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Hand hygiene: An effective tool to control infection

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Abstract
Hand hygiene, either by hand disinfection or hand washing remains to be most pivotal in controlling infection in healthcare settings. Hand hygiene is a simple practice that has been at the core of infection prevention for over 150 years. Yet getting healthcare personnel to follow recommended hand hygiene practices in today's complex and demanding healthcare environment continues to be a monumental challenge. Even in the developed world, adherence is estimated to be less than 50%, meaning healthcare personnel practice hand hygiene fewer than half of the times that they should.

Health care associated infections are drawing increasing attention from patients, insurers, governments and regulatory bodies. This is not only because of the magnitude of the problem in terms of the associated morbidity, mortality and cost of treatment, but also due to the growing recognition that most of these are preventable. The medical community is witnessing in tandem unprecedented advancements in the understanding of pathophysiology of infectious diseases and the global spread of multi-drug resistant infections in health care set-ups. These factors, compounded by the paucity of availability of new antimicrobials have necessitated a re-look into the role of basic practices of infection prevention in modern day health care. There is now undisputed evidence that strict adherence to hand hygiene reduces the risk of cross-transmission of infections. Simple preventive measures have been proven effective to contain infections. An advanced level of hand hygiene program with elements of infection control should be offered to the all the professionals working in healthcare setting. Cultural and behavioural issues would play in role in low compliance despite of the efforts to improve quality of healthcare. This review focuses on one of the simplest, low cost but least accepted tool in infection prevention.

Keywords: hand hygiene, hand washing, Hand hygiene levels, best practices, HCAI (health care associated infections)

Introduction

Background

Hand washing, also known as hand hygiene, is the act of cleaning one's hands for the purpose of removing soil, dirt, and microorganisms. This may be done with or without the use of water, other liquids, or soap. In situations where tap water and soap is not available, such as in certain areas of developing countries or while camping, other options include pouring water from a hanging jerrycan or gourd or using ash instead of water.

Medical hand hygiene pertains to the hygiene practices related to the administration of medicine and medical care that prevents or minimizes disease and the spreading of disease. The main medical purpose of washing hands is to cleanse the hands of pathogens including bacteria and viruses chemicals which can cause personal harm or disease. This is especially important for people who handle food or work in the medical field, but it is also an important practice for the general public.

Hand washing with soap consistently at critical moments during the day prevents the spread of diseases like diarrhoea and cholera which are transmitted through fecal-oral routes. Handwashing also protects against impetigo which is transmitted through direct physical contact. People can become infected with respiratory diseases such as influenza or the common cold, for example, if they do not wash their hands before touching their eyes, nose, or mouth. As a general rule, hand washing protects people poorly or not at all from droplet and airborne diseases, such as measles, chickenpox, influenza, and tuberculosis.

Historical Aspects

The importance of hand washing for human health - particularly for people in vulnerable circumstances like mothers who had just given birth or wounded soldiers in hospitals - was first recognized in the mid 19th century by two remarkable pioneers of hand hygiene: the Hungarian physician Ignaz Semmelweis who worked in Vienna, Austria and Florence Nightingale, the English "founder of modern nursing". At that time most people still believed that infections were caused by foul odors called miasmas.

In the 1980s, foodborne outbreaks and healthcare-associated infections led the United States Centers for Disease Control and Prevention to more actively promote hand hygiene as an important way to prevent the spread of infection. The outbreak

of swine flu in 2009 led to increased awareness in many countries of the importance of washing hands with soap to protect oneself from such infectious diseases. For example, posters with "correct handwashing techniques" were hung up next to hand washing sinks in public toilets and in the toilets of office buildings and airports in Germany.

Discussion

Normal Flora of Hand

There are two types of microbes colonizing 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 (HCWs) during direct contact with patients or their nearby contaminated environmental surfaces and are the organisms most frequently associated with HCAI (health care associated infections)

Colonization and Transmission

The hands of HCW (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 h. Approximately 10 skin epithelial cells containing viable microorganisms are shed daily from the normal skin which can contaminate the gowns, bed linen, bedside furniture, and other objects in the patient's immediate environment. Hand carriage of resistant pathogens has repeatedly been shown to be associated with nosocomial infections The highest rates of hand contamination are reported from critical care areas, which also report most cases of cross-transmission. The hands may become contaminated by merely touching the patent's intact skin or inanimate objects in patients' rooms or during the "clean" procedures like recording blood pressure.

Importance of Hand Hygiene

Proper hand hygiene is the single most important, simplest, and least expensive means of reducing the prevalence of HAIs (health care associated infections) and the spread of antimicrobial resistance[1.]Several studies have demonstrated that handwashing virtally eradicates the carriage of MRSA which invariably occurs on the hands of HCPs
(Health Care Professionals) working in ICU (Intensive Care Units). An increase in handwashing compliance has been found to be accompanied by a fall in MRSA rates. The hand hygiene liason group identified nine controlled studies, all of which showed significant reductions in infection related outcomes, even in settings with a high infection rates in critically ill patients Transmission of Health-care-associated *Klebsiella* species. has also been documented to reduce with improvement in hand hygiene. The evidence suggests that adherence to hand hygiene practices has significantly reduced the rates of acquisition of pathogens on hands and has ultimately reduced the rates of HAIs (health care associated infections) in a hospital

Indications of Health Hygiene

There are five critical times during the day where washing hands with soap is important to reduce fecal-oral transmission of disease: after defecation, after cleaning a child's bottom, before feeding a child, before eating and before preparing food or handling raw meat, fish, or poultry
Medically hands are to be washed with soap and water when (*i*) visibly dirty or contaminated with proteinaceous material, blood, or other body fluids and if exposure to *Bacillus anthracis* is suspected or proven (since the physical action of washing and rinsing hands in such circumstances is recommended because alcohols, chlorhexidine, iodophors, and other antiseptic agents have poor activity against spores); (*ii*) After using a restroom, wash hands with a non-antimicrobial soap and water or with an antimicrobial soap and water; and (*iii*) before and after having food.
In all other clinical situations described below, when hands are not visibly soiled, an alcohol-based hand rub should be used routinely for decontaminating hands. (*i*) Before having direct contact with patients. (*ii*) Before donning sterile gloves when inserting a central intravascular catheter. (*iii*) Before inserting indwelling urinary catheters, peripheral vascular catheters, or other invasive devices that do not require a surgical procedure. (*iv*) After contact with a patient's intact skin (*e.g*., when taking a pulse or blood pressure or lifting a patient). (*v*) After contact with body fluids or excretions, mucous membranes, nonintact skin, and wound dressings if hands are not visibly soiled. (*vi*) After contact with inanimate objects (including medical equipment) in the immediate vicinity of the patient. (*vii*) After removing gloves. (*viii*) If moving from a contaminated body site to a clean body site during patient care.

Role of Hand Hygiene in Public Health

Hand washing has the following additional public health benefits:

- helps minimize the spread of influenza
- diarrhea prevention[
- avoiding respiratory infections
- a preventive measure for infant deaths at their home birth deliveries
- improved hand washing practices have been shown to lead to small improvements in the length growth in children under five years of age

In developing countries, childhood mortality rates related to respiratory and diarrheal diseases can be reduced by introducing simple behavioral changes, such as hand washing with soap. This simple action can reduce the rate of mortality from these diseases by almost 50 percent.
Hand washing with soap is the single most effective and inexpensive way to prevent diarrhea and acute respiratory infections (ARI), as automatic behavior performed in homes, schools, and communities worldwide. Pneumonia, a major ARI, is the number one cause of mortality among children under five years old, taking the life of an estimated 1.8 million children per year. Diarrhea and pneumonia together account for almost 3.5 million child deaths annually. According to UNICEF, turning hand washing with soap before eating and after using the toilet into an ingrained habit can save more lives than any single vaccine or medical intervention, cutting deaths from diarrhea by almost half and deaths from acute respiratory infections by one-quarter. Hand washing is usually integrated together with other sanitation interventions as part of water, sanitation and hygiene (WASH) programmes.
A possible small detrimental effect of hand washing is that frequent hand washing can lead to skin damage due to drying

of the skin. Excessive hand washing is commonly seen as a symptom of obsessive-compulsive disorder (OCD). [9]

Behavioral Issues

In many countries, there is a low prevalence of hand washing with soap. A study of hand washing in 54 countries in 2015 found that on average, 38.7% of households practised handwashing with soap Several Behaviour change methodologies now exist to increase uptake of the behaviour of handwashing with soap at the critical times.

Group hand washing for school children at set times of the day is one option in developing countries to engrain handwashing in children's behaviors. The "Essential Health Care Program" implemented by the Philippine Department of Education in the Philippines is an example of at scale action to promote children's health and education. Deworming twice a year, supplemented with washing hands daily with soap, brushing teeth daily with fluoride, is at the core of this national program. It has also been successfully implemented in Indonesia.

Medical Issues

Medical hand-washing became mandatory long after Hungarian physician Ignaz Semmelweis discovered its effectiveness (in 1846) in preventing disease in a hospital environment. There are nowadays electronic devices in some hospitals that provide feedback to remind hospital staff to wash their hands when they forget.] One study has found decreased infection rates with their use.

Medical hand-washing is for a minimum of 15 seconds, using generous amounts of soap and water or gel to lather and rub each part of the hands Hands should be rubbed together with digits interlocking. If there is debris under fingernails, a bristle brush may be used to remove it. Since germs may remain in the water on the hands, it is important to rinse well and wipe dry with a clean towel. After drying, the paper towel should be used to turn off the water (and open any exit door if necessary). This avoids re-contaminating the hands from those surfaces.

The purpose of hand-washing in the health-care setting is to remove pathogenic microorganisms ("germs") and avoid transmitting them. The *New England Journal of Medicine* reports that a lack of hand-washing remains at unacceptable levels in most medical environments, with large numbers of doctors and nurses routinely forgetting to wash their hands before touching patients. One study showed that proper hand-washing and other simple procedures can decrease the rate of catheter-related bloodstream infections by 66 percent.[43]

The World Health Organization has published a sheet demonstrating standard hand-washing and hand-rubbing in health-care sectors.]The draft guidance of hand hygiene by the organization can also be found at its website for public comment. A relevant review was conducted by Whitby *et al.* Commercial devices can measure and validate hand hygiene, if demonstration of regulatory compliance is required.

The WHO "Save Lives: Clean Your Hands" programme [1, 2] reinforces the "My 5 Moments for Hand Hygiene" approach as key to protect the patients, HCWs and the health-care environment against the spread of pathogens and thus reduce HAIs. This approach encourages HCWs to clean their hands:

- before touching a patient,
- before clean/aseptic procedures,
- after body fluid exposure/risk,
- after touching a patient and
- after touching patient surroundings

The addition of antiseptic chemicals to soap ("medicated" or "antimicrobial" soaps) confers killing action to a hand-washing agent. Such killing action may be desired prior to performing surgery or in settings in which antibiotic-resistant organisms are highly prevalent [47].

To 'scrub' one's hands for a surgical operation, it is necessary to have a tap that can be turned on and off without touching it with the hands, some chlorhexidine or iodine wash, sterile towels for drying the hands after washing, and a sterile brush for scrubbing and another sterile instrument for cleaning under the fingernails. All jewelry should be removed. This procedure requires washing the hands and forearms up to the elbow, usually 2–6 minutes. Long scrub-times (10 minutes) are not necessary. When rinsing, water on the forearms must be prevented from running back to the hands. After hand-washing is completed, the hands are dried with a sterile cloth and a surgical gown is donned.

Effectiveness of hand hygiene

Interventions that promote hand washing can reduce diarrhoea episodes by about a third, and this is comparable to providing clean water in low income areas. Furthermore, 48% reductions in diarrhoea episodes can be associated with hand washing with soap.

To reduce the spread of germs, it is also better to wash the hands and/or use a hand antiseptic before and after tending to a sick person.

For control of staphylococcal infections in hospitals, it has been found that the greatest benefit from hand-cleansing came from the first 20% of washing, and that very little additional benefit was gained when hand cleansing frequency was increased beyond 35% [50]. Washing with plain soap results in more than triple the rate of bacterial infectious disease transmitted to food as compared to washing with antibacterial soap. Comparing hand-rubbing with alcohol-based solution with hand washing with antibacterial soap for a median time of 30 seconds each showed that the alcohol hand-rubbing reduced bacterial contamination 26% more than the antibacterial soap. But soap and water is more effective than alcohol-based hand rubs for reducing H1N1 influenza A virus[and Clostridium difficile spores from hands.

Status of hand hygiene in India

In India, the quality of healthcare is governed by various factors, the principal amongst these being whether the health care organization is government or private-sector run. There is also an economic and regional disparity throughout the country. About 75 per cent of health infrastructure, medical manpower and other health resources are concentrated in urban areas, where 27 per cent of the population lives. There is a lack of availability of clean water for drinking and washing. Like in other developing countries, the priority given to prevention and control of HCAI is minimal. This is primarily due to lack of infrastructure, trained manpower, surveillance systems, poor sanitation, overcrowding and understaffing of hospitals, unfavourable social background of population, lack of legislations mandating accreditation of hospitals and a general attitude of non-compliance amongst health care providers towards even basic procedures of infection control. In India, although hand hygiene is imbibed as a custom and promoted at

school and community levels to reduce the burden of diarrhoea, there is a paucity of information on activities to promote hand hygiene in health care professionals Sporadic reports document the role of hands in spreading infection and isolated efforts at improving hand hygiene across the country.

The practice of compulsory training on standard precautions, safe hospital practices and infection control for all postgraduates upon course-induction, as is being done in a few Delhi medical colleges seems very promising for our country. Such an exercise may be made mandatory across all medical and nursing colleges of India, especially since the "patient safety" is increasingly being prioritized by the Government of India and the country being one of the 120 signatories pledging support to the WHO launched world alliance

Conclusions

Although evidence based guidelines are increasingly being implemented in the developed countries, the developing countries still lack basic health care facilities, surveillance networks and resources to curtail HAIs. Lack of hand washing facilities (*e.g*., sinks, running water and sewage systems) are major deterrents for implementation of hand hygiene. The use of WHO advocated alcohol based hand rubs is a practical solution to overcome these constraints, because these can be distributed individually to staff for pocket carriage and placed at the point of care. The major advantage is that its use is well applicable to situations typical of developing countries, such as two patients sharing the same bed, or patient's relatives being requested to help in care provision. Several countries have also initiated nationally co-ordinated activities (http://www.who.int/gpsc/national-campaigns/en/) to promote hand hygiene. However, global Healthcare Infection Prevention programmes can only be successful, if these populous developing nations are able to control the menace by formulation of national or local policies and strictly implementing the guidelines.

Hand washing should become an educational priority. Educational interventions for medical students should provide clear evidence that HCWs hands become grossly contaminated with pathogens upon patient contact and that alcohol hand rubs are the easiest and most effective means of decontaminating hands and thereby reducing the rates of HAIs. Increasing the emphasis on infection control, giving the charge of infection control to senior organizational members, changing the paradigm of surveillance to continuous monitoring and effective data feedback are some of the important measures which need to be initiated in Indian hospitals.

One of the reasons microbes have survived in nature is probably their simplicity: a simple genomic framework with genetic encryptation of basic survival strategies. To tackle these microbes, human beings will have to follow basic and simple protocols of infection prevention. The health care practitioners in our country need to brace themselves to inculcate the simple, basic and effective practice of hand hygiene in their daily patient care activities and serve as a role model for future generations of doctors, nurses and paramedical personnels.

In the past year, the visibility of novel strategies to improve hand hygiene in healthcare has increased — from technologies that can monitor and report hand hygiene performance in real time, to smartphone applications that streamline hand hygiene data collection by human observers, to financial incentive schemes that pay or fine healthcare personnel based on hand hygiene performance. Creative or high-tech solutions must work in parallel with the fundamental building blocks of hand hygiene improvement: education, grassroots promotion, and leadership.. To date more than 12,500 facilities have joined the "SAVE LIVES: Clean Your Hands campaign", including nearly 2,500 U.S. healthcare facilities. This campaign is centers around the WHO's multimodal hand hygiene improvement strategy, which includes as key elements: 1) system change, 2) training and education, 3) evaluation and feedback, 4) reminders in the workplace, and 5) institutional safety climate.

We must do all we can to protect patients and ensure that patients within our healthcare facilities are receiving safe care.

With "Clean Care is Safer Care" as a prime agenda of the global initiative of WHO on patient safety programmes, it is time for developing countries to formulate the much-needed policies for implementation of basic infection prevention practices in health care set-ups.

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