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Review

Hand Sanitizer For Disinfection

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Abstract

Hand hygiene is the most important as it may be contaminated easily from direct contact with airborne microorganism droplets from coughs and sneezes. Especially, in situations like pandemic outbreak, it is crucial to interrupt the transmission chain of the virus, bacteria by the practice of regular hand sanitization. It can be achieved with contact isolation and strict infection control tools like supporting good hand hygiene in hospital settings and in public. The success of the hand sanitization uniquely depends on the use of effective hand disinfecting agents formulated in various types and their mechanism of action such as water-based or alcohol-based hand sanitizer and non-water based or non-alcohol based hand sanitizer with the latter being widely used in hospital settings. Till date, most of the effective hand sanitizer products are alcohol-based formulations containing 62%–95% of alcohol as it can denature the proteins of microbes and the ability to inactivate viruses, bacteria. This systematic review correlated with the data and it will investigate the range of available hand sanitizers and their effectiveness as well as the formulation aspects, adverse effects, efficiency and safety. Further, this article highlights the efficacy of alcohol-based hand sanitizer, non- alcohol based hand sanitizer against the coronavirus.

Keywords: hand sanitizer, hand disinfectants, infection control

INTRODUCTION

The emergence of novel pathogens, bacterial or viral, has always posed significant challenges to public health around the globe. One of these threatening 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 epidemic by the World Health Organization in early 2020. Since its discovery in December 2019 in Wuhan, there have been over three million confirmed cases globally by April 2020. With cases increasing exponentially around the world, it has a remarkable burden on all aspects of society despite aggressive isolation methods to prevent the spread of the virus. Currently, therapeutic strategies to deal with COVID-19 are only supportive, making prevention planned at transmission the best method at this time. One of the many ways to apply to prevent the spread of this virus, as with earlier contagious pathogens, is frequent and effective handwashing. In both healthcare and section 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 increase of bacterial and viral infections, making it one of the essential protocols in decreasing healthcare burden. An extent of hand sanitizers are available with various combinations of ingredients and modes of delivery. Given the popularity of hand sanitizers during this epidemic, it is important to understand which types of hand sanitizers work best against this novel virus. In this review, we will discuss the role of various types of alcohol-based hand sanitizers in effective removal of bacterial and viral pathogens with the focus on the effectiveness against enveloped viruses, such as SARS-CoV-2.

Viral versus bacterial structure

Viruses are relatively simple structural infectious agents with a range of 2 structural components (Fig.1). First, they contain heritable material, such as DNA or RNA. The genetic matter inside viruses are either single stranded (ssDNA or sRNA) or double stranded (dsDNA or dsRNA). The strands are also both positively or negatively sensed. Positive sense DNA suggests it is directly transformable into protein if it were RNA. Negative sense RNA, on the further hand, is the complementary strand for messenger RNA. In sequence to protect and encapsulate the genetic material, all viruses also contain a protein coat, called a capsid. Viruses can then additionally be divided by the presence or absence of a lipid envelope, which determines whether viruses are "enveloped" or "non-enveloped." Despite being composed of several structural and functional elements that are common to many life forms, such as heritable material and lipid envelopes, viruses must have a host to replicate, and hence are not usually described as living entities.

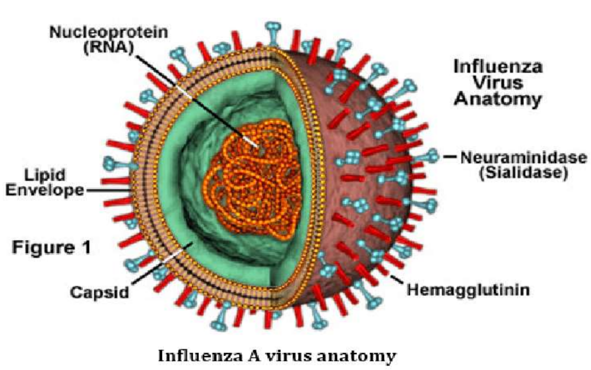

Fig 1: Virus Image

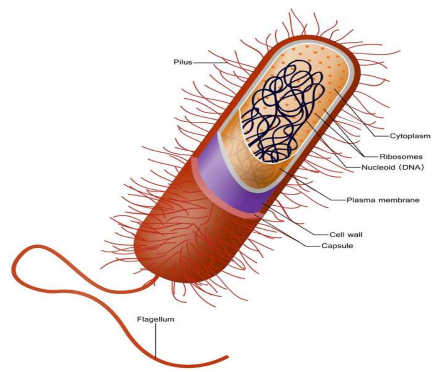

Fig 2: Bacteria Image

Bacteria are single-celled living organisms that, not similar to viruses, do typically survive without a host and thus are viewed as living agents. The genetic material is freely floating DNA, and likewise to viruses, bacteria lack nuclei (Fig.2). Like viruses, bacteria are various in their structure. They typically have an inner cell membrane and an outer cell wall, though special cases do exist. Peptidoglycan, a component of the outer cell wall, is a polymer containing sugars and amino acids. Bacteria contain various thicknesses of peptidoglycan which partly explains whether bacteria stain purple or pink during the Gram-stain procedure, and thus determines the classification of "gram-positive" or in order to replicate, and hence are not usually described as living entities. replicate, and hence are not usually described as living entities.

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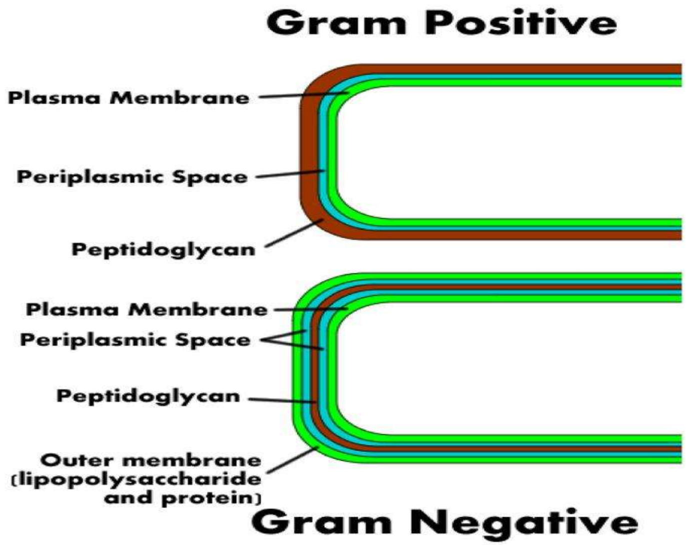

Fig 3: Image of Gram positive and Gram-negative Bacteria

Hand sanitizer ingredients
There are two types of hand sanitizers:
(1) non-alcohol-based hand sanitizers (NABHS)
(2) alcohol-based hand sanitizers (ABHS).

The most common main active ingredient of NABHS, benzalkonium chloride, a quaternary ammonium, is a frequently used disinfectant. Disinfectants with benzalkonium chloride are commonly less irritating than those with alcohol, though more recent proof suggests it may cause contact dermatitis more often than previously thought. Although ABHS are less user-friendly on skin than NABHS, ABHS are most important in health care settings given their low cost and efficacy of reducing infectious transmission. NABHS, however, are less trying regarding their flammability and abuse potential.

Hand sanitizer preparations containing alcohol on the other hand can contain ethanol, isopropyl alcohol, *n*-propanol, or a mixture of these, water, as well as excipients and humectants. Solutions containing alcohol between 60% and 95% in volume are most frequent and effective. Humectants are included to prevent skin dehydration and excipients help stabilize the product as well as extend the time needed for the evaporation of alcohol, thereby increasing its biocidal activity.

Alcohol mechanism of action against bacteria

The compound, *n-propanol,* is the most commonly used alcohol compound in sanitizers. It is not known with much trust the exact mechanism of alcohol's antimicrobial activity; however, it may be interconnected membrane damage, and inhibition of mRNA and protein synthesis through result on ribosomes and RNA polymerase or associated with protein denaturation. For activity against bacteria, its peak bactericidal efficacy is achieved at concentrations between 60% and 90%. In fact, absolute alcohol, or alcohol that is no more than 1% water, is less bactericidal than alcohol between the aforementioned ranges. Water is thus analytic in the protein denaturation process. No matter which process, if not multiple, are high-flown by alcohol, essential metabolic pathways, membrane damage and loss of cellular integrity ultimately occur. It is important to note, however, that alcohol shows bactericidal activity against vegetative bacteria—those go through metabolism and binary fission—but not against spores.

Alcohol mechanism of action against viruses

The viral targets of alcohol-based hand sanitizers are mostly the viral envelope, if present, which is derived from host lipid envelopes, the protein capsid, which contains and protects the genetic material, and the genetic material itself. Given that all these elements are necessary for the viral life cycle (eg, attachment, penetration, biosynthesis, maturation, lysis), and thus evaluative for its ability to transmit to another host, it can be presumed that altering the structure or function of any of the previously mentioned components will typically render the virus ineffective.

While less is known as regards the specific mechanism of action of alcohols agents against viruses compared to bacteria, it is understood that ethanol's have a broader and stronger virucidal activity than propanol. In fact, high concentration of ethanol has shown to be highly effective against enveloped viruses and thus is effective against the majority of clinically applicable viruses. It is also interesting to note that adding acids to ethanol solutions can increase its efficacy against viruses that are more immune to ethanol alone. Despite the potential synergism of ethanol and acidity, it remains known that most hand sanitizers continue to be ineffective against nonenveloped viruses.

Non alcohol mechanism of action

The example followed for the NABHS is benzalkonium chloride. The main component of NABHS is benzalkonium chloride and it is not practical towards non enveloped viruses. And a report exhibits its potency against human coxsackie virus exception that it is not enveloped. The lipid enveloped in both bacteria and viruses seems, given this exception, to be a vital structure for the practicality of benzalkonium chloride. The benzalkonium chloride cationic head group is gradually absorbed in the lipid bilayer to phospholipids negatively charged phosphate heads, thereby increasing its concentration, giving to decreased membrane fluidity and thus to the formation of hydrophilic membrane gaps. The alkyl chains 'tail' portion of benzalkonium chloride further disrupts and disturbs the lipid bilayer by penetrating the surface and disturbing the structural and functional characteristics. Consequently, the activity of the protein is disrupted and the variation of the above effects results in the absorption of bilayer components into benzalkonium chloride or phosphor lipid micelles. Benzalkonium chloride suppresses inter cellular targets and contradicts the transcriptional actions of DNA.

Efficacy of hand sanitizer

It is more powerful to study viruses than bacteria. Many studies have tried to test the efficacy of hand sanitizers on viruses and bacteria. Use of alcohol-based hand sanitizers are suggested by WHO for protection against multiple viruses including the coronavirus as it has proven effective in quantitative suspension testing. Other sterile sources containing isopropyl alcohol as the main ingredient also have proven effective against multiple surrounded viruses.

A review of the composition on the effectiveness of handwashing against severe acute respiratory syndrome (SARS) transmission found that nine out of 10 small case-control studies showed that hand washing reduced the chance of social contamination. Vivo evidence of viral inactivity after the use of hand sanitizers is untouchable by standard methods. Vitro studies have established that alcohol-based cleaning agents can be effective in reducing viral load.

The SARS-CoV-2 transmission has an incubation time of 10 days, which makes it easy to cultivate through drops, contaminated hands or surfaces. Therefore, the effect of viral inactivity on all transmitters should be considered. Alcoholic cleaning agents have been able to deactivate SARS-CoV-2 and MERS-CoV (also pre-activated coronaviruses) on living surfaces like plastic, glass, and metal. A key limitation in analyzing the actual performance of hand disinfection is the reoccur process of self-reported data gathering, which may not be the same and objective in terms of the regularity and method of handwashing.

Adverse effects

1.Skin dryness.
2.Trigger eczema and psoriasis symptoms.
3.Antibiotic resistance.
4.Irritate the skin.
5.Toxic to health.
6.Alter the communities of beneficial bacteria.\

Safety measurements

- Don't swallow hand sanitizer
- Keep hand sanitizer away from reaching children and supervise their use
- Avoid products that say "FDA-Approved" on the label there are no hands approved by the FDA
- Use hand sanitizer in a well- ventilated area

CONCLUSION

With the current research in the writing, it is difficult to confidently submit one mode of hand sanitizing delivery over the other. What we can state, however, is that soap and water is better than sanitizer, and when hand washing is unavailable or inappropriate, a sufficient volume of sanitizer is important to ensure complete hand coverage, and compliance is critical for appropriate hand sterility. And finally, with the virucidal data on viruses of similar structure to SARS-CoV-2, this virus can be effectively inactivated with present hand hygiene products, though future research should try to determine this directly.

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