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Alcohol Based Hand Sanitizers: Assurance and Apprehensions Revisited.

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ABSTRACT

Maintenance of hand hygiene is essential to reduce the transmission of viruses and other germs. Alcohol based hand sanitizers provide an alternative measure for hand hygiene and are preferred over hand washing, because of the mobility and convenience they offer. Agencies like CDC and WHO have published guidelines, promoting and emphasising the effectiveness of hand sanitizers. Studies have shown that hand sanitizers have been effective in reducing the infection rates. Recently, a growing number of reports have shown that alcohol based hand sanitizers may not be the universal remedy for hand hygiene. An increased risk for outbreaks of contagious virus in health care settings has been observed on account of over-reliance on hand sanitizers. Researchers are suspecting the outcome and consequences of long term use of hand sanitizers. Additionally, stray incidence of intentional consumption is definitely going to dent the reputation of alcohol based hand sanitizers. The effort, awareness and increased adherence for hand hygiene in health care settings generated after introduction of hand sanitizers will be seriously hampered. A careful approach and rigorous trials for evaluation of alcohol based hand sanitizers is required at this moment in time.

Key words: Disinfectants, hand washing/methods, ethanol, norovirus

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INTRODUCTION

Proper hand hygiene can decrease the transmission of cold viruses and other germ is an established fact. Washing hands is considered the best way to maintain personal hygiene and protect oneself from diseases. [1] The Centers for Disease control and Prevention (CDC) promote and encourage routine hand washing, especially during cold and influenza season. In the last one decade, the occasional scare caused by intercontinental spread of, previously SARS and H1N1 in recent times, have made hand sanitizers a convenient alternative. They have become a preferred choice because of their mobility, convenience, and unavailability of soap and water at all the places. The use of hand sanitizers has risen with changing lifestyles in developing nations like India within last 4-5 years, although the trend of using hand-sanitizers picked up in the US and European countries almost a decade ago.

Hand sanitizers: a prelude

Presently available hand sanitizers that are considered effective comprise 62% to 95% of alcohol as an active ingredient which helps in killing viruses or bacteria. There are also non-alcoholic sanitizers based on benzalkonium chloride or chlorinated aromatic compound triclosan or povidone-iodine and pyroglutamic acids, but studies evaluating these are limited. These products are available as fast-drying gels, foams, wipes and mixed with moisturizing lotions and/or emollients.

The mode of action of both the sanitizers is more or less similar. They denature the protein of microbes. Alcohol also denatures lipids and causes dehydration in bacteria. Benzalkonium chloride, on the other hand, has the capacity to denature cell membrane and protein, and act on a broad range of organisms. Besides, benzalkonium chloride has been in use in disinfectants and antiseptics for more than 50 years. According to CDC, hand sanitizers containing at least 60% alcohol can quickly decrease the number of the germs on hands in most of the situations. They prove to be ineffective when the hands are visibly dirty. [2]

Hand hygiene: is it obligatory

Reduction of infectious disease requires interruption of person to person transmission. Review of evidences suggests that personal and environmental hygiene prevents spread of infection, [3] and maintaining hand hygiene is one way. The opportunities for the spread of infection are frequently offered at primary schools, hostels, day care centers, crèches, and extended care centers. Observing hand hygiene and its improvement has facilitated a reduction in the incidence of infection at homes, [4, 5] childcare centers [6,7] and hostels.[8] Promotion and implementation of hand washing program in the schools, brought a reduction of 42% in school absenteeism [9,10] and reduced the incidence of gastrointestinal and respiratory illness among children.[11]

Alcohol based hand sanitizers: how efficient they are

The antimicrobial effectiveness of short-chain alcohols, mainly ethanol, has been well documented in the literature. In general, the most effective ethanol concentration range has been reported to be greater than 50%, acting in 1 minute. [12] These facts allow alcohol based hand sanitizers to establish as an alternative hand cleaning technology. CDC along with World Health Organization (WHO), is promoting the use of sanitizers and has published guidelines that emphasize the efficacy of hand sanitizers when compared to hand wash. WHO's guidelines on hand hygiene reads, "A systematic review of publications between 1992 and 2002 on the effectiveness of alcohol-based solutions for hand hygiene showed that alcohol-based hand rubs remove organisms more effectively, require less time, and irritate skin less often than hand washing with soap or antiseptic agents and water."

Children are the most vulnerable population and the consequences of infectious disease in children may have significant economic and social impact beyond the direct effects of the disease on the health of the child. This includes absence from school, transmission of infectious disease to other pupils, staff, and family members, and time off from work for parents/guardians. Reduction of the transmission of infectious disease between children at schools could be an effective way of reducing the community incidence of infectious disease. A comparison between the efficacy of alcohol based hand sanitizer and standard hand washing among school children of 2nd and 3rd grade, demonstrated no significant difference in the absenteeism rate, and a preference for hand sanitizer,[13] which is on expected lines as hand sanitizers are more convenient. The implementation of educational program to inculcate hand hygiene and respiratory hygiene using non pharmaceutical interventions for prevention of spread of influenza among school children, proved successful in reducing the absenteeism rate and the incidence of influenza A infection by 52%. An increased awareness for routine hand hygiene, an average use of hand sanitizer 2-4 times a day and significantly low absent episodes were positive outcomes of the educational program.[14] As a result of low compliance and improper hand washing techniques, the focus of regulatory and advisory agencies have shifted onto convenient alcohol based hand sanitizers. They are efficacious in removing most germs including most species of fungi and viruses [15] and addition of organic acids like citric and malic acid provide them a residual activity for 2-4 hrs.[16] Most manufacturers of hand sanitizers claim that the sanitizers kill 99.9 percent of germs, however caution need to be exercised, as products are tested *in vitro* and on inanimate objects using controlled variables. A disparity may appear in natural settings due to inconsistent compliance with hand cleansing after contamination or inadvertent recontamination after cleansing. Further, alcohol evaporates quickly, killing the first layer or so of the germs, leaving enough at the lower level or up the arm to re-colonise, possibly contributing to discrepancy in natural settings. Studies have shown that use of alcohol based hand sanitizers by care givers in an acute care facility and extended care facility reduced the infection rates by nearly 30% and 36% respectively, providing an additional tool for effective infection control.[17, 18] At least 3 different delivery system for hand sanitizers are available- foams, gels and wipes- and are equally efficacious in reducing the viral load significantly.[19] However, concerns have been raised regarding the foam preparation as they require more than 30 seconds for drying, which in clinical practice will

lead to application of small amounts. A long drying time may reduce the compliance of healthcare workers in applying the recommended amount of foam. [20] By CDC recommendation, a person should apply a sufficient amount of product to the palm of one hand and rub hands together, making sure to distribute product over all areas of hands and fingers until they are dry.

Alcohol based hand sanitizers: some concerns.

Alcohol based sanitizers kill most type of the bacteria, fungi and viruses in few seconds. In fact they are tremendously effective in preventing the spread of seasonal flu, H1N1, colds and other viral and bacterial based disease. Rubbing the hand with sanitizer for 15 seconds is ideally required, and hence immensely convenient. But, now the efficacy of sanitizers designed to kill any germs is in doubt. It is well established that alcohols are effective against lipophilic, enveloped viruses. Ethanol affects the viral capsid protein but not the nucleic acid, suggesting that alcohols inactivate enveloped viruses more easily than “naked” viruses. [21] The results of previous study suggest that alcohol is effective, but that the antiviral efficacy depends on the specific virus. It is apparent that the alcohol-based sanitizer is effective against viruses in 30 seconds; but with considerable variation, depending on the viral species.[15] Ethanol-based hand sanitizers are effective to restrain the transmission of enveloped viruses such as influenza virus, hepatitis B virus, and herpes simplex viruses 1 and 2.[22] However, recent studies suggest that they are less effective for controlling the transmission of enteroviruses particularly nonenveloped human noro viruses (HuNoV). The use of simple rinse with water or use of antibacterial liquid soap is more effective than alcohol based sanitizer for control of contamination of hand with Norwalk virus, however rubbing fingers together for physical removal is essential while rinsing with water.[23] The poor efficacy of ethanol-based hand sanitizers against Norwalk virus, and perhaps other HuNoV, has important implications for infection control in health care settings and food service establishments where these products are commonly used and where HuNoV outbreaks are most frequent. This concern was validated in recent survey of long term care facilities, where 53% of 161 facilities preferring alcohol based sanitizers reported norovirus outbreaks as compared with 18% facilities showing preference for soap and water. [24] Although, the retrospective design of the study forbids to presume a causal link between sanitizer use and outbreaks, but stresses the need for a robust, prospective study. Minnesota department of health, issued guidelines for food services establishment in December 2009- citing the inability of hand sanitizers to kill norovirus- that foodworkers have to use 60% alcohol based hand sanitizers after proper hand wash using soap and warm water for 20 seconds.[25] Keeping in view the reports being generated, CDC in March 2011, released an updated norovirus outbreak management and disease prevention guidelines which states “proper hand washing with soap and running water for at least 20 seconds is the most effective way to reduce norovirus contamination on the hands, whereas hand sanitizers might serve as an effective adjunct in between proper handwashings but should not be considered a substitute for soap and water handwashing”. [26] A recent study concluded that alcohol based hand sanitizers (ABHS) were less effective than hand wash with soap and water at removing *Clostridium difficile* spores from the hands, with a transfer of 30% residual spores by handshake following use of ABHS.[27] Furthermore, ABHS are able to kill bacteria and viruses

on hand but incapable of removing dirt, organic material, blood and faeces, thus making soap and water hand wash essential in wards and restrooms.

Researchers have expressed apprehension that inflammatory disorders of gut could occur as a result of exposure to PAMPs (Pathogen associated molecular patterns). PAMPs are molecular patterns of bacteria and viruses, which include lipopolysaccharide (LPS), DNA, RNA, and are left behind after killing by ABHS. [28] These findings should make us contemplate that how far we are justified in over relying on hand sanitizers for personal hygiene. Very recently a dangerous trend has started appearing among the teenagers, of both intentional and accidental alcohol poisoning by ABHS. [29] Health officials are worried that this may develop into major problem, as ABHS are easily accessible over-the-counter and inexpensive. The suggestion for concerned parent is to treat hand sanitizer like liquor or medications and switch to non-gel based foam sanitizers. The situation gets more complex when certain pharmaceutical companies advertise their products to be capable of preventing MRSA (methicillin resistant staphylococcal aureus) infections. MRSA is capable of causing life threatening skin and systemic infections which are resistant to even standard antibiotics. To curb this practice, drug controlling agencies need to be cautious and monitor the illegitimate and unauthenticated advertising by the companies. US FDA (Food and Drug Administration) for the protection of consumers have issued suggestion asking them not to purchase over the counter hand sanitizer, claiming to prevent infection from MRSA, E coli and H1N1 flu or other bacteria. [30] The agency also urges consumer to wash hand frequently stating "In general, wash hands often, especially before handling food, to help avoid getting sick. Wash hands with warm water and soap for 20 seconds."

Thus it seems that ABHS may not prove a universal remedy for maintaining hygiene. Keeping in view the concerns generated of late, it is vital at this juncture to conduct prospective and rigorous studies for evaluation of ABHS efficacy. Since, ABHS have undoubtedly improved adherence to hand hygiene; a downgrade will be a setback. Hand washing and ABHS need to complement each other, until some tangible evidence emerges.

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