

REVIEW ARTICLE

HAND HYGIENE - A REVIEW

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ABSTRACT

Hand hygiene is the primary measure to reduce infections. It is a simple action, but the lack of compliance among healthcare providers worldwide is a problem. Hand hygiene has been described as the cornerstone and starting point in all infection control programs, with the hands of healthcare staff being the drivers and promoters of infection in critically ill patients. In both healthcare and community settings, alcohol-based hand sanitizers have become a popular alternative to traditional handwashing with soap and water. The review gives an insight into hand hygiene, the types and indications of hand washing and hand sanitizers.

Key words: Hand hygiene, disinfection, asepsis, cross infection

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INTRODUCTION

The human skin is a reservoir of numerous microorganisms. Price, in 1938, divided the microorganisms recovered from hand into two categories: resident flora and transient flora. The resident flora is permanent inhabitant of the skin, colonize deeper layers of skin, are usually non-pathogenic, and are more resistant to removal. The transient flora on the other hand are mainly acquired from the environment or by direct contact with patients, usually do not multiply on the skin, colonize superficial layers of skin, and are most often responsible for cross infections in hospitals.¹

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Hand hygiene

Hand hygiene has been described as the cornerstone and starting point in all infection control programs, with the hands of healthcare staff being the drivers and promoters of infection in critically ill patients. Hand hygiene is identified as the treating intervention strategy that reduces cross-transmission of pathogens in the healthcare environment. It has been proven to reduce the incidence of nosocomial infections³.

In the wake of the growing burden of healthcare-associated infections, the increasing severity of illness and complexity of treatment, superimposed by multi-drug resistant pathogen infections, health care practitioners are reversing back to the basics of infection preventions by simple measures like hand hygiene. With “Clean Care is Safer Care” as a prime agenda of the global initiative of the World Health Organization on patient safety programs, it is time for developing countries to formulate the much-needed policies for implementation of basic infection prevention practices in health care set-ups.⁴

Microflora of hands

There are two types of micro-organism that colonize hands: the resident flora, which consists of microorganisms residing under the superficial cells of the

stratum corneum, and the transient flora, which colonizes the superficial layers of the skin, and is more amenable to removal by routine hand hygiene. Transient microorganisms survive, but do not usually multiply on the skin. They are often acquired by health care workers during direct contact with patients or their nearby contaminated environmental surfaces and are the organisms most frequently associated with health care associated infections. The hands of health care workers are commonly colonized with pathogens like methicillin-resistant *S. aureus* (MRSA), vancomycin resistant *Enterococcus* (VRE), MDR-Gram Negative bacteria (GNBs), *Candida* spp., and *Clostridium difficile*, which can survive for as long as 150 hours. Approximately 10⁶ skin epithelial cells containing viable microorganisms are shed daily from the normal skin. The hands may become contaminated by merely touching the patient's intact skin or inanimate objects.⁴

Types of handwash

Hand washing with soap and water has been considered a measure of personal hygiene since ages. Three main broad types of procedures can be employed for hand hygiene.

- 1) **Social Hand wash** - using plain non-medicated soap.
- 2) **Antiseptic and surgical hand wash** - using medicated soap.
- 3) **Hygienic and surgical hand disinfection** - using antiseptic leave on preparation.

Handwashing with soap and water removes excess organic matter and temporarily reduces the number of resident and transient flora. Antiseptics enhance the antibacterial effect and hence the transient flora is almost eliminated.

Alcohol-based hand rubs have been recommended for use in health care settings for hand hygiene.⁵

Indications for Hand Washing

The Centre for Disease Control and Healthcare Infection Control Practices Advisory Committee outlines the following indications⁶

- A. Wash hands with soap and water when visibly dirty or visibly soiled with blood or other body fluids or after using the toilet.
- B. If exposure to potential spore-forming pathogens is strongly suspected or proven, hand washing with soap and water is the preferred means.
- C. Use an alcohol-based hand rub as the preferred means for routine hand antisepsis in all other clinical situations described in items D(a) to D(f) listed below if hands are not visibly soiled. If alcohol-based hand rub is not obtainable, wash hands with soap and water.
- D. Perform hand hygiene:
 - a. before and after touching the patient.
 - b. before handling an invasive device for patient care, regardless of whether or not gloves are used.
 - c. after contact with body fluids or excretions, mucous membranes, non-intact skin, or wound dressings.
 - d. if moving from a contaminated body site to another body site during care of the same patient.
 - e. after contact with inanimate surfaces and objects (including medical equipment) in the immediate vicinity of the patient.
 - f. after removing sterile or non-sterile gloves.
- E. Before handling medication or preparing food to perform hand hygiene using an alcohol-based hand rub or wash hands with either plain or antimicrobial soap and water
- F. Soap and alcohol-based hand rub should not be used concomitantly.

Hand Sanitizers

One of the many ways implemented to prevent the spread of infections is frequent and effective handwashing. In both healthcare and community settings, alcohol-based hand sanitizers have become a popular alternative to traditional handwashing with soap and water. Alcohol-based hand sanitizers have been utilized as an effective alternative to handwashing to prevent the spread of bacterial and viral infections, making it one of the essential proto-

cols in decreasing the healthcare burden. A range of hand sanitizers is available with various combinations of ingredients and modes of delivery.

The emergence of novel pathogens, bacterial or viral, has always posed serious challenges to public health around the globe. One of these dangerous pathogens is “severe acute respiratory syndrome coronavirus 2” or SARS-CoV-2, more commonly known for causing coronavirus disease 2019 or COVID-19, which has been declared a global pandemic by the World Health Organization in early 2020.^{7,8}

There are 2 large categories of hand sanitizers:

- (1) non-alcohol based hand sanitizers (NABHS)
- (2) alcohol-based hand sanitizers (ABHS).

The most common primary active ingredient of NABHS, benzalkonium chloride, quaternary ammonium, is a commonly used disinfectant. Disinfectants with benzalkonium chloride are generally less irritating than those with alcohol, though more recent evidence suggests it may cause contact dermatitis more often than previously thought. Although ABHS is less user-friendly on the skin than NABHS, ABHS predominate in health care settings given their low cost and efficacy of reducing infectious transmission. NABHS, however, are less worrisome regarding their flammability and abuse potential. Hand sanitizer preparations containing alcohol on the other hand can include ethanol, isopropyl alcohol, n-propanol, or a combination of these, water, as well as excipients and humectants. Solutions containing alcohols between 60% and 95% in the volume are most prevalent and effective. Humectants are included to prevent skin dehydration and excipients help stabilize the product as well as prolong the time needed for the evaporation of alcohol, thereby increasing its biocidal activity.⁷

Efficacy of Hand Sanitizers against microbes

Bacteria and fungi

Traditionally, bacteria on hands can be categorized as resident and transient floras. Common resident

floras include *Staphylococcus aureus*, *Staphylococcus epidermidis*, and *Enterococcus faecalis*, which colonize deep layers of the skin and are resistant to mechanical removal. On the other hand, transient floras such as *Staphylococcus aureus*, *Escherichia coli*, and *Pseudomonas aeruginosa*, colonize the superficial layers of skin. Numerous bacterial strains can be transmitted to the host from other sources that can potentially develop into a variety of bacterial infections. ABHS are very effective or quickly destroying many pathogens by the action of the aqueous alcohol solution without the need for water or drying with towels. According to the Centres for Disease Control and Prevention (CDC), ABHS has excellent *in vitro* antimicrobial activity, including multi-drug-resistant pathogens, such as methicillin-resistant *Staphylococcus aureus*, vancomycin-resistant *Enterococcus*. Specific *in vitro* studies show that hand sanitizers containing 60%-80% ethanol produced 4 to 6 log reduction in 15-30 seconds against a range of bacterial and fungal species. Numerous studies have also documented *in vivo* antimicrobial activity from contaminated hands. Different alcohol-based hand sanitizers have demonstrated antimicrobial effects against various gram-positive and gram-negative bacteria using the Kirby-Bauer method. With the increasing use of hand sanitizers as an infectious control measure, it is also important to note any potential tolerance mechanisms from bacteria.⁷

Viruses

Although viruses are more difficult to directly study *in vivo* compared to bacteria, numerous studies have attempted to validate the effectiveness of hand sanitizers on viruses. The World Health Organization recommends alcohol-based hand sanitizer formulations against bovine viral diarrhea virus, hepatitis C virus, Zika virus, murine norovirus, and coronaviruses as shown with effective inactivation in quantitative suspension tests. Other formulations from Sterillium that contain isopropanol as the main ingredient also completely inactivated enveloped enteric and respiratory viruses, such as H1N1 influenza A virus, but failed to inactivate nonenveloped viruses, except rotavirus. As evidence on the novel SARS-CoV-2 continues to rapidly emerge, data from previous coronaviruses can be extrapolated in the context of

the efficacy of hand disinfection given their structural similarity.⁷

Sanitizers versus soaps

Numerous hand sanitizers, consisting of different ingredients and methods of application, have been compared. However, the CDC recommends washing hands with soap and water whenever possible over hand sanitizers, in the community setting. This is because handwashing reduces the amounts of all types of germs and chemicals on hands. But if soap and water are not available, using a hand sanitizer with at least 60% alcohol can help you avoid getting sick and spreading germs to others. Hand sanitizers may not be as effective when hands are visibly dirty or greasy. The guidance for effective handwashing and use of hand sanitizer in community settings was developed based on data from several studies conducted in community settings.⁹⁻¹¹ Regarding clinical settings, studies show that hand sanitizers work well, where hands come into contact with germs but generally are not heavily soiled or greasy.^{5,11-13}

Selection of hand sanitizers

The major determinants for selection of hand hygiene products are antimicrobial profile, user acceptance, and cost. Post-contamination hand hygiene products must have at least bactericidal, fungicidal (yeasts), and virucidal (coated viruses) activity. Since hands of HCWs are frequently contaminated with blood during routine patient care, activity against coated viruses should be included in the minimum spectrum of activity of an agent for hand hygiene. Additional activity against fungi (including molds), mycobacteria, and bacterial spores may be relevant in high-risk wards or during outbreaks. Pre-operative hand hygiene should be at least bactericidal and fungicidal (yeasts) since the hands of most HCWs carry yeasts and surgical-site infections have also been associated with hand carriage of yeasts during an outbreak. Hospital administrators should also consider the acceptability of the product (smell, feel, skin irritation) by the users and its allergenic potential. An alcohol-based hand rub requires less time, is microbiologically more effective, and is less irritating to the skin than traditional handwashing with soap and water.⁴

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