motion of left palm around right thumb and vice versa.
9. Rub both palms with the front and back of fingertips. Rotational motion, backwards and forwards, with clasped fingers of right hand in left palm and vice versa.

Kerr recommends the following for 15 – 30 seconds.

1. Rub palm to palm, fingers not interlocked.
2. Rub the back of each hand, interlocking fingers.
3. Rub palm to palm with the fingers interlocked.
4. Backs of fingers to opposing palms with fingers held together.
5. Rub backs of interlaced fingers.
6. Wash both thumbs. Rotational motion of left palm around right thumb and vice versa.
7. Rub both palms with the front and back of fingertips. Rotational motion, backwards and forwards, with clasped fingers of right hand in left palm and vice versa.

Springhouse (1998) recommends the following.

1. Remove rings and watch or push watch well up the forearm.
2. With your hands angled downward under the faucet, adjust the water temperature to comfortably warm.
3. Wet your hands and wrists with warm water and apply soap from a dispenser. Don't use bar soap because it allows cross-contamination.
4. Hold your hands below elbow level to prevent water from running up your arms and back down, potentially contaminating the clean areas.
5. Work up a lather by scrubbing vigorously with the soap for 10-15 seconds. The soap and warm water, aided by the friction, loosens surface microorganisms to flush them away in water.
6. Be sure to clean beneath fingernails, around cuticles and knuckles, and on the back sides of fingers and hands.
7. If you still have a wedding ring on, move it up and down the finger to clean underneath.
8. Avoid splashing water on yourself or the floor. Microorganisms spread more easily on wet surfaces, and wet floors are slippery and dangerous.
9. Avoid touching the sink or faucets, because they are considered contaminated.
10. Rinse hands and wrists well. Running water flushes suds, soil and microorganisms.
11. Pat hands dry with a paper towel. Avoid rubbing, which can cause skin abrasions and chapping.
12. To prevent recontaminating your hands on the faucet handles, cover each handle with a dry paper towel when you turn off the water.

The CDC's guidelines that appear in "The ABC's of Safe and Healthy Child Care" (2000) include the following:

1. Always use warm, running water and a mild, preferably liquid, soap. Antibacterial soaps may be used but are not required.
2. Wet the hands and apply a small amount (dime to quarter size) of liquid soap to hands.

3. Rub hands together for at least 15 seconds. Be sure to scrub between fingers, under fingernails and around the tops and palms of the hands.
4. Rinse hands under warm running water. Leave the water running while drying hands.
5. Dry hands with a clean disposable towel. Be careful to avoid touching the faucet handles or towel holder with clean hands.
6. Turn the faucet off using the towel as a barrier between your hands and the faucet handle.
7. Discard the used towel in a trash can lined with fluid resistant (plastic) bag. Trash cans with foot pedal operated lids are preferable.
8. Consider using hand lotion to prevent chapping of hands. If using lotions, use liquids or tubes that can be squirted so that the hands do not have direct contact with the container spout. Direct contact with the spout could contaminate the lotion inside the container.

U S Chemical Recommended Handwashing Technique

1. If you are wearing a watch, push it up your wrist. Remove any rings (it is always better to not wear any rings).
2. Turn on the water, adjust the temperature to warm, and leave on all during handwashing.
3. Wet all surfaces of the hands up to the wrists. Point the fingers down through handwashing so that contaminated water does not run up the arm and back down, contaminating the clean hands.
4. Apply a proper dose of soap from the liquid soap dispenser.
5. Work soap into a lather by rubbing hands vigorously with the palms together and the fingers together (not interlaced).
6. Avoid contamination by avoiding splashing of clothing, other skin surfaces, or other items. Germs spread more readily on wet surfaces.
7. Rub the back of each hand with the palm of the other hand. The hands should be at a 90° angle.
8. Rub palm to palm with the fingers interlaced.
9. Rub the backs of each hand with interlaced fingers. Hands point in the same direction.
10. Wash both thumbs with a rotational motion while holding one thumb in the closed palm of the other hand.
11. Rub both palms with the front and back of fingertips. Fingertips should be together. Use a rotational motion.
12. Clean under the fingernails if using a fingernail brush.
13. If you have a wedding ring on, move it up and down the finger to clean under the ring.
14. The entire scrubbing process should take 10 – 20 seconds. In a food environment it should take at least 20 seconds.
15. Rinse hands under running water. Remember to keep hands pointed down during rinsing. Dirty water should run off the fingertips, not the elbows.
16. Use a paper towel to dry hands by blotting or patting. To minimize skin irritation, do not rub hands with towel.
17. Cover the faucet handle(s) with the paper towel and turn off the water. Do not touch the faucet handle(s) directly or the sink. It is considered contaminated.
18. Dispose of towel in a trash can with a fluid resistant (plastic) bag. Trash cans with lids and foot operated pedals are preferred.
19. Apply lotion to hands if desired. Food service workers should not use hand lotion during their shifts.

In situations where handwashing facilities are inadequate or inaccessible, and if the hands are not visibly soiled, using an alcohol gel hand rub is adequate. If the hands are soiled, a handwashing towelette should first be used and then an alcohol gel hand rub should follow. This technique is especially appropriate for temporary food processing facilities, such as temporary restaurants in a county fair.

Subungal (under the fingernails) cleaning may be more important than the scrubbing technique because these areas collect oily bacteria laden dirt and debris that cannot be easily removed through handwashing. Nails require patient and vigorous brushing and running water.

Surgical Hand Scrub – two alternatives are recommended Laufman:

1. Alcohol preparation
    A. Wash hands and arms and clean fingernails. Dry.
    B. Apply alcohol solution containing emollient, rubbing until dry. Use approximately 3 to 5 mL per application. Continue applications for approximately 5 minutes using a total of 9 to 25 mL of the alcohol solution.

2. Traditional 5 minute scrubs with an agent containing CHG or an iodophor. Hand soaps such as these, which contain antimicrobials that exhibit a residual activity on the skin, can help maintain lower bacterial counts under gloves. The American College of Surgeons states that a surgical scrub of 120 seconds, which includes brushing of the nails and fingertip areas, is adequate.

Recommended by Springhouse (1998) is the following 5 minute scrub.

1. Before scrubbing, put on your mask and face shield or goggles and put a scrub cap or hat over your hair.
2. Hold your hands higher than your elbows. Wet your hands and forearms under the running water, letting the water run from the fingertips to the elbows so that the hands become cleaner than the elbows.
3. Open a sterile scrub brush and nail cleaner pack. Apply an approved antimicrobial hand soap to your hands.
4. Clean your nails with the nail cleaner.
5. Remove the brush from the package and begin to scrub your hands, beginning with the fingers. Wash each finger and the areas between the fingers, the front and back of the hands, the wrist and continue up the elbow. Repeat for the other hand.
6. The entire scrubbing process should take 10 minutes (5 minutes per hand).
7. After completion of the scrub, discard the brush and allow excess moisture to flow from the elbows into the sink, not on the areas scrubbed.
8. Don't touch any part of the faucet, sink or clothing.
9. Dry the hands on a sterile cloth towel. Starting with the hand, dry one hand and arm on half of the sterile towel, moving from the fingers to the elbow. Use the other half of the sterile towel to dry the other hand and arm. Then discard the towel in the appropriate container.
10. Put on the sterile gown and gloves.

Some surgical scrub procedures recommend only a 2 minute or 120 second scrub, instead of a five minute scrub, with an appropriate antimicrobial hand soap.

Preoperative Skin Preparation –

1. Unless necessary, hair should not be removed from the operative site. If hair removal is necessary, a chemical that causes hair to be removed (depilatory) or clipping is preferred. If shaving is necessary, wet shaving should be performed immediately prior to surgery. Studies have shown that shaving many hours in advance of surgery increases the rate of wound infection. Any time the skin surface is altered, such as by shaving, this seems to favor heavier bacterial colonization. Because of this, the CDC now recommends that hair be clipped rather than shaved, unless the hair will impede surgery. A surgical clipper with a disposable head is the preferred hair removal method today.
2. Prior to selecting an antiseptic for the skin, the patient's history should be assessed for sensitivity to the antiseptic, particularly if iodine is used.
3. Physically clean the patient's skin prior to antiseptic application.
4. Working from the intended operative site outwards, a wide area of skin should be thoroughly cleansed. The area should be gently, but thoroughly scrubbed. Sprays alone are not recommended. While alcohols are the recommended agent of choice, iodophors or chlorhexidine are also acceptable.
5. The antiseptic should be allowed to air dry. Do not allow it to pool under the patient.

HANDSOAP DISPENSERS

Ideally, all handsoap dispensers should be "other than hand operated", such as elbow operated or back of the wrist operated, so that when dispensing hand soap, the operator does not accidentally contaminate the dispenser with dirty hands. The dispenser should also have a positive break, like the Personal Hygiene System does. This positive break provides a gap between the soap dispensing point and the receiving hand, preventing accidental contamination of the hand soap still in the dispenser. Contamination of dispensers has been documented for every antiseptic ingredient except alcohol.

The CDC cautions that if liquid hand soap is used, the dispenser should be replaced or cleaned and filled with fresh hand soap when empty. Hand soap should not be added to a partially full dispenser because of risk of contamination. Contaminated liquid hand soap dispensers have been associated with several nosocomial outbreaks. Refillable containers are inappropriate for use in health care and food preparation environments. In the 60s and 70s, outbreaks of nosocomial infections were traced to contaminated lotions. This led to the banning of hand moisturizing products in health care facilities. In the 80s and 90s, the increased prevalence of skin problems associated with handwashing and gloving procedures along with better dispensing methods for creams and lotions have resulted in the recognition that creams and lotions applied to the hands are probably essential in clinical practice.

Antimicrobial agents in the cream or lotion are not needed, as long as dispenser contamination is prevented. Several studies have shown that creams and lotions, even without antimicrobial agents, greatly reduce the dispersal of bacteria from the skin up to four hours. Some of its effectiveness may simply be in preventing the bacteria present from shedding into the environment, thus helping to prevent cross-contamination. Moisturizers prevent skin dehydration, desquamation (shedding of the skin) and loss of lipids. A Swedish study demonstrated that the use of a moisturizing cream accelerated the rate of recovery for damaged skin. Creams and lotions should be tested for their compatibility with latex or the other gloving materials used to insure that the lotion does not degrade the glove.

HAND DRYING

Drying is as important as washing for good hygiene. There are many methods for drying the hands, such as communal hand towels, disposable paper towels, hot air dryers and continuous roll towels. Blackmore found that cotton towels were more efficient in removing bacteria than paper towels. However, paper towels do have other advantages in that they are quicker to dispense and more accessible, allowing several users to dry their hands at once. He also concluded that hand drying is not as critical if handwashing is effective, because most of the organisms that remain on the hands are benign. Also, pathogenic organisms are in the minority. Campbell concluded that the low quality hard paper towels, frequently used in hospitals to control costs, were perceived as unabsorbent and damaging to the hands. The hands were left feeling damp after drying even after vigorous wiping with the paper towel. This resulted in additional aggressive rubbing of the hands in an attempt to dry the hands, which resulted in skin irritation.

Marples and Towers demonstrated that 10% of microorganisms inoculated onto moist fabric were transferred to hands by grasping the fabric. Subsequently, 85% of the contaminating organisms on wet hands were transferred to sterile fabric. When either the contaminated fabric or the hands were dry, the number of organisms transferred was smaller. Microorganisms transfer more readily from wet surfaces than from dry surfaces. Cloth towels should not be used in health care settings because of cross-contamination concerns. Cotton towels can be vehicles for transferring bacteria. This does not include surgical scrubbing, where sterile towels are used once and then cleaned and sterilized. Hot air dryers also should not be used as they have been shown to increase the bacterial count in the air by over 500% as well as increasing the bacterial contamination of the local environment. They also take much longer to dry hands than do paper towels. When drying the hands, friction is created which will help remove microorganisms. Paper towel dispensers or automatic dispensers should dispense individual pieces (folded towels) or in the case of roll paper towels, should be dispensed from an “other than hand activated” dispenser. Dispensing of the paper towel by multiple employees should not recontaminate their hands by touching a common surface, such as a dispensing button or crank. Crank operated paper towel dispensers have the potential of recontaminating clean hands and should not be used in health care environments at all.

THE COMMON COLD

Dr. Bennett Lorber wrote an excellent article on the common cold in 1996. Most of this section is taken from his work.
It is worthwhile to discuss the common cold in the context of handwashing, because handwashing can prevent much of the transmission of the colds which happen each year. During their first year, children have approximately 1.2 rhinovirus colds per year. Young children typically have five to seven colds per year, but the number may be as high as twice that for children in day care. Being one of the most common human infections, the frequency of colds decreases with age and are rarely fatal. Colds tend to peak in the fall and spring with the median symptom duration in adults being three weeks. Smokers have the same infection rates as nonsmokers, but their colds are more severe and smokers develop stronger coughs.
Household studies indicate that infection with viral replication and shedding (meaning a person is contagious) can occur without the person showing symptoms of being ill, but 70% to 90% of transmitted infections are symptomatic. This means that the person transmitting the infection was displaying symptoms at the time they infected someone else. Viruses are always the

cause of colds, but many different types of viruses can cause colds. Rhinoviruses are the most common, causing 30 - 40% of all colds. Coronaviruses cause 10 - 15% of colds. A group of viruses including Respiratory Syncytial Virus, Adenovirus, Parainfluenza Virus and Influenza Virus cause 10-15% of colds, with 5% of colds caused by other viruses. The remaining 25-40% of colds are caused by unknown agents, but it is assumed that they are caused by viruses as well. Viruses show a lot of genetic variation with 89 serotypes being seen in one study, making developing an immunization difficult. That is why there are different flu immunization shots each year, while the same shot is not given each year. There are at least 100 antigenically distinct types of rhinoviruses. A person could become infected with a different strain every year for 100 years and not run out of rhinoviruses. Rhinoviruses are strong and remain active for at least three hours after drying on hard surfaces. They are members of the Picornaviridae family of viruses, which includes enteroviruses, such as Poliovirus and Hepatitis A Virus.

Tiny amounts of these viruses (1/10 of a tissue culture infecting dose) will cause disease. Within 24 hours of becoming infected, viruses are shed from the nose. Shedding peaks on the second and third days, with large amounts of virus being shed. Thus, when they are the most infectious (contagious), many people will display symptoms but only minor symptoms. While there is much suspicion that large and small droplet aerosols can spread colds, studies have demonstrated that this is an unlikely way for people to become infected. In one study, large droplet aerosols were found to rarely transmit a cold. Large droplet aerosols require long contact times, severe colds and coughing as symptoms. Small droplet aerosols did not transmit any colds at all in the same study. Infectious aerosols produced by coughing and sneezing do not come from nasal secretions, which are highly infectious, but from the salivary pool in the mouth, where very little virus is located. A kissing experiment, where donors kissed recipients twice for 45 seconds (using the kissing technique most natural to them) only resulted in an 8% transmission rate for colds.

Studies have shown that ten second hand contact, transmitted a cold 71% of the time in one study. Virus was found on the hands of 40% of donors. On multiple sampling, the number reached 90%. It is found in only 10% of cough or sneeze samples. It appears that the most likely route of infection is from the donor's nose to the donor's hands to the recipients hands and finally to the recipients nose or eye. When viruses reach a tear duct in the eye, the viruses are passed into the nasal cavity through the tear duct, facilitating infection. Fomites can also aid in transmitting colds as was demonstrated in a card playing study.

Despite the bodies ability to produce antibodies to prevent reinfection for viral diseases such as mumps, measles, rubella and chicken pox, neutralizing antibodies for rhinoviruses are found in serum (the fluid portion of blood) only 40–85% of the time, even when people are symptomatic. Immunity to coronaviruses appears to be short lived, making it possible to become reinfected with the same immunotype later. Thus, a person may recover from a cold only to continually become reinfected with the same strain of virus.

Facial tissues mechanically block virus transmission, when used and promptly thrown away. However, if the liquid in the tissue contacts the hands, the hands can spread the virus. Therefore, it is critical to wash one's hands every time the nose is blown. If this is not possible, because of lack of access to handwashing facilities, using an alcohol gel instant hand sanitizer will help accomplish the same effect. Keeping the hands away from one's eyes and nose also helps prevent the spread of colds, but handwashing is more critical.

COMPONENTS OF A RECOMMENDED HANDWASHING PROGRAM

A. A successful handwashing compliance program for routine handwashing starts with a commitment from the facility management to invest in training and materials.
B. Ongoing education should be conducted to communicate the success or lack of success in the facility. Nosocomial infection rates can be compared to other facilities, but the rate within a facility is more important.
C. Adequate numbers of handwashing sinks and paper towel dispensers must be located in the employees working environment so that handwashing is convenient. If sinks aren't convenient, handwashing won't be performed. Alcohol gel hand sanitizer dispensers should be installed at each handwashing sink as well. Employees should be encouraged to use the alcohol gel between patient contacts, even if they think their hands are not contaminated, or if they aren't going to wash their hands.
D. In locations where handwashing sinks can't be conveniently installed, alcohol gel hand sanitizer dispensers should be installed.

E. Hand lotion dispensers should be installed anywhere a hand soap or alcohol gel hand sanitizer is located in a health care environment. Food service workers should not use hand lotion during working hours.
F. All dispensers should be “other than hand operated”, such as elbow or back of wrist activated or automatic and equipped with a positive break to prevent accidental contamination of the dispenser.
G. Hand towels should be single fold (individual) paper towels, roll fed, or automatically fed paper towels if the dispenser is “other than hand operated”. The towels should be as soft on the hands as possible.
H. The facility management should decide if they want to use antibacterial hand soaps for routine handwashing.
I. Employees should be required to keep their nails short and clean. Jewelry should be limited to a plain wedding band, but a policy of no rings at all is preferable. Other rings, particularly those with stones and ridges, should not be worn at all.
J. Glove wearing should be preceded and followed by handwashing. Nonsterile gloves should be evaluated for their effectiveness in the particular environment. Gloves must prevent the permeation of viruses the same size as Hepatitis B. Desired resistance to drugs commonly encountered should also be evaluated.
K. Gloves should be used around any patient with an antibiotic resistant infection, such as MRSA, VRE or VISA.
L. Nail brushes should be evaluated for their advantages versus their limitations and liabilities. If used, they must be kept clean and prevented from causing cross-contamination.
M. If faucets with automatic shutoffs are not used, the faucets should be “other than hand operated”. Requiring employees to use paper towels to turn off the faucet is an unnecessary risk due to the unlikelihood of compliance.

SUMMARY

Handwashing is a critical part of controlling the spread of microorganisms and disease but is usually under-performed. Surveys repeatedly demonstrate that overall compliance is low, yet people generally have the information they need to understand how and why to perform proper handwashing. Many, if not most, occurrences of transmission that result in nosocomial infections can be prevented by simply having the health care staff wash their hands more frequently. This brochure discussed the technical aspects of handwashing and proposed strategies to aid in compliance.

U S Chemical
Providing Exceptional Quality Since 1962

316 Hart St., Watertown, WI 53094 • **Phone:** (800) 424-1075 **Fax:** (920) 206-3977