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Review Article

Role of disinfection and hand hygiene: a COVID-19 perspective

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ABSTRACT

Coronavirus disease 2019 (COVID-19) being an acute respiratory disease caused by a novel coronavirus (SARS-CoV-2) is transmitted in most instances through respiratory droplets, direct contact with cases, and also through contaminated surfaces/objects. Though the virus survives on environmental surfaces for varied periods, it gets easily inactivated by disinfectants. Therefore, this article aims to highlight the role of surface disinfection and hand disinfection during the COVID-19 pandemic. Disinfection with appropriate and recommended physical or chemical disinfectants will not only reduce the spread of the disease but also play a significant part in flattening the curve. Alcohol-based disinfectants and other chemical disinfectants play major roles. Ether, ethanol, hydrogen peroxide, sodium hypochlorite, other chlorine-containing disinfectants, peracetic acid, chloroform used under appropriate concentrations and techniques are necessary to stop the chain of transmission. Hand disinfection using soap and water or alcohol-based hand rubs are also of equal importance. Irrespective of the importance, the judicious use of disinfectants is also necessary. Therefore, the fastest, easiest, and most effective way to halt or reduce the spread of SARS-CoV-2 the virus resulting in the coronavirus disease (COVID-19) is through surface disinfection and handwashing with soap and water and its role in the COVID-19 pandemic is highly important.

Keywords: Coronavirus, COVID-19, Disinfection, Handwashing

INTRODUCTION

The coronavirus disease is gripping the world through its devastating pandemic currently. Its transmission through droplets occurs when a person is in close contact with someone who has respiratory symptoms (e.g., coughing or sneezing) and is therefore at risk of having his/her mucosae or conjunctiva (eyes) exposed to potentially infective respiratory droplets. Transmission may also occur through fomites in the immediate environment around the infected person.[1] Droplets may also land on surfaces where the virus could remain viable; thus, the immediate environment of an infected individual can serve as a source of transmission.[2] Therefore, this article aims to highlight the role of surface disinfection and hand disinfection during the COVID-19 pandemic.

Common terminologies explained

Disinfection: Thermal or chemical destruction of pathogenic and other types of microorganisms. Disinfection is less lethal than sterilization because it destroys the most recognized pathogenic microorganisms but not necessarily all microbial forms (e.g., bacterial spores.[3]

Disinfectants: usually a chemical agent (but sometimes a physical agent) that destroys disease-causing pathogens or other harmful microorganisms but might not kill bacterial spores. It refers to substances applied to inanimate objects.[3]

Sterilization: Validated process used to render a product free of all forms of viable microorganisms. In a

sterilization process, the presence of microorganisms on any individual item can be expressed in terms of probability. Although this probability can be reduced to a very low number, it can never be reduced to zero.[3]

Decontamination: The use of physical or chemical means to remove, inactivate, or destroy blood borne pathogens on a surface or item to the point where they are no longer capable of transmitting infectious particles and the surface or item is rendered safe for handling, use, or disposal.[3]

Cleaning: The removal of visible soil (e.g., organic and inorganic material) from objects and surfaces and normally is accomplished manually or mechanically using water with detergents or enzymatic products. Thorough cleaning is essential before high-level disinfection and sterilization because inorganic and organic materials that remain on the surfaces of instruments interfere with the effectiveness of these processes.[4]

Sanitation: Sanitation refers to the provision of facilities and services for the safe management of human excreta from the toilet to containment and storage and treatment onsite or conveyance, treatment and eventual safe end use or disposal.

Antiseptics: Substance that prevents or arrests the growth or action of microorganisms by inhibiting their activity or by destroying them. The term is used especially for preparations applied topically to living tissue.[3]

Asepsis: is a process where the chemical agents (antiseptics) are applied on to the body surface (skin), which kill or inhibit the microorganisms present on skin.[3]

Contact time: Time a disinfectant is in direct contact with the surface or item to be disinfected. For surface disinfection, this period is framed by the application to the surface until complete drying has occurred.[3]

Viability of SARS-CoV-2 on aerosols and different surfaces

The disinfection process of SARS-CoV-2 virus is highly dependent on the surface, article or substance being disinfected. Thus, it is also necessary to know the viability of the virus in different surfaces or aerosols and it is listed in Table 2.

Table 1: Some important milestones in the history of disinfection and sterilization.

Ancient civilization (from 4000 BC)	**Clear water = clean water; Egypt: alum to remove suspended solids in water; China: filters to remove suspended solids in water; India: heat foul water by boiling and exposing to sunlight and by dipping seven times into a piece of hot copper, then to filter and cool in an earthen vessel**
The Roman Empire (27 BC-476 AD)	No major treatment was provided (other than the incidental mild disinfection effect of sunlight on water in open aqueducts)
1847, Ignaz Semmelweis	One of the first to sense that hands play an important role in the chain of transmission. At the obstetrical clinic in Vienna, the German-Hungarian physician ordered the use of chlorinated lime solution for handwashing. The mortality rate due to childbed fever dropped from 18% to 2%.
1850, John Snow London, England	One of the first known uses of chlorine for water disinfection attempted to disinfect the broad street pump water supply in London after an outbreak of cholera.
In 1862, Louis Pasteur	He proved that bacteria can only evolve from existing bacterial cells and not from inanimate matter. The chemist developed and pioneered the procedures of disinfection, sterilization and pasteurization.
1862	Autoclave was invented and used for sterilization
1865, Sir Joseph Lister	He concluded from Pasteur's findings that bacteria must also be responsible for poor wound healing. His remedy was to use carbolic acid to disinfect the air and the hands, and to soak dressings before covering wounds
1897, Sims Woodhead Kent, England	One of the publicly approved uses of chlorine for water disinfection; used "bleach solution" as a temporary measure to sterilize potable water supply during a typhoid outbreak.

Types of disinfectants recommended for SARS-CoV-2

SARS-CoV-2 is sensitive to:

Physical disinfectants: including ultraviolet radiation and heat (56°C for 30 minutes).

Chemical disinfectants (for one minute): ether, ethanol (62-75%), hydrogen peroxide 0.5%, sodium hypochlorite 0.1%, other chlorine-containing disinfectants, peracetic acid and chloroform.

On the basis of surface of application, the disinfectants are grouped as below:

Hands: Soap and water, alcohol-containing quick-drying hand disinfectant, chlorine-containing disinfectant, hydrogen peroxide.

Skin: 0.5% iodine-based disinfectant, hydrogen peroxide.

Mucosa: 0.05% iodine-based disinfectant.

Table 2: Viability of SARS-CoV-2 on aerosols and different surfaces[5]

Type of surface/aerosols	Viability	Approximate half-life (hours)
Aerosols	Up to 3 hours	1-2
Stainless steel	Up to 72 hours	5-6
Cardboard/paper	Up to 24 hours	3-4
Plastic	Up to 72 hours	6-7
Copper	Up to 4 hours	≈1

The commonly used chemical disinfectants in hospital disinfection settings can be grouped and described here:[6]

Hand and skin disinfectants

Alcohol: Ethyl alcohol**,** isopropyl alcohol.

Iodophors: 7.5% povidone iodine surgical scrub, soap containing povidone iodine for hand washing. Iodophors in a concentration of 0.5-10% can also be used for handwashing to reduce the infectivity of enveloped viruses.

Phenolics: Phenol has occupied a prominent place in the field of hospital disinfection since its initial use as a germicide by Lister in his pioneering work on antiseptic surgery.

Surface disinfectants

Chlorine and chlorine compounds: Sodium hypochlorite (liquid), household bleach, calcium hypochlorite (solid).

0.1% sodium hypochlorite solution as surface disinfectant, can efficiently inactivate human coronaviruses within 1 minute. World Health Organisation (WHO) recommends sodium hypochlorite at 0.5% (equivalent to 5000 ppm) for disinfecting surfaces.

Hydrogen peroxide (used as hard surface disinfectants)

0.5% accelerated hydrogen peroxide in 1 minute has virucidal activity as surface disinfectant.

Quaternary ammonium compounds

The quaternaries commonly are used in ordinary environmental sanitation of noncritical surfaces, such as floors, furniture, and walls. Centre for disease control and prevention (CDCP) suggests Environmental Protection Agency (EPA), registered quaternary ammonium compounds are appropriate to use for disinfecting medical equipment that contacts intact skin.[6]

GENERAL RECOMMENDATIONS FOR ROUTINE CLEANING AND DISINFECTION OF HOUSEHOLD ITEMS

Frequently touched surfaces

It is necessary to practice routine cleaning of frequently touched surfaces (for example tables, doorknobs, light switches, handles, desks, toilets, faucets, sinks, and electronics.) with household cleaners and EPA-registered disinfectants external icon that is appropriate for the surface, following label instructions.[7]

Linens

Machine washing of the linens with warm water 60-90°C (140-190°F) with laundry detergent has been recommended. If machine washing is not possible, linens can be soaked in hot water and soap in a large drum using a stick to stir but being careful to avoid splashing. The drum then should be emptied, and the linens should be soaked in 0.05% chlorine for approximately 30 minutes. The laundry should be rinsed with clean water and the linens should be allowed to dry fully in sunlight.[2,8]

For hard and soft porous surfaces

For hard surfaces disinfection, chemical disinfectants are to be used. In case of soft porous surfaces (example, carpets, rugs, drapes, etc.) cleaning and disinfection suitable for the material should be followed. Laundry should be disinfected after use. The use of gloves needs to be highlighted here.[9]

For electronics

For electronics such as cell phones, tablets, touch screens, remote controls, and keyboards, remove visible contamination if present. It is advised to follow the manufacturer's instructions for all cleaning and disinfection products. Using of wipeable covers for electronics is also recommended. If no manufacturer guidance is available, the use of alcohol-based wipes or sprays containing at least 70% alcohol to disinfect touch screens need to be considered. The surfaces of the electronics should be wiped thoroughly to avoid pooling of liquids.[9]

Hand disinfection

The role of hand hygiene during COVID-19 pandemic

Hand hygiene has been established as extremely important in the prevention of the spread of the COVID-19 virus. Hand washing and the use of hand sanitizers have been emphasized to fight the transmission of the SARS-CoV-2 virus. To stop the spread of the disease we need to break the chain of transmission and that can be done through regular training sessions at health-care facilities aimed at promoting best hand hygiene practices

and ensuring the availability of the necessary infrastructure (equipment and supplies). All health-care facilities should establish hand hygiene programmes, if they do not have them already, or strengthen existing ones. Procurement of adequate quantities of hand hygiene supplies; hand hygiene refresher courses and communications campaigns need to be focused upon.[2]

Use of soap and water in disinfecting hands

During a global pandemic, one of the cheapest, easiest, and most important ways to prevent the spread of a virus is to wash your hands frequently with soap and water for a minimum of 15-30 seconds, on an average of 20 seconds following the appropriate steps.[10]

Use of alcohol-based hand sanitizers or hand rubs in disinfecting hands

The exact contribution of hand hygiene to the reduction of the direct and indirect spread of coronaviruses between people is currently unknown. However, hand washing mechanically removes pathogens, and laboratory data demonstrate that alcohol-based hand rubs (ABHR) formulations containing 80% ethanol or 75% isopropanol, both of which are in the range of alcohol concentrations recommended by Centre for disease control and prevention, inactivate SARS-CoV-2. ABHR effectively reduces the number of pathogens that may be present on the hands of healthcare providers after brief interactions with patients or the care environment.

The Role of disinfection during COVID-19 pandemic

Due to the route of transmission being droplet infection, the transmissibility rate of COVID-19 can be higher than other infective viruses. Therefore, the fastest, easiest, and most effective way to halt or reduce the spread of SARS-CoV-2 the virus resulting in the coronavirus disease (COVID-19) is through surface disinfection and handwashing with soap and water.

A study done by Kampf et al reports that human coronaviruses can remain infectious on inanimate surfaces for up to 9 days. Surface disinfection with 0.1% sodium hypochlorite or 62-71% ethanol significantly reduces corona-virus infectivity on surfaces within 1 minute exposure time, expecting a similar effect against the SARS-CoV-2.[11]

Another such study concludes that some disinfectant agents effectively reduce coronavirus infectivity within 1 minute such as, 62%-71% ethanol, 0.5% hydrogen peroxide or 0.1% sodium hypochlorite. Compounds such as 0.05-0.2% benzalkonium chloride or 0.02% chlorhexidine digluconate are less effective. Therefore, an effective surface disinfection may help to ensure an early containment and prevention of further viral spread.[12]

These, further highlight the role of appropriate disinfection strategies against COVID-19 pandemic.

The current recommendations by the Government of India, Centre for disease control and prevention and World Health Organisation (WHO) promote and highlight the very same need.

Disinfection with appropriate and recommended physical or chemical disinfectants will not only reduce the spread of the disease but also play a significant part in flattening the curve. Handwashing and surface disinfection are therefore the need of the hour. Social distancing and use of face covers being other important parameters play an important role here as well.

Proper knowledge regarding the correct disinfectant, technique of disinfection, its concentration and safe use is the key for the control of COVID-19 pandemic.

Social issues and limitations

The rapid spread of the COVID-19 pandemic resulted in panic, apathy and insecurity among the people. There have been instances of injudicious use and hoarding of disinfection substances as a result. This has resulted in indiscriminate and ineffective use of these important disinfectants. However, the knowledge regarding appropriate use is inadequate among the general public.

CONCLUSION

Coronavirus disease 2019 (COVID-19) being an acute respiratory disease caused by a novel Coronavirus (SARS-CoV-2) is transmitted in most instances through respiratory droplets, direct contact with cases and also through contaminated surfaces/objects. Though the virus survives on environmental surfaces for varied period of time, it gets easily inactivated by chemical disinfectants. So, the correct and effective use of disinfectants, handwashing and washing using soap and water, hand disinfection with ABHRs are extremely important.

Therefore, in order to curtail the spread of the disease there is an immense role of disinfection, more importantly its adequate knowledge and correct use.

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