



Hand Hygiene: Cleaning Up Our Act!

Studies have shown that health-care professionals wash their hands half as often as they should. Those practising in community-based and acute-care settings need to consider advances in hand hygiene to minimize the spread of micro-organisms among patients.

By Judy A. McLeod RN CIC; and John M. Embil MD, FRCPC, FACP

Presented at Bug Day 2001, held in conjunction between the Winnipeg Health Sciences Centre and the University of Manitoba, Winnipeg, Manitoba, October 2001.



Dr. Embil is associate professor, departments of medicine and medical microbiology, University of Manitoba, and consultant, infectious diseases, University of Manitoba teaching hospitals. He also is director, infection prevention and control unit, Health Sciences Centre, Winnipeg.



Ms. McLeod is a certified infection control practitioner at the Health Sciences Centre in Winnipeg. She serves as a consultant to the surgical programs of the centre for infection prevention and control unit.

Hand Hygiene

Handwashing is one of the most important ways to reduce the transmission of potentially infectious micro-organisms between patients and health-care providers. Health-care professionals, however, wash their hands approximately half as often as they should and usually for a shorter duration than is recommended.¹⁻⁹ Furthermore, staff overestimate the frequency and quality of their handwashing behaviour.³ Even minimal contact with a patient, such as touching a patient's shoulder or hand while taking his/her blood pressure may result in bacteria being transmitted to the hands of the health-care provider.⁷ These micro-organisms can then spread to others. Similarly, health-care providers colonized with antibiotic-resistant micro-organisms can spread the micro-organisms to critically ill patients after a relatively short period of contact.⁷

A number of hand-cleansing agents are now available, ranging from the conventional soap and water, to waterless alcohol-based hand-hygiene

products. The latter are one solution to poor compliance with hand "degerming," and are challenging the tradition and rituals of hand antisepsis, particularly for surgical teams.^{1,9-14} Alcohol-based antiseptics effectively reduce bacterial numbers on the skin, are more accessible than sinks, require less time to use and cause less skin irritation and dryness than washing hands with soap and water.^{1,4,6,15} Health-care workers in community-based and acute-care settings need to consider these advances in hand hygiene to minimize the transmission of micro-organisms among patients.⁹

Hand Hygiene

Hand hygiene is a general term that applies to handwashing, antiseptic handwashing and the use of antiseptic handrubs and surgical hand antisepsis. The aims of hand hygiene, regardless of the agent or technique used, are as follows:¹⁻⁷

Summary

Hand Hygiene: Cleaning Up Our Act

- Healthy skin releases approximately 10^7 squamous epithelial cells daily, of which approximately 10% contain viable bacteria. Lipids are an important component in maintaining the hydration, pliability and effectiveness of skin as a barrier.
- There is a misconception that handwashing with soap consistently and reliably prevents microbial transmission, however, studies have demonstrated simple handwashing with soap may actually increase the dissemination of organisms.
- It has become standard practice to use an antimicrobial soap in high-risk areas, where frequent hand washing is required (*i.e.*, intensive care units, neonatal units and when caring for immunocompromised patients).
- Even with the use of antiseptic preparations, it is impossible to eliminate micro-organisms entirely.
- Antiseptic agents should include the parameters of immediate, persistent and residual antimicrobial action. They should be non-toxic, non-allergenic, mild and non-irritating to the skin.
- Bacterial flora colonizing patients have been recovered from the hands of up to 30% of health-care workers who wore gloves during patient contact. Using gloves without hand hygiene upon glove removal results in dirtier hands, as organisms multiply in the moist, warm environment of gloved hands.

- To reduce the transmission of pathogenic micro-organisms in health-care settings;
- To minimize the risk of increasing antimicrobial resistance in the skin flora;
- To promote improved hand hygiene practices and maintain skin health; and
- To maximize the antimicrobial effectiveness of hand hygiene practices.

The following are frequently used terms when defining hand hygiene:

- *Transient flora:* Micro-organisms on the skin that are not consistently present and are easily removed with handwashing (*i.e.*, a health-care provider handles soiled linen and contaminates his/her hands). These new micro-organisms, which are picked up on the hands, are known as transient flora and are distinct from a person's resident flora.
- *Resident flora:* Micro-organisms that are permanent residents of the skin and are not readily removed by mechanical friction and plain soap and water. Although the numbers of these micro-organisms may decrease with handwashing, their carriage will never be completely eliminated.
- *Antiseptic agent:* Antiseptic agents are antimicrobial substances applied to the skin to reduce microflora. Examples include alcohols, chlorhexidine gluconate, chlorine, hexachlorophene, iodine and iodophors, para-chloro-meta-xyleneol (PCMX), quaternary ammonium compounds and triclosan.
- *Handwashing:* Washing hands with plain (non-antimicrobial) soap and water.
- *Hand antiseptics:* The use of topically applied antiseptic agents (hand wash or rub) to render the hands free of transient microbial flora.
- *Surgical hand antiseptics:* Antiseptic handwashes or antiseptic handrubs performed preoperatively by surgical personnel to eliminate transient, and reduce resident, hand flora. A surgical handscrub product refers to an antiseptic containing preparations that significantly reduce the number of micro-organisms on the hands of health-care personnel and have a persistent effect.
- *Waterless antiseptic agent:* An antiseptic agent that does not require use of exogenous water. After applying the agent, the individual rubs the hands together until the agent has dried.
- *Antiseptic handwash:* Applying a fast-acting waterless antiseptic agent to all surfaces of the hands to reduce the number of micro-organisms present on the hands of health-care workers.

The Pioneers of Hand Hygiene and Antisepsis

The seeds of handwashing were planted in the 11th century. It was subsequently postulated in the 16th century that “germs” caused infection, although what constituted a “germ” was not known. In 1847, Philipp Ignaz Semmelweis (1818-1865), an obstetrician in Vienna, recognized that the hands of health-care personnel served as vectors for transmitting agents responsible for sepsis between patients and health-care providers and back to other patients. In 1861, he produced the first scientific evidence correlating the cleansing of a health-care worker's hands with an antiseptic agent and the reduction in health-care-acquired infection. When the findings of other pioneers, such as Oliver Wendell Holmes (1809-1894) in the U.S. and Joseph Lister (1856-1885) in Scotland, were disseminated, the practice of routine disinfectant handwashing became more widely accepted as an essential principle of infection prevention and control practice.⁷ In 1843, Holmes demonstrated that health-care providers were responsible for the transmission of infection, and he described measures to limit the spread of puerperal fever. Lister observed high mortality rates from post-sur-

Hand Hygiene

gical sepsis and developed principles of antiseptic surgery. These pioneers faced opposition in their day, and the lessons learned from their efforts remain difficult to implement in routine practice today.^{16,17} Good hand hygiene practices are not easy to implement nor maintain.

The Barriers To Compliance With Hand Hygiene

The barriers to compliance with proper hand hygiene in health-care settings include, but are not limited to:^{1,7,8,13,17}

- Poor role models and habits among staff;
- Priorities in care (high workload, too busy, not enough hours in the day);
- Sicker patients, under-staffing, overcrowding;
- Participation in patient-care activities perceived to be low-risk;
- Inconvenient or lack of access to hand hygiene facilities;
- The risk of skin irritation;
- Lack of knowledge of guidelines/protocols; and
- The belief that glove use obviates the need for hand hygiene.

The Importance of Skin

Healthy skin releases approximately 10^7 squamous epithelial cells daily, of which approximately 10% contain viable bacteria. Lipids are an important component in maintaining the hydration, pliability and effectiveness of skin as a barrier.^{1,3,10,18,19} Removal of a certain amount of contaminated surface cells with the attached bacteria is essential to maintaining normal skin hygiene. Damaged skin harbours large numbers of potential pathogens. Washing damaged skin with either plain or antiseptic soap is less effective in reducing the number of bacteria on hands than is washing normal skin.

The number of organisms shed from damaged skin also are often higher than from healthy skin.

Where Do Micro-Organisms Live On Your Hands?

The subungual region and the tips of the fingernails are the primary source of the flora that live on hands. Recent reports indicate that false nails harbour fungi and bacteria and are implicated in surgical site infections. Different antiseptic hand-washing products have different effects on sanitizing the subungual region.^{1,9}

The Effects Of Soap On Skin

Soaps and detergents may increase the pH level of the skin, reduce lipids and increase transepidermal water loss, resulting in drying and increased shedding of squamous epithelial cells.^{1,10,12,15} There is a misconception that handwashing with soap consistently and reliably prevents microbial transmission, however, studies have demonstrated simple handwashing with soap may actually increase the dissemination of organisms.^{1,10,20} Studies of showering and bathing have shown the more frequently plain soap is used, the more normal skin flora is shed. A similar effect is noted with handwashing. Squames contain viable bacteria that can be shed into the environment.

Studies comparing antiseptic handwash with plain soap have demonstrated a reduction in the number of micro-organisms on the hands of those using antiseptic agents, such as para-chloro-meta-xyleneol (PCMX), triclosan and chlorhexidine gluconate (CHG). Controls using plain soap showed less of a reduction in the number of

micro-organisms on the hands, with increased shedding of micro-organisms. Even though participants were washing frequently, there were more bacteria on their hands.¹⁸ It has, therefore, become standard practice to use an antimicrobial soap in high-risk areas where frequent handwashing is required (*i.e.*, intensive care units, neonatal units and when caring for immunocompromised patients). Even with the use of antiseptic preparations, it is impossible to eliminate micro-organisms entirely.^{1,10,20}

Ideal Properties Of A Hand Antiseptic

Antiseptic agents should include the parameters of immediate, persistent and residual antimicrobial action. They should be non-toxic, non-allergenic, mild and non-irritating to the skin. Antiseptic agents also should have a broad-spectrum antibacterial activity and must be fast-acting, easy and pleasant to use, as well as cost effective.¹⁻³

Choosing A Hand Antiseptic Agent

Criteria for selecting a hand antiseptic agent should include product safety, efficacy, cost, aesthetics (*i.e.*, fragrance, texture, feel, drying time, dispenser design and function) and any other “sociologic” factors that make the product more acceptable to the user. There is a hierarchy of the effectiveness of hand hygiene agents. The active ingredient in a hand scrub agent is a major predictor of the extent of microbial activity. The hierarchy from greatest effectiveness is as follows:¹⁻³

1. Alcohol (ALC);
2. Chlorhexidine gluconate (CHG);
3. Povidone-iodine (PI);

4. Para-chloro-meta-zylenol (PCMX), triclosan, and
5. Plain soap.

There are many different agents available for hand hygiene. Table 1 demonstrates the choice of agents, their advantages and disadvantages. Their efficacy, cost and level of personnel acceptance vary from product to product.

“Degerming” Your Hands

It is essential to get tough on germs by degerming your hands.

Before contact with patients. Be prepared for potential contamination that is not readily apparent, such as direct contact with a patient’s intact skin (*i.e.*, taking a pulse or blood pressure, performing physical examinations or procedures and lifting or physically assisting a patient).

After contact with patients. Be sure to wash your hands following these situations:

- After glove removal;
- When you have visibly soiled hands;
- Following contact with environmental surfaces in the immediate vicinity of patients/residents;
- Following contact with potentially contaminated objects;
- After examining a patient/resident and before handling the medical chart;
- After using the washroom;
- After blowing your nose; and
- Whenever in doubt.

Common objects in the workplace may be transfer points for germs (*i.e.*, stethoscopes, door-knobs, phones, faucets, pens and countertops).

Glove use. Glove use does not provide complete protection against hand contamination. Using gloves can give the practitioner a false sense that his/her hands are clean after patient contact. Bacterial flora colonizing patients have been recovered from the hands of up to 30% of health-

Hand Hygiene

Table 1

Options for Hand Disinfection Agents

Agent	Advantages	Disadvantages
<p>Plain soap Bar, tissue, leaf, liquid.</p> <p>Properties:</p> <ul style="list-style-type: none"> • Non-antimicrobial. • Detergent. <p>Indication for use:</p> <ul style="list-style-type: none"> • Routine handwashing, minimal 15 seconds contact time. 	<ul style="list-style-type: none"> • Mechanically removes loosely adherent transient flora. 	<ul style="list-style-type: none"> • Does not remove permanent resident flora. • Provides minimal microbial killing. • No sustained antimicrobial activity. • May fail to remove pathogens from hands of hospital personnel. • May become contaminated with gram-negative bacteria. • May result in increased bacteria counts on the skin. • May cause more skin dryness than cleaning hands with an alcohol-based product.
<p>Antiseptic Handwash Chlorhexidine (CHG), hexachlorophene, iodine and iodophors (<i>i.e.</i>, povidone iodine [PI]), para-chloro-meta-xylenol [PCMX], quaternary ammonium compounds, triclosan.</p> <p>Properties:</p> <ul style="list-style-type: none"> • Contain antimicrobial substances to reduce the number of microbial flora. • Detergent-based. <p>Indication For Use:</p> <ul style="list-style-type: none"> • High-risk settings (<i>i.e.</i>, intensive care, neonatal units). 	<ul style="list-style-type: none"> • Reduces the transient and resident skin flora. • Persistent antimicrobial activity in the presence of organic matter. • CHG and PI shown to be equal in antibacterial activity. • CHG and hexachlorophene when used over time increasingly reduce flora due to persistent or substantive chemical activity on the skin. • Iodine is fast-acting. 	<ul style="list-style-type: none"> • Mildness depends on formulation. • CHG is neutralized by anionic surfactants present in most over-the-counter hand lotions. • CHG compatible non-anionic lotions should be used with chlorhexidine containing products. • The initial antimicrobial activity of CHG is sometimes not as good or certainly not better than PI. • PCMX and triclosan are an inferior choice to alcohol, CHG and PI due to decreased antimicrobial activity. • Iodine stains skin and jewelry. • Iodine irritating to skin. • Iodophors may be neutralized by organic material.

Table 1 Cont'd

Options for Hand Disinfection Agents Cont'd

Agent	Advantages	Disadvantages
<p>Alcohol-Based Waterless Antiseptics</p> <p>Isopropanol, ethanol, n-propanol, or a combination of two of these.</p> <p>Properties:</p> <ul style="list-style-type: none"> • Denatures proteins. • 50% to 80% alcohol most effective. • Addition of other antiseptic agents can result in persistent activity. <p>Indication For Use:</p> <ul style="list-style-type: none"> • To “degerm” hands. • When hands are not visibly soiled: A substitute for soap and water handwashing. • If hands are visibly soiled: An alternative to the traditional antiseptic handwash with water. Use plain, mild soap and water wash followed by the application of an alcohol-based product even in high-risk acute care settings. • Brushless application for surgical teams. • Community settings (<i>i.e.</i>, day-care centres, emergency vehicles, disasters, personal care homes), and when running water and sinks are not readily available. 	<ul style="list-style-type: none"> • More effective antibacterial activity than handwashing with plain soap, antimicrobial soaps or detergent and water. • Superior to PI or CHG in terms of initial kill. • Rapid antibacterial action. • Broad-spectrum activity against gram negative, gram-positive organisms (including MRSA and VRE), viruses, mycobacterium tuberculosis and fungi. • Not affected by organic debris (dirt and blood). • Inexpensive. • Time-saving. • Dispensers or individual containers more accessible than sinks. • Well-formulated products with emollients or moisturizers cause less skin irritation and dryness than handwashing or scrubbing. • The new alcohol emollient-containing products have a decreased drying effect on skin, take longer to dry. The effectiveness lasts longer, as the activity of the alcohol is prolonged. • Easier to don gloves. 	<ul style="list-style-type: none"> • Alcohol alone: No sustained antimicrobial activity once dries to protect from recontamination of hands. • Alcohol alone: not a good cleaner (no surfactant). • Drying to the skin if not formulated with emollients. • Poor activity against bacterial spores • Flammable. • Requires education and change in practice.

Hand Hygiene



Figure 1. Thoroughly wet hands.



Figure 2. Apply handwashing agent and rub all surfaces of hands vigorously for 15 seconds, paying close attention to the areas under and around the fingernails and between the fingers.



Figure 3. Rinse hands well.

care workers who wore gloves during patient contact.¹ Furthermore, wearing gloves does not provide complete protection against acquiring infections caused by hepatitis B and herpes simplex virus.¹ In such instances, pathogens presumably gain access to the caregiver's hands *via* small defects in gloves.¹ Using gloves without perform-

ing proper hand hygiene upon glove removal results in dirtier hands as organisms multiply in the moist warm environment of gloved hands. Contamination of the hands may occur during glove removal, and failure to remove gloves after caring for a patient may result in the transmission of micro-organisms from one patient to another.¹

Handwashing technique using soap and water solutions. The steps for routine handwashing are shown in Figures 1 to 5 and are as follows:

- Thoroughly wet hands with warm water. Apply 3 mL to 5 mL of a handwashing agent to hands and rub them vigorously for at least 15 seconds, covering all surfaces of hands and fingers. Pay close attention to the areas under the fingernails and between the fingers. Rinse hands thoroughly and dry with a disposable paper towel or hot-air dryer. If the sink does not have foot controls or an automatic shutoff, use paper towel to turn off the faucet to avoid re-contaminating your hands.



Figure 4. Dry with a paper towel.



Figure 5. Turn off tap with paper towel to avoid recontaminating hands.

- Thorough handdrying is an important step because moisture left on the hands is a breeding ground for bacteria. Contact with moist hands transfers bacteria and germs from dirty surfaces to skin, food and other objects. Keep your work environments clean and clean surfaces properly.

Waterless alcohol-based handrub or hand rinse disinfection technique. The following steps are most helpful for hand decontamination when using an alcohol-based hand rub:¹

- If your hands are visibly soiled, handwashing with water and a handwashing agent should be done first. Apply an adequate volume of alcohol-based handrub onto the palm of one hand. Follow the manufacturer's recommendations on the volume of product to use. Rub the agent vigorously into the hands until it evaporates and the hands are dry. Make sure the product covers all surfaces of the hands and fingers, including the tips of the fingers and the areas between the fingers, until the hands are dry.
- It should take 15 to 25 seconds for the hands to dry.

Surgical scrub with a waterless alcohol-based agent. It has been suggested that surgical teams should consider switching from the traditional surgical hand scrub to a soap and water wash (no brush), followed by an alcohol-based surgical hand and forearm rub.^{1,21}

Conclusion

Recent studies and new draft guidelines state that alcohol-based handrubs are the most effective agents for reducing the number of bacteria on the hands of health-care personnel.¹ Antiseptic soaps and detergents are the next most effective, and non-antimicrobial soaps are the least effective, despite having been, and in many cases remaining, the gold standard for hand hygiene. Soap and water are recommended for visibly soiled hands. Waterless antiseptic agents are recommended for routine decontamination of hands for all clinical indications (except when hands are visibly soiled) and as one of the options for the surgical hand hygiene. You can be a role model and “clean up your act,” so others are encouraged to clean up

Hand Hygiene

theirs. "Degerm" your hands "before" and "after" all patient contacts. Maintain your skin health. Promoting and monitoring hand hygiene is an essential barrier component of infection prevention. Consider the cost of a nosocomial infection in relation to the provision of hand hygiene products. It has been speculated that the cost of hand hygiene products for a whole facility is comparable to the cost of one nosocomial infection.²²



References

1. Boyce JM, Pittet D, Hand Hygiene Task Force, and the Healthcare Infection Control Practices Advisory Committee. Developed and sponsored by the CDC Healthcare Infection Control Practices Advisory Committee (HICPAC), the Society for Healthcare Epidemiology of America (SHEA), the Association for Professionals in Infection Control and Epidemiology (APIC), and the Infectious Diseases Society of America (IDSA). CDC draft 2002 guideline for hand hygiene in healthcare settings (under review) December 2001. www.cdc.gov/ncidod/hip/hhguide.htm
2. Garner JS, Favero MS: Hospital Infections Program Center for Infectious Diseases, Centers for Disease Control and Prevention. CDC guideline for handwashing and hospital environmental control 1985. *MMWR* 1987; 36:2S. www.cdc.gov/ncidod/hip/Guide/guide.htm
3. Larson EL: APIC Guidelines Committee. APIC guideline for handwashing and hand antisepsis in health-care settings. *Am J Infect Control* 1995 ;23:251-69.
4. Health Canada: Infection control guidelines. Handwashing, cleaning, disinfection and sterilization in health care. *CCDR* 1998; 24S8:1-9.
5. Health Canada: Infection control guidelines for routine practices and additional precautions for preventing the transmission of infection in health care. *CCDR* 1999; 25S4:1-142.
6. Pittet D, Boyce JM: Hand hygiene and patient care: Pursuing the Semmelweis legacy. *Lancet Infectious Diseases* 2001; April:9-20.
7. Pittet D, Dharan S, Touveneau S, et al: Bacterial contamination of the hands of hospital staff during routine patient care. *Arch Intern Med* 1999; 159:821-6.
8. Trick WE, Weinstein RA: Hand hygiene for intensive care unit personnel: Rub it in. *Crit Care Med* 2001; 29:1083-84.
9. Newman JL, Jampani HB. Waterless antimicrobial hand disinfection. *Surg Serv Management* March 2000; 6:36-39.
10. Larson E. Skin hygiene and infection prevention: More of the same or different approaches. *Clin Infect Dis* 1999;29:1287-94.
11. Larson EL, Aiello AE, Heilman JM, Lyle CT, Cronquist A, Stahl JB, Della-Latta P. Comparison of different regimens for surgical hand preparation. *AORN J* 2001; 73:412-4,417-8,420.
12. Jones RD, Jampani H, Mulberry G, Rizer RL. Moisturizing alcohol hand gels for surgical hand preparation. *AORN J* 2000; 71:584-7,589-90,592.
13. Hobson DW, Woller W, Anderson L, et al: Development and evaluation of a new alcohol-based surgical hand scrub formulation with persistent antimicrobial characteristics and brushless application. *Am J Infect Control* 1998; 26:507-12.
14. Boyce JM: Using alcohol for hand antisepsis: Dispelling old myths. *Infect Control Hosp Epidemiol* 2000; 21:438-41.
15. Boyce JM, Kelliher S, Vallande N: Skin irritation and dryness associated with two hand-hygiene regimens: Soap and water hand washing versus hand antisepsis with an alcoholic hand gel. *Infect Control Hosp Epidemiol* 2000 Jul; 21(7):442-8.
16. Pittet D, Hugonnet S, Harbarth S, et al: Effectiveness of a hospital-wide programme to improve compliance with hand hygiene. *Infection Control Programme. Lancet* 2000; 356:1307-12.
17. Pittet D: Improving compliance with hand hygiene in hospitals. *Infect Control Hosp Epidemiol* 2000; 21:381-6.
18. Larson E: Hygiene of the skin: When is clean too clean? *Emerg Infect Dis* 2001; 7:225-30.
19. Larson E, Silberger M, Jakob K, et al: Assessment of alternative hand hygiene regimens to improve skin health among neonatal intensive care unit nurses. *Heart Lung* 2000; 29:136-42.
20. Larson EL, Aiello AE, Bastyr J, et al: Assessment of two hand hygiene regimens for intensive care unit personnel. *Crit Care Med* 2001 May; 29(5):944-51.
21. Larson EL, Aillo AE, Heilman JM: Comparison of different regimens for surgical hand preparation. *AORN J* 2001; 73:412-32.
22. Jarvis WR: Selected aspects of the socioeconomic impact of nosocomial infections: Morbidity, Mortality, Cost, and Prevention. *Infect Control Hosp Epidemiol* 1996; 17:552-7.