Hand Hygiene: An Update

Maureen K. Bolon, MD, MS

KEYWORDS

- Hand hygiene • Handwashing • Alcohol-based hand rub
- Health care-associated infections

KEY POINTS

- Hand hygiene by health care workers is a key factor in preventing health care–associated infections, yet hand hygiene occurs only 40% of the time.
- Alcohol-based hand rubs offer excellent antimicrobial killing, while facilitating hand hygiene with their ease of use.
- New technologies offer innovative ways to monitor and improve hand hygiene by health care workers, yet costs and limitations remain.

INTRODUCTION

The crucial role of hand hygiene in the prevention of health care–associated infection was initially established independently by Oliver Wendell Holmes and Ignaz Semmelweis in the 1840s.[1] Semmelweis, whose insights predated the germ theory by several decades, is credited with recognizing that the hands of medical staff were contaminated while performing autopsies and consequently were responsible for the transmission of "cadaverous particles" during obstetric examinations, leading to puerperal sepsis and death.[2] He further demonstrated that hand antisepsis with chlorinated lime resulted in a dramatic decrease in maternal mortality. More than a century later, Mortimer and colleagues[3] established the importance of hand hygiene in preventing *Staphylococcus aureus* transmission in a neonatal unit. When cared for by nurses who did not perform hand hygiene, infants in this study were more likely to acquire *S aureus* than those cared for by nurses who performed hand hygiene with hexachlorophene. As was the case in Semmelweis' time, evidence of the benefits of hand hygiene have not translated into universal adoption of the practice. Recent decades have seen major advances in medical science, including in the field of health care epidemiology. Yet, despite these advances and the development of well-accepted guidelines regarding the practice of hand hygiene, rates of hand hygiene performance by health care workers remain disappointingly low.

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Division of Infectious Diseases, Department of Medicine, Northwestern University Feinberg School of Medicine, 645 North Michigan Avenue, Suite 900, Chicago, IL 60611, USA
E-mail address: m-bolon@northwestern.edu

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HUMAN SKIN AND SKIN FLORA

Human skin is colonized with bacteria. Counts vary depending on body location; bacterial counts on the hands of health care workers have been reported to range from 3.9×10^4 to 4.6×10^6 colony-forming units (CFUs)/cm^2.[1] Two classifications of skin flora have been delineated: transient flora and resident flora. Transient flora are those associated most frequently with health care–associated infections and are, therefore, the primary target of hand hygiene within the health care setting. Transient flora reside in the uppermost level of the stratum corneum and are acquired by direct contact with patients or with environmental surfaces associated with patients.[1] These loosely adherent organisms can be transmitted to other patients or to the environment if they are not removed by mechanical friction, the detergent properties of soap and water, or killed by antiseptic agents.[4] Numerous pathogens have been identified among the transient flora of health care workers' hands, including *S aureus*, *Klebsiella pneumoniae*, *Acinetobacter spp*., *Enterobacter spp*., and *Candida spp*. Health care workers with skin damage or chronic skin conditions are more likely to be colonized with pathogenic organisms in greater quantities (both the number of different organisms and the bacterial counts), which can make them more likely to transmit infectious pathogens.[5,6] Resident flora are the low-pathogenicity, permanent residents of the deeper layers of the skin.[4,7] These organisms cause infection only when a normal barrier is disrupted, such as with the placement of an intravenous catheter. Resident flora cannot be removed solely by mechanical friction; thus, an antiseptic agent must be used before the performance of invasive procedures. Surgical hand antisepsis is a special case, in that the goal is to reduce resident flora for the duration of the surgical procedure to prevent contamination of the surgical field if a glove becomes punctured or torn.[1]

To interrupt transmission of health care–associated infections spread via health care workers' hands, it is useful to consider the sequence of events necessary for this to occur[1]:

1. Organisms present on the patient's skin or in the proximity of the patient are transferred to the hands of the health care worker;
2. Organisms must be capable of surviving for a short period on the hands of the health care worker;
3. Hand hygiene is inadequate, performed with an inappropriate agent, or omitted entirely; and
4. Contaminated hands of the health care worker must come in direct contact with another patient or with an inanimate object that will come in direct contact with the patient.

The contribution of contact with the immediate patient environment (as opposed to the patient directly) to the contamination of health care workers' hands must be emphasized. Viable organisms are present in the 10^6 skin squames that humans shed daily; these may proceed to contaminate patient gowns, bed linen, and furniture.[1] Organisms that are resistant to desiccation, such as staphylococci and enterococci, may thereby join transient flora on the hands of health care workers.

Hand hygiene terms are listed in **Table 1**. The antimicrobial activity of the 3 categories of hand hygiene agents (plain soap, alcohol-based hand rub, and antimicrobial soap) are discussed herein. Handwashing with plain soap removes dirt and transient flora via a detergent effect and mechanical friction. The log reduction of hand flora increases with duration of handwashing, but because the duration of handwashing averages from 6 to 24 seconds in observational studies of health care workers, a realistic expectation would be a reduction of 0.6 to 1.1 $\log_{10}$ CFU after a "typical"