



Handwashing: Problems and Solutions: Part I & II

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One of the greatest triumphs of science and medicine over the last two millennia has been the identification of the causal link between microorganisms and infection. The pioneering works of Pasteur, Fleming, and Semmelweis laid the foundation for a fortress of health protections, which has proven virtually unbreachable until approximately a decade ago. Aggressive public health campaigns minimized outbreaks of pneumonia, polio, and small pox and left the public with the general impression that epidemics caused by microorganisms were a thing of the past. The times are definitely changing, however. The emergence of resistant strains of tuberculosis, the global spread of acquired immunodeficiency virus (AIDS), and the appearance of hantavirus and hemorrhagic fever produced by the Ebola virus give a clear indication that the struggle to overcome unseen pathogens is far from over. This situation has prompted the Centers for Disease Control and Prevention (CDC) to review its policy on prevention and response to global epidemics, both natural and man-made. The present stance of the CDC has been presented in its policy entitled, Preventing Emerging Infectious Diseases: A Strategy for the 21st Century.¹ This plan is the second phase of an effort launched in 1994 with the publication of CDC's Addressing Emerging Infectious Disease Threats: A Prevention Strategy for the United States.² While the implementation of this project is well underway and already producing results, fulfilling CDC's broader vision for a safer world will require a long-term commitment and sustained effort organized around the four interdependent goals of: 1) Surveillance and Response; 2) Applied Research; 3) Training and Infrastructure; and 4) Prevention and Control. If the US is going to be effective in establishing international strategies to meet these goals, a review of effectiveness of the existing procedures for infrastructure, training, and prevention is merited at the national and local (hospital/clinical) levels.

Among the vast arsenal of measures for dealing with microbial infections, one of the most effective is the straightforward practice of handwashing. Numerous studies support the finding that handwashing reduces carrying pathogens on the hands and nosocomial infections. In an evaluation of the effectiveness of handwashing practices aimed at preventing nosocomial infections, Steere, *et. al.*,³ found that handwashing is generally considered to be the most important procedure for prevention of nosocomial infections. The CDC's position is presented clearly by Garner and Favero,⁴ which also pinpoints

handwashing as the single most important method of preventing nosocomial infections. In a useful, recent mathematical model of the dynamics of transmission of nosocomial infections, Cooper, *et. al.*,⁵ examined the spread of a handborne nosocomial pathogen, *S. aureus* in a general medical ward. Even small increases in the frequency of effective handwashes

were found to be sufficient to bring endemic organisms under control. In an excellent literature review of the link between hand hygiene and nosocomial infections, Larson⁶ finds evidence for a causal relationship between good hand hygiene and reduced pathogen transmission. Another recent analysis examined the progression of the foodborne illness outbreak of *E. coli* O157: H7 in New York, 1999. Handwashing was found to be the most important factor in preventing the secondary spread of the infection. Of the over 900 children primarily infected with the pathogen, only 10 received the infection secondarily.⁷ All of the data clearly demonstrate that handwashing is an effective means for decreasing the morbidity and mortality from nosocomial infections arising from hand-transmitted pathogens.⁸⁻¹⁰

General Indications for Handwashing

Handwashing guidelines have been developed by several regulatory agencies but are fairly summarized in the Guideline for Handwashing and Hospital Environmental Control for the CDC⁴ and in the more recent APIC Guideline for Hand Washing and Hand Antisepsis in Health-care Settings.¹¹ In the CDC guideline, handwashing is defined as the vigorous rubbing together of all surfaces of soap-lathered hands

followed by rinsing under a stream of water. Handwashing with plain (non-antimicrobial) soaps or detergents (in bar, granule, leaflet, or liquid form) suspends microorganisms and allows their removal via rinsing. This mechanical degerming process can be improved by up to 10 fold with the addition of chemical antimicrobial agents, depending on the nature of the added antimicrobial agent. The net degerming process achieved with this type of formulation is due both to mechanical removal, and chemical inactivation of microorganisms. The improvement achieved by the addition of an antimicrobial agent is demonstrated by ideal results obtained from the test protocol recommended by the FDA for the *in vivo* performance assessment of healthcare personnel handwashes (21CFR333.470, 1994).¹² This protocol tests a product's antimicrobial activity with a series of 10 sequential bacterial hand contaminations followed by subsequent washing after each contamination with a control, non-medicated soap (wash 1), or the test product (washes 2-10) and a 30-second rinse. The bacteria remaining on the hands are recovered after this glove juice sampling, the excess antimicrobial agent is neutralized, and a sample is plated on growth agar for enumeration 24-48 hours later. Under these circumstances, a non-antimicrobial handwash will achieve about a ten-fold (1 log₁₀) reduction of bacteria on the hands. In contrast, satisfactory performance of a healthcare personnel antiseptic handwash is achieved when the antimicrobial formulation produces a 100 fold (2 log₁₀) reduction after the first use, and a 1000 fold (3 log₁₀) reduction after the tenth use. The results of Dyer, *et al.*,¹⁸ show the degerming activity is improved by adding an effective antimicrobial component (in this case benzalkonium chloride) to a non-antimicrobial formulation (containing surfactants and allantoin). Those results indicate that a non-antimicrobial soap fails to remove transient pathogenic microorganisms sufficiently when contamination is heavy. The literature contains numerous similar examples of this effect. The recommendation from the 1985 CDC guideline that plain soap be used for handwashing unless otherwise indicated was promoted based upon a lack of evidence to justify the use of antimicrobial handwashes. However, in the light of these more recent findings, it is apparent that the use of medicated soaps and/or lotions whose *in vitro* and *in vivo* performance meets the above-mentioned Federal standards is warranted. As stated by Larson, (1995)¹¹, parameters for the selection and use of antiseptic agents in the healthcare setting should depend upon the product's intrinsic *in vitro* and *in vivo* performance and for its antimicrobial spectrum of activity.

Active Ingredients

The APIC Guideline¹¹ supplies a review of the benefits and disadvantages of several of the active agents most commonly used in topical antimicrobial antiseptic handsanitizers and handwashes. Briefly, the six antiseptic active ingredients are alcohol, chlorhexidine gluconate, iodine and iodophors, hexachlorophene, and parachlorometaxyleneol.

Alcohol (either ethanol at 62-70% vol/vol in water, n-propanol, or isopropanol) provides a rapid reduc-

tion in microbial counts on the skin surface. They are useful against a broad range of gram-positive and gram-negative bacteria, and a wide variety of fungi and viruses (*in vitro*). Since the antiviral activities of alcohol derive from *in vitro* studies, the ability of alcohol to prevent transmission of these viruses to healthcare workers is unknown. A one-minute vigorous rubbing with enough alcohol to cover the hands completely has been shown to be an effective method for hand antisepsis. Negative aspects of alcohol sanitizers include a lack of chemical persistence of activity, a strong tendency to dry the skin, and flammability. Alcohol sanitizers are also not recommended for use in the presence of physical dirt.¹¹

Chlorhexidine gluconate (CHG) has a broad antimicrobial spectrum with better activity against gram-positive bacteria than gram-negative bacteria. It inhibits fungal growth and is active against enveloped viruses *in vitro*. Since the antiviral activity of CHG is derived from *in vitro* studies, the ability of CHG to prevent transmission of these viruses to healthcare workers is unknown. CHG is nontoxic, and has a low skin-irritation potential. It has limited systemic absorption, but has some potential for sensitization of the skin. The activity of CHG is not affected significantly by blood or other organic material but is reduced in very acidic and basic conditions and in the presence of anionic and nonionic surfactants. Because of this, the activity of CHG is formulation dependent.

Iodine and iodophors have been used widely in clinical perioperative applications for years. Products used for handwashing and surgical scrub applications employ poly-vinylpyrrolidone (PVP) to limit the instantaneous availability of the iodine molecule. This type of formulation presents a tremendous utility in topical iodine antiseptic applications as unbuffered iodine can have very adverse effects on skin. The antimicrobial spectrum of iodine includes gram-negative and gram-positive bacteria, fungi, and viruses. As above, since the antiviral activity of iodine is derived from *in vitro* studies, its ability to prevent transmission of these viruses to healthcare workers is unknown. Iodine and to some extent the PVP-iodine solutions can cause skin irritation and sensitization reactions. Systemic absorption is significant, and has been associated with the induction of hyperthyroidism in infants. Iodophore solutions containing 7.5% freely-available iodine (*e.g.* povidone iodine) are used as surgical scrubs, and concentrations as low as 0.05% free iodine have been shown to have good antimicrobial activity.

Chloroxylenol (parachlorometaxyleneol, PCMX) in solutions ranging from 0.5% - 3.75% is less active than CHG and has better activity against gram-positive than gram-negative bacteria. Activity is improved in the presence of a cationic chelator, such as ethylenediaminetetraacetic acid (EDTA). PCMX is active against tubercle bacillus, some fungi and viruses, although its ability to prevent virus spread in healthcare workers has not been ascertained. Although it penetrates the skin, it has a low potential for skin irritation and sensitization. On the other hand, PCMX is inactivated by nonionic surfactants and in acidic conditions. Therefore, the efficacy of PCMX is, as CHG, highly formulation dependent.

Triclosan has concentration-dependent activity against gram-positive and gram-negative bacteria although to a lesser degree than any of the agents mentioned above. It has been used widely in commercial soaps and detergents but is often employed at concentrations beyond those found to be maximally-effective by FDA review (*i.e.* 0.2%).¹² At recommended concentrations, triclosan tends toward inhibitory rather than cidal antibacterial action. In a recent test, a commercially-available solution of 2% triclosan for use as a healthcare personnel handwash product did not meet federal performance standards.⁶⁹ Although it has been pointed out that to date there have been no reports of use-associated antimicrobial resistance to triclosan,¹³ the compound has recently been demonstrated *in vitro* to cause drug resistance in important pathogens.¹⁴⁻¹⁶ This may have a significant impact on its long-term application for both healthcare and domestic uses. Because of the above limitations, the application of triclosan in healthcare settings is questioned.

In addition to the actives mentioned above, recent literature suggests that benzalkonium chloride (BAC), a broad-spectrum antimicrobial agent that has been used for decades for surface sanitation in the healthcare industry and that has been approved for use as an OTC topical antiseptic at concentrations between 0.1-0.13% has useful applications in antiseptic formulations. Although BAC by itself is inactivated in the presence of hard water and anionic soaps and detergents, a significant improvement of activity is gained when BAC is contained in a formulation of nonionic and amphoteric surfactants, hydroxypropylmethylcellulose (HPMC), and allantoin, a natural skin protectant (SAB formulation). In such a formulation, the activity of BAC is improved greatly against gram-positive and gram-negative bacteria, fungi, and lipid-enveloped viruses, and the potential for skin irritation and sensitization is decreased.^{17,18} Because effectiveness in the application of hand antiseptic has only been demonstrated for BAC in the above mentioned SAB application, the use of BAC is highly formulation dependent.

Healthcare Personnel Handwash

Although stringent, the existing Federal standard¹² is a thorough and effective method of measuring a formulation's clinical suitability. In general, acceptable formulations for a healthcare personnel handwash should 1) possess a broad spectrum of antimicrobial activity, including activity against Gram-positive and Gram-negative bacteria, yeast, and molds; 2) must be quick-acting (generally accepted as 15-30 seconds for practical use); 3) must be effective in the presence of a heavy soil load; and 4) must demonstrate a persistence of activity with continued use.¹⁹ When reviewing a product for clinical acceptability as a healthcare personnel handwash, the infection control staff can distinguish acceptable formulations quickly by examining the antimicrobial spectrum of the finished product and by determining whether the product meets the bacterial load reduction requirements (given above) in the 10 handwash glove juice protocol

with *Serratia marcescens* (a 2 log₁₀ reduction by wash 1, and a 3 log₁₀ reduction by wash 10). Recent publications²⁰ have made use of similar testing procedures from the American Society for Testing and Materials (ASTM) upon which the Federal 10-handwash protocol was based (ASTM E 1174-94).²¹ Although the Federal protocol was based on the ASTM protocol, certain differences between the two exist, including the requirement of a shorter period of time for the drying-on of the applied microorganisms prior to the test wash in the ASTM protocol. A shorter drying-on time may cause a lesser adherence of bacteria to the skin, thereby facilitating mechanical removal through handwashing and rinsing.

Surgical Scrubs

Under the surgical scrub test, acceptable formulations will 1) produce a 1 log₁₀ reduction from the baseline skin microorganism count after the first scrub with the bacterial count not exceeding the baseline after 6 hours of gloved occlusion on the first day of the test procedure; 2) produce a 2 log₁₀ reduction from the baseline skin microorganism count after the third scrub with the bacterial count not exceeding the baseline after 6 hours of gloved occlusion on the second day of the test procedure; 3) produce a 3 log₁₀ reduction from the baseline skin microorganism count after the first scrub, with the bacterial count not exceeding the baseline after 6 hours of gloved occlusion on the fifth (final) day of the test procedure; and 4) meet *in vitro* antimicrobial performance standards given in 21 CFR 333.470). Paulson²² has presented an excellent examination of the antimicrobial properties of 5 surgical scrub preparations with the FDA protocol mentioned above. The formulations' immediate (within 60 seconds after product use), persistent (up to several hours after product use), and residual (24 hours after product use) antimicrobial effectiveness properties were evaluated. It was found that 2% and 4% CHG solutions possessed significant immediate, persistent, and residual antimicrobial activities. An iodophor product possessed immediate and persistent properties but lacked significant residual efficacy. A PCMX product showed low levels of immediate and persistent activity with no residual activity, and an alcohol detergent composition did not meet Federal performance standards, the latter having failed to produce statistically significant immediate or residual effects. In spite of a growing movement for the acceptance of alcohol for use as the active ingredient in surgical scrub preparations, this finding prompted the author to question the suitability of the alcohol product for this application. In addition, it was pointed out that such compositions may be better suited for applications requiring good, immediate antimicrobial effectiveness in skin antiseptics, such as skin prep solutions for phlebotomy.

Perioperative Skin Preparations

The Federal standards for a perioperative skin preparation consist of the same *in vitro* activity requirements as described for the surgical scrub and healthcare personnel handwashes. Performance

standards also require that these compositions decrease native bacteria count 2 log₁₀ units per square centimeter on an abdominal test site and 3 log₁₀ units per square centimeter on a groin test site and that subsequent bacterial counts not exceed the baseline value within 6 hours after product use. In the application of skin preparation for injection, a product should reduce the bacteria content 1 log₁₀ unit per square centimeter on dry skin. In addition to the above products whose performance standards are given in tentative final monograph form, the category of instant hand sanitizer has arisen in the past few years. Although no federal monograph exists yet that covers this type of application, the category of product may be thought of loosely as a topical antiseptic intended for protracted use. The need for this type of product has been pointed out in several studies,^{18, 23} citing primarily time and/or facility constraints to proper handwashing. The 1985 CDC Guideline and the APIC Guidelines indicate that antimicrobial-containing foams and rinses may be used in areas without easy access to sinks but does not provide strict performance standards for these compositions. At present, the majority of products available to the medical professional contain either ethanol (62-70%) or isopropanol. The FDA has made its product performance expectations for this type of product known¹⁹; moreover, these expectations parallel existing standards for healthcare personnel handwashes, *i.e.*, quick antimicrobial efficacy, broad antimicrobial spectrum, an ability to perform under a heavy soil load, and persistence of activity. Alcohol-based instant hand sanitizers constitute the majority of products presently available to the medical industry but meet only 2 of these 4 criteria, *i.e.*, speed of action and breadth of antimicrobial spectrum. Larson¹¹ questioned the use of alcohol-based products in situations of heavy soil load (dirt, organic contaminants) and moderate amounts of blood and also pointed out that a major disadvantage of alcohol-based products for skin antiseptics is the skin-drying effect associated with long-term use, although some emollient-containing formulations have been developed to minimize this effect. In addition, several studies have shown that alcohol-based instant hand sanitizers fail to meet the performance standards of the 10 handwash glove-juice protocol with *Serratia marcescens* for healthcare personnel antiseptic handwash formulations.^{18, 20, 24} The performance of this type of sanitizer worsens with frequent continued use as determined by the 10-handwash protocol. In a test using a modification of the ASTM protocol, Paulson noticed this effect and ascribed it to artifact associated with the omission of a water rinse after hand sanitization. Because the deterioration of effectiveness has also been observed in protocols that include a water rinse after the use of the sanitizer,¹² the possibility exists that a long-term alcohol sanitizer use may disturb the stratum corneum barrier and allow transient microorganisms to become deeply incorporated into the skin. Some support for this is provided by Miller, *et al.*,²⁵ who in a review of alcohol-based instant hand sanitizers food service workers, found that such products actually increase the surface load of bacteria on the hands. This effect may be similar in origin to that

caused by plain anionic soap and water, in which frequent handwashing trauma increases the shedding of viable bacteria in desquamating epithelium.²⁶⁻²⁸ Furthermore, it is known that hands damaged from excessive handwashing can carry an increased load of bacterial pathogens,²⁶⁻²⁷ suggesting that long term use of handwashing agents, which significantly alter the structure of the stratum corneum can increase the skin-bacterial load of medical professionals and therefore increase the potential for hand-transmission of nosocomial infections. This finding is supported in the literature^{28,30,31} and has been attributed to the removal of some skin lipid layer during washing.³²⁻³³ Furthermore, ethanol has been employed widely to increase stratum corneum permeability for topically applied drugs.³⁴⁻³⁹ Therefore, ethanol may cause a physicochemical perturbation of either the lipid-lamellar structure, or the protein structure, or both, of the stratum corneum that allows the passage of native flora from the deeper layers of the skin to the skin surface, or transiently acquired pathogens to become more deeply integrated into the stratum corneum. The introduction of pathogenic deep-seated bacteria could potentially disrupt the micro-ecosystems of native skin flora,³² and would certainly be more difficult to remove with routine hand sanitization measures. Therefore, the development of an instant hand sanitizer formulation that did not disrupt the stratum corneum structure with long term use and which met the performance criterion given by FDA would be useful to the medical community. One such formulation (SAB formulation mentioned earlier) was the subject of a set of recent effectiveness studies.^{18,24} This formulation met Federal performance standards for a healthcare personnel handwash as given in 21CFR 333.470.

Handwashing Compliance: A Nightmare

Formulation issues aside, the hospital infection control staff should always peruse product literature closely to determine if the data presented support the claims made and whether products meet FDA performance standards. In addition, the choice of the antiseptic product should always be reviewed for the application in which it will be used; the ultimate goal is to increase user compliance while decreasing nosocomial infections arising from poor hand hygiene.⁴ This, unfortunately, is not a simple task: the figure for handwashing non-compliance healthcare personnel is estimated at an astonishing 70-80%. Watanakunakorn, *et al.*,⁴⁰ performed a six-week observational study of handwashing and infection control practices in a community teaching hospital and found the prevalence of handwashing to be 56% in surgical units, 39.2% in medical intensive care units, 30% in intermediate care units, and 22.8% in general units, whereas Tibballs,⁴¹ found handwashing compliance to be between 10.6 and 12.4%. In another two week observational study following 26 ward rounds (239 patient/clinical events), clinicians were observed to wash their hands between patients only 41% of the required time with observed compliance of subsets of clinicians being 26% for admitting clinicians and 55% for follow-up/consultant physicians.⁴²

Part II

Several studies have indicated that the issue of handwashing non-compliance by physicians is complex. Larson⁴³ points out that operator compliance with product use is not only dependent on its clinical performance but also on its subjective acceptability (packaging, odor, etc.) and on the individual perception of product harshness with prolonged use. In a review of the barriers to handwashing compliance, Springthorpe and Sattar⁴⁴ identified three main obstacles: 1) the amount of time needed for proper handwashing; 2) the convenience and user-acceptability of handwashing and hand-drying facilities, and 3) the condition of the skin barrier. It is clear that handwashing compliance may suffer in understaffed clinical settings. Staff increases require increased spending, which in the present era of cost reductions by health maintenance organizations may not be achieved easily. The great cost of nosocomial infections to healthcare systems may outweigh any financial benefits recovered through increasing patient/staff ratios and jeopardizing compliance with basic universal precautions.⁴⁴ Voss and Widmer²³ indicate that the time needed to achieve 100% compliance with present handwashing guidelines could decrease the time available for other routine cleaning and disinfection and adversely impact overall patient care. The authors further indicated that the use of appropriate instant hand sanitizers might be a time-effective alternative to handwashing. Such an improvement might increase the convenience and accessibility of hand sanitization for physicians. In that study, the 16 hours required for maximal compliance with soap and water practices shifted to only three hours when bedside dispensers for instant sanitizers were made available. Care should be taken to ensure that bedside dispensers are not contaminated with frequent use. A touch-free design for a dispenser in such a frequent-use setting is, therefore, desirable; however, design flaws associated with present touch-free systems (based on infrared light detection alone) can cause inappropriate product release, which can result in increased maintenance costs and even in injury to the public in the event that the product is released onto the floor.⁴⁵⁻⁴⁷ Such flaws have been a limiting factor to the widespread use of touch-free systems in the US. An improved dispenser, which releases product based on the detection of both human bioelectric field and infrared light greatly decreases the chance of misdispensing the product. Cost-effective dispensers that incorporate this type of detection system are anticipated to be available to the medical community by Fall 2000.⁴⁸ Care should be taken to determine the potential for their long-term acceptance and utility in different healthcare settings. Automated devices should be flexible enough in implementation and use to allow adjustments based on staff acceptance.⁴⁹

A significant impediment to proper handwashing is the condition of the hands, in particular whether the product causes painful chapping or dermatitis with frequent use. Smit, *et al.*,⁵⁰ indicated that nursing staff have a prevalence of hand dermatitis and chapping of about 30%. Larson⁵¹ reported that although skin damage was apparent in 25% of observed nurses, 86% rated themselves as having some sort of skin problem. Such difficulties associated with handwashing and gloving practices can affect compliance and, therefore, increase pathogen carriage on the hands. Because of this effect, the infection control staff should ensure that any formulation accepted for frequent use is non-irritating and has a minimal potential for skin sensitization. It is important to realize that skin reactive properties of active ingredients are, just as for antimicrobial activity, highly formulation dependent. For example, sodium lauryl sulfate is known to disrupt the stratum corneum water barrier and can cause hand dermatitis associated with handwashing.⁵²⁻⁵³ This adverse effect is amplified with the use of gloves and in high temperature situations⁵⁴⁻⁵⁵ but can be avoided if urea is added to the formulation.⁵⁶ Another example is benzalkonium chloride, which has been approved for use in a topical antiseptic application at 0.13% v/v⁵⁷ but which can be a dermal irritant at this and higher concentrations.⁵⁸⁻⁵⁹ In the context of a formulation containing amphoteric and nonionic surfactants and allantoin, however, antimicrobial effectiveness is improved with the minimization of dermal irritancy and sensitization.⁶⁰

Is Staff Education an Effective Solution?

Efforts have also been made to improve handwashing compliance through physician and staff education programs. In one study, Dorsey, *et al.*,⁶¹ found that minimal intervention via posting of CDC handwashing recommendations and the distribution of educational material resulted in a noticeable but statistically insignificant improvement in total handwashing. Interestingly, this study also indicated that nurse practitioners and registered nurses had significantly higher adherence to recommended handwashing between patients than emergency physicians did. Mayers, *et al.*,⁶² observed a nursing staff for three months, and then substituted the normal hand sanitizer with an emollient based formulation in parallel with implementation of a daily program of feedback to nurses on their handwashing frequency. While no increase in handwashing was observed upon switching to the emollient-based sanitizer, feedback provided to the experimental ICU increased handwashing frequency to 92% of the required levels and was significantly higher than handwashing in the control unit. A follow up observation, however, indicated that when feedback was removed, compliance fell to baseline levels. Similar findings regarding the effectiveness of

education feedback and enforcement have been presented by Conly, *et al.*,⁶³ and Dubbert, *et al.*⁶⁴ In the latter study, education alone produced an immediate improvement in compliance, which declined to baseline four weeks after instruction ended. Because the obstacles to handwashing compliance are interrelated, they may be very difficult to resolve.⁴³ Specifically, changing only one parameter may not change hand-cleansing behavior in the long term. Ironically, even multifaceted intervention attempts have failed to achieve long-term success. In a prospective study, Larson, *et al.*⁴⁹ implemented intervention, which included focus group sessions, installation of automatic sinks, and feedback to staff on handwashing frequency. Although some significant differences between the control and experimental ICU units were observed during active intervention, the differences had returned to baseline by the two-month follow-up.

Overall, it seems that a common method in studies that have demonstrated a measure of even temporary success at improving handwashing compliance is that of consistent monitoring of performance followed by feedback. Maintenance of a feedback program is difficult to achieve due to costs and time constraints of healthcare personnel. Increasing the community's awareness of the importance of handwashing could have a favorable impact on the compliance rate of handwashing in healthcare workers.⁶⁶ McGuckin, *et al.*,⁶⁷ performed a six-week intervention/control study at four community hospitals consisting of two general medical/surgery in-patient floors with no obstetric or pediatric patients and with each hospital serving as its own control. Within 24 hours of admission, patients were educated on the importance of asking their healthcare workers to wash their hands prior to touching them. The follow-up indicated that 81% of the patients enrolled in the study read the educational pamphlet on handwashing that was provided, and 57% asked their healthcare workers whether they had washed their hands. Fifty-seven percent of the healthcare personnel that were asked responded favorably to the inquiries. This patient handwashing education model was found to improve healthcare handwashing compliance by approximately 34% as measured by increased soap usage. The cost savings estimated with the implementation of the patient-education model in a 300 bed 10,000 admission hospital range from \$50,000-\$60,000 per year, based on approximately 160 preventable infections per year. Overall, it appears that this latest method of patient-based intervention meets the need for a sustainable program of reinforcement of good handwashing practices in healthcare workers. †

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For a list of references, access the ICT Web site.