

Hand Hygiene FactFinder

Committed to providing helpful information to International Spine Intervention Society members about key patient safety issues, the Society's Patient Safety Committee has developed a FactFinder series. FactFinders will explore and debunk myths surrounding patient safety issues. The intent of this FactFinder is to present the evidence regarding the importance of hand hygiene and its role in decreasing the risk of infectious complications following spinal procedures.

Myth: Washing hands with soap and water is as effective as using antiseptic solutions or surgical scrubs.

Fact: Non-antimicrobial soaps contain detergents that are effective in removing loose dirt, transient bacteria, and spores from skin surfaces. However, non-antimicrobial soaps have limited bactericidal activity compared to antimicrobial soap, antiseptic hand washes, or surgical scrubs.

Historical

In 1822, Labarraque, a French pharmacist, demonstrated that solutions containing chlorides of lime or soda could eradicate the foul odors associated with human corpses and that such solutions could be used as disinfectants and antiseptics. In an 1825 paper, he stated that physicians and other persons attending patients with contagious diseases would benefit from moistening their hands with a liquid chloride solution.¹ In 1847, students and physicians working at a maternity clinic were instructed to clean their hands with a chlorine solution between each patient, which resulted in a significant reduction of the maternal mortality rate for years. This intervention was the first evidence indicating that cleansing heavily contaminated hands with an antiseptic agent between patient contacts may reduce health care-associated transmission of contagious diseases more effectively than hand washing with plain soap and water.²

In 1975 and 1985, the Centers of Disease Control and Prevention (CDC) published formal written guidelines on hand washing practices in hospitals.^{3,4} These guidelines recommended hand washing with non-antimicrobial soap between the majority of patient contacts and washing with antimicrobial soap before and after performing invasive procedures or caring for patients at high risk. Use of waterless antiseptic agents (*e.g.*, alcohol-based solutions) was recommended only in situations where sinks were not available. In 1988, the Association for Professionals in Infection Control (APIC) initially published guidelines for hand washing and hand antisepsis similar to the CDC guidelines but updated APIC guidelines in 1995 included more detailed discussion of alcohol-based hand rubs and supported their use in more clinical settings than had been recommended in earlier guidelines.^{5,6} In 1995 and 1996, the Healthcare Infection Control Practices Advisory Committee (HICPAC) recommended that either antimicrobial soap or a waterless antiseptic agent be used for cleaning hands upon leaving the rooms of patients with multidrug-resistant pathogens (*e.g.*, vancomycin-resistant enterococci [VRE] and methicillin-resistant

Staphylococcus aureus [MRSA]).^{7,8} These guidelines also provided recommendations for hand washing and hand antisepsis in other clinical settings, including routine patient care. Although the APIC and HICPAC guidelines have been adopted by the majority of hospitals, adherence of health care workers (HCWs) to these recommended hand washing practices has remained low.^{9,10}

Normal Bacterial Skin Flora

To understand the objectives of different approaches to hand cleansing, knowledge of normal bacterial skin flora is essential. Normal human skin is colonized with bacteria. In 1938, bacteria recovered from the hands were categorized as transient or resident.¹¹ Transient flora, which colonize the superficial layers of the skin, are more amenable to removal by routine hand washing. They are often acquired by HCWs during direct patient contact or contact with contaminated surfaces within close proximity of the patient. Transient flora are the organisms most frequently associated with health care-associated infections. In contrast, resident flora are attached to deeper layers of the skin, more resistant to removal, and less likely to be associated with such infections. The hands of HCWs may become persistently colonized with pathogenic flora (*e.g.*, *S. aureus*), gram-negative bacilli, or yeast. Investigators have documented that although the number of transient and resident flora varies considerably from person to person, it is often relatively constant for any specific person.^{11,12}

Soaps

Plain (non-antimicrobial) soaps have detergent properties to remove dirt, soil, and various organic substances from the hands. They have minimal, if any, antimicrobial activity but can remove loosely adherent transient flora and spores. Antimicrobial soaps have the same properties as plain soaps with added antimicrobial activity.

Antiseptic Agents

Antiseptic agents are antimicrobial substances that are applied to the skin to reduce the number of microbial flora; they typically include chemicals such as alcohols, chlorhexidine, chlorine, or iodine. In the United States, antiseptic hand wash products intended for use by HCWs are regulated by the Food and Drug Administration's (FDA) Division of Over-the-Counter Drug Products.¹³ In 1994, FDA published a "Monograph for Health-Care Antiseptic Drug Products" that separated these antiseptic agents into three categories: preoperative skin preparations, antiseptic hand washes, and surgical hand scrubs. Preoperative skin preparations are fast-acting, broad-spectrum, and persistent antiseptic-containing preparations that substantially reduce the number of microorganisms on intact skin.

Antiseptic hand washes are designed for frequent use to reduce the number of microorganisms on intact skin after adequate washing, rinsing, and drying. They are broad-spectrum, fast-acting, and if possible, persistent (*i.e.*, will maintain a long duration of antiseptic activity). Surgical hand scrubs are antiseptic-containing preparations that substantially reduce the number of microorganisms on intact skin. They are broad-spectrum, fast-acting, and persistent.

Alcohol-based antiseptics

Numerous studies have documented the *in vivo* antimicrobial activity of alcohols in effectively reducing the bacterial counts on the hands of HCWs.^{11,14-16} In addition, alcohol-based products more effectively reduce bacterial counts than soaps or detergents containing hexachlorophene, povidone-iodine, or 4% chlorhexidine.¹⁷ In the United States, alcohol-based hand antiseptics contain isopropanol, ethanol, or a combination of the two. Their antimicrobial activity is attributed to their ability to denature proteins. Solutions containing 60%-95% alcohol are most effective and have excellent *in vitro* germicidal activity against gram-positive and gram-negative vegetative bacteria, including multidrug-resistant pathogens (*e.g.*, MRSA), Mycobacterium TB, and various fungi. Certain enveloped (lipophilic) viruses (*e.g.*, herpes simplex virus, HIV, influenza, etc.) are susceptible to alcohols when tested *in vitro*. However, alcohols are flammable, requiring providers to rub hands together after application of alcohol-based products until all the alcohol has evaporated.

Chlorhexidine

Preparations containing chlorhexidine act by disrupting the cytoplasmic membranes, resulting in precipitation of cellular contents. Therefore, chlorhexidine products must be repeatedly scrubbed on the skin for a set amount of time, in order to be effective. Compared to alcohol-based preparations, chlorhexidine's antimicrobial effect occurs more slowly. Chlorhexidine has good activity against gram-positive bacteria, and somewhat less activity against gram-negative bacteria and fungi. It has *in vitro* activity against enveloped viruses (*e.g.*, HSV, HIV, CMV, influenza, and RSV) but substantially less activity against non-enveloped viruses (*e.g.*, rotavirus, adenovirus, and enteroviruses). Addition of low concentrations (0.5%–1.0%) of chlorhexidine to alcohol-based preparations results in greater residual activity than alcohol alone. Care must be taken to avoid contact with the eyes when using preparations with >1% chlorhexidine, as it can cause conjunctivitis and severe corneal damage.

Iodine and Iodophors

Iodine has been recognized as an effective antiseptic since the 1800s. Iodophors have since replaced iodine as the active ingredient in antiseptics. Iodine molecules rapidly penetrate the cell wall of microorganisms to impair protein synthesis and alter cell membranes. These compounds must typically be allowed to dry on the skin for full antimicrobial activity. Iodine and iodophors have bactericidal activity against gram-positive, gram-negative, and certain spore-forming bacteria (*e.g.*, clostridia and *Bacillus* spp.) and are active against mycobacteria, viruses, and fungi. Povidone-iodine 5%-10% has been tentatively classified by FDA as a Category I agent (*i.e.*, a safe and effective agent for use as an antiseptic handwash).

Of note, none of the above agents (alcohols, chlorhexidine, iodophors) are reliably sporicidal against *Clostridium* spp. or *Bacillus* spp.

Surgical Scrubs

Bacteria on the hands of surgeons can cause wound infections if introduced into the operative field during surgery.¹⁸ Rapid multiplication of bacteria occurs under surgical gloves if hands are washed with a non-antimicrobial soap. However, bacterial growth is

slowed by preoperative scrubbing with an antiseptic agent.¹⁹ Reducing resident skin flora on the hands of the surgical team for the duration of a procedure reduces the risk of bacteria being released into the surgical field if gloves become punctured or torn during surgery.²⁰ Studies have demonstrated that formulations containing 60%-95% alcohol alone or 50%-95% alcohol combined with limited amounts of a quaternary ammonium compound, hexachlorophene, or chlorhexidine gluconate lower bacterial counts on the skin immediately after scrubbing more effectively than other agents. The next most active agents (in order of decreasing activity) are chlorhexidine gluconate, iodophors, triclosan, and plain soap.

Several studies have demonstrated that scrubbing for five minutes reduces bacterial counts as effectively as a 10-minute scrub.²¹⁻²³ In other studies, scrubbing for two or three minutes reduced bacterial counts to acceptable levels.²⁴⁻²⁶

Surgical hand-antiseptis protocols have required personnel to scrub with a brush, but this practice can damage the skin of personnel and result in increased shedding of bacteria from the hands.^{27,28} Scrubbing with a disposable sponge or combination sponge-brush has reduced bacterial counts on the hands as effectively as scrubbing with a brush.²⁹⁻³¹

Gloves

In addition to hand hygiene, the CDC has recommended that HCWs wear gloves to: 1) reduce the risk of personnel acquiring infections from patients, 2) prevent health-care worker flora from being transmitted to patients, and 3) reduce transient contamination of the hands of personnel by flora that can be transmitted from one patient to another. The effectiveness of gloves in preventing contamination of HCWs' hands has been confirmed in several clinical studies and the Occupational Safety and Health Administration (OSHA) mandates that gloves be worn during all patient-care activities that may involve exposure to blood or body fluids that may be contaminated with blood.

Summary

- Hospital-based studies have demonstrated a temporal relationship between improved hand-hygiene practices and reduced infection rates.
- The effectiveness of hand hygiene depends on the amount of hand-hygiene solution used, the duration of hand-hygiene procedure and the selection of hand-hygiene agent(s).
- Alcohol-based hand rubs are the most efficacious agents for reducing the number of bacteria on the hands of personnel.
- Antiseptic soaps and detergents are the next most effective.
- Non-antimicrobial soaps are the least effective.

Final Recommendations

- When hands are visibly dirty or contaminated with proteinaceous material, blood, or other body fluids, hands should be washed, at a minimum, with either a non-antimicrobial soap and water or an antimicrobial soap and water.
- If hands are not visibly soiled, use an alcohol-based hand rub to routinely decontaminate hands.

- Decontaminate hands, if possible with an alcohol-based hand rub (and if not, with an antiseptic soap), before having direct contact with patients, before donning sterile gloves for sterile procedures, and after contact with a patient's intact skin (*e.g.*, taking a pulse or BP).
- Before eating and after using a restroom, wash hands, at a minimum, with a non-antimicrobial soap and water or with an antimicrobial soap and water.
- Antimicrobial-impregnated wipes (*i.e.*, towelettes) may be considered as an alternative to washing hands with non-antimicrobial soap and water. Because they are not as effective as alcohol-based hand rubs or washing hands with an antimicrobial soap and water for reducing bacterial counts on the hands of HCWs, they are not a substitute for using an alcohol-based hand rub or antimicrobial soap.

References:

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