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# Sodium Hypochlorite Usage During Covid-19 – Reassurance or a Menace

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***Abstract:** Sodium hypochlorite (NaOCl) is a highly essential chemical compound used regularly under numerous circumstances. It is a clear, yellowish liquid that is inflammable and a strong oxidant. It has been used for many years and is recommended as the disinfectant of choice to prevent the spread of infection and cross-infection between healthcare professionals and patients. The current COVID-19 pandemic has necessitated its use in abundance not only in healthcare units, but also in public places. It is like a double-edged sword that requires careful follow-up of a set of protocols and precautions during its use to avoid its side effects and health problems among healthcare workers and the public.*

***Key Words:** SARS-CoV-2, Sodium Hypochlorite, Disinfection, Microorganisms*

## I. INTRODUCTION

Coronavirus disease 2019 (COVID-19) is a respiratory infection caused by SARS-CoV-2 (COVID-19 virus). It is transmitted mainly through respiratory droplets and spreads with close physical contact. Corona, in Latin, means crown, which belongs to the family Coronaviridae. They are large, enveloped, single-stranded RNA viruses with the genomes packed inside a helical capsid of nucleocapsid protein (N) and surrounded by fragile lipid envelope associated with three structural proteins - the membrane protein (M), envelope protein (E) and spike protein (S), which mediate virus entry into host cells. Some also have envelope-associated hemagglutinin-esterase protein (HE) [1].

At 21-23°C and 40% humidity, the life span and survival rate of coronavirus depends upon the materials on which it thrives upon, such as paper and tissue paper (3hr), air (3hr), copper (4hr), cardboard (24hrs), wood (2days), cloth (2days), stainless steel (2-3days), polypropylene plastic (3days), glass (4days), paper money (4days) and outside of surgical mask (7days). The survival rate of a virus on metal, glass, or plastic can increase by up to 9 days [2]. One of the best ways to control the spread of this infection that has caused the pandemic is to sanitise and disinfect the affected areas regularly.

Disinfection is a process which eliminates all or many pathogenic microorganisms on objects but not the bacterial endospores [3].

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Disinfectants are used to prevent the spread of disease and reduce the potential risk of contamination. Ideally, disinfectants should have a broad antimicrobial spectrum, rapid bactericidal action, be nontoxic to living beings and the environment, lack poisonous residues, have a deodoriser, be colourless, non-flammable, non-staining, and cost-effective [4].

Factors affecting disinfection include organic load, level of microbial contamination, nature of objects, temperature, and pH of the disinfectant. Depending on these factors they are subdivided into chemical sterilant (disinfectants which kill endospores after long exposure 6-10hr), high level disinfectant (kill all microorganism except some bacterial endospores after less exposure, 45min), intermediate disinfectant (kills tubercle bacilli, vegetative bacteria, most viruses and fungi but not endospores), low level disinfectant (kill vegetative bacteria, some fungi and few viruses at less exposure, 10 min). Disinfection with 62% to 71% ethanol, 0.5% hydrogen peroxide, or 1% sodium hypochlorite (a commonly used disinfectant) can kill viruses within a minute [5].

With their ability to inhibit the acquaintance and spread of the COVID-19 virus, disinfectants have emerged as one of the key combatants against COVID-19. Disinfectants such as quaternary ammonium compounds, sodium hypochlorite, accelerated hydrogen peroxide, phenolic compounds, and peracetic acid are used in healthcare units. Sodium hypochlorite is one of the primary disinfectants used routinely today [6].

## II. SODIUM HYPOCHLORITE

During World War I, Dakin introduced a sodium hypochlorite solution for the antisepsis of infected wounds. It is known as Dakin solution, Dakin fluid, or Carrel-Dakin fluid. It consists of a mixture of sodium peroxide (NaO2) and hydrochloric acid (HCl), which produces sodium hypochlorite. This dilute sodium hypochlorite (NaOCl) is commonly referred to as bleach. It is a clear, pale yellowish liquid with chlorine odour, containing 1 to 18% chlorine [7]. It can cause burns and should be stored carefully to prevent deterioration [8]. It is inexpensive and has a relatively short shelf life of 3 months. The shelf life is dependent on factors such as sunlight, temperature, vibration, and the starting concentration at the time of preparation [9]. Sodium hypochlorite is effective against bacteria, viruses, and fungi, and acts as a disinfectant like chlorine [10].

### A. Preparation of Sodium Hypochlorite

Sodium hypochlorite preparation can be done by dissolving the salt in softened water to form a concentrated solution. This will electrolyse in water and form sodium hypochlorite solution. 150g of active chlorine will be present per litre. During this process, caution should be taken to handle the explosive hydrogen gas that will also be formed. Another method of preparing NaOCl is by adding chlorine gas ($Cl_2$) to caustic soda (NaOH). One of the end products would be oxygen, and the other would be hypochlorous acid (HOCl). These two substances play distinct roles in oxidation and disinfection processes, respectively, by interacting with the proteins of biological molecules. The disinfection ability increases with the lowering of the pH by the release of the acid [9].

## B. Storage of Sodium Hypochlorite

Storage of NaOCl solution must fulfil criteria such as storage life, requirements, tank materials, and temperature. It is stored in an anticorrosive container which will also manage the instability of the solution. As sodium hypochlorite undergoes decomposition, its effectiveness decreases due to the slow breakdown of the solution, resulting in a reduction of its oxidative and corrosive effects. NaOCl is best stored at 60°F (15°C) in a cool, dark room, away from direct sunlight, as it decomposes under UV radiation and heat. The tank materials in which NaOCl is stored include HDPE, fibreglass-reinforced plastic, PVC, titanium bolts, PTFE, PVDF, FKM, tantalum, and chlorobutyl rubber-lined steel. Specific gravity of this solution is 1.9. If the solution must be kept outside, then the tank material should consist of insulation, mastic coatings, and heat tracing. The vent should be at least double the diameter of the inlet pipe of the tank to prevent oxygen accumulation. If it is not stored correctly, oxygen gas accumulation can cause hazardous pressure and be dangerous [11].

If the initial concentration of NaOCl is high, it breaks the chemical faster, and further reaction with water will be slowed. Hence, optimal concentrations should be maintained [12].

## C. c) Mechanism of Action

When sodium hypochlorite disinfectant meets a contaminated surface, the HOCl penetrates the microbial cells through their cell membranes, inhibiting enzyme activities and damaging the DNA and cell membranes. Complete penetration of the solution generates oxidative stress, which in turn damages the cellular components of microbial cells. Studies have shown that the cell structures of a few microorganisms, such as mycobacteria and corynebacteria, are protected by a hydrophobic lipid bilayer, which prevents the penetration of HOCL [12].

## D. General Principles of Using a Hospital Disinfectant

Equipment or surfaces should be spotless, free from dust and other debris that could interfere with the disinfectant's action. Disinfectant should be used for equipment which have the potential to spread the infection. They are categorised into groups such as critical, semi-critical, and non-critical items. Vital items are those in direct contact with tissues or the vascular system and need sterilisation. Semi-critical items that contact the mucous membrane or non-intact skin require high-level disinfectants. Non-critical items are those that require surface contact for cleaning [13].

Depending on the needs, different concentrations of NaOCl are prepared, such as 0.006% NaOCl solution for cloths and mops, and 0.01% NaOCl solution for work surfaces, floors, crockery, and cutlery. General disinfection is done using a 0.1% solution to sanitise walls, bathrooms, and other surfaces, including laboratory work surfaces, sinks, and pierre jars. A 0.25% solution is used on blood-spillage areas [14].

i. *Prevention and Control guidelines in using NaOCl disinfectant in health care units: NCDC (National Centre for Disease Control) & WHO Guidelines [15]:*

The floor, toilet floor, bed screen, shower screen, and railings of the clinical hospital areas are disinfected first by using three buckets. One bucket contains plain water, a second includes a detergent solution to remove dust and other particles, and a third contains 1% sodium hypochlorite after the area has been dried. Disinfectant should be used according to the manufacturer's instructions regarding dilution and contact time. Objects contaminated with blood, other body fluids, secretions, or excretions are cleaned first after wearing the personal protective equipment (PPE kit) and then disinfected using freshly prepared 1% sodium hypochlorite. The solution should be in contact with the surface for 20 minutes. All sample-containing containers should be disinfected before transportation with 1% sodium hypochlorite. Spraying of sodium hypochlorite should be avoided, as it has limited disease control ability and is also hazardous to healthcare workers.

Ceiling, walls, doors, and door knobs can be disinfected by first using hot water, followed by detergent, and then a 1% sodium hypochlorite (NaOCl) solution. The surfaces should be touched only after they dry.

Clinical areas, laboratories, and spill areas can be disinfected using 1% sodium hypochlorite, including rag pieces, absorbent paper, gloves, a spill care kit, a Mop, and Hot water. Gloves should be worn constantly. If the spill areas are large, cover them with absorbent paper or a rag. The broken glass and sharps should be removed carefully using a pair of forceps and disposed of in a puncture-proof sharps container. Let the sodium hypochlorite (1%) remain on the spill areas for 10–20 minutes. Then clean the area and discard the cleaning material into an infectious waste bin. Mop the area again with soap and hot water followed by 1% sodium hypochlorite.

White cloth, Mattress/pillow with a Rexin cover, must be washed using 1% NaOCl for 20 minutes, while wearing a PPE kit.

ii. *Concentration of sodium hypochlorite and its efficiency against different microorganisms [16]:*

1% and 2% sodium hypochlorite are microbial resistant to MRSA (Methicillin-resistant Staphylococcus aureus) isolates from surfaces, the environment, and ICU equipment.

0.5% of sodium hypochlorite inactivates the C. Difficile spore and vegetative spore. 0.5%, 1%, and 2% sodium hypochlorite inactivate MRSA, P. Aeruginosa, K. Pneumoniae, S. Aureus, S.

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Epidermidis, S. Haemolyticus, S. Marcescens, E. Cloacae, E. coli, and P. Mirabilis. 0.1% sodium hypochlorite inactivates viruses that have been present on dry surfaces for a long time; however, the protective action of NaOCl decreases when it is rehydrated.

5.25% of NaOCl inactivates the growth of albicans, tropicalis, lusitaniae, parapsilosis, kefyr, labrata (clinical isolates) after 30 seconds of contact.

The disinfected surface will be safe until the next person touches it. Hence, the surface must be disinfected after each use to maintain safety. When a single bacterium occupies the surface, it reproduces into 2.4 million in about 6 hours.

## III. DISADVANTAGES

Sodium hypochlorite releases toxic chlorine gas when heated above 35°C. The chlorinated compounds emitted while cleaning are carcinogenic to humans. They can cause irritation or injury to mucous membranes, conjunctiva, respiratory tract, or gastrointestinal tract. It can also cause necrosis depending on the period of exposure. Bronchospasm, skin damage, acute respiratory distress syndrome (ARDS) and severe necrosis have also been reported [17].

High concentrations are known to cause breakdown of muscle tissue. This rhabdomyolysis releases a protein called myoglobin into the bloodstream, which can affect the kidneys and lead to acute kidney injury. Hemolysis of RBCs takes place when HOCl are inhaled directly. When HOCl reacts with proteins and lipids, it generates free radicals, such as superoxide and OH radicals. These are also known to damage renal epithelial cells, causing severe renal diseases [18].

Viruses can show resistance to disinfection due to their cellular property. They are always attached to materials such as host cells, cell debris, soil, or aerosols. These are called viral clumping protective factors, which reduce the penetration of disinfectants. Therefore, before using disinfectants, it is necessary to clean surfaces or materials with soap or detergent [19]. NaOCl solutions are less hazardous at 1% concentration than the standard supplied solution of 14% concentration [20].

Sodium hypochlorite is unstable. Chlorine evaporates at a rate of 0.75 gram per day from solution. Sodium hypochlorite disintegrates when heated or if it contacts acids, sunlight, certain metals, and poisonous and corrosive gases, including chlorine gas. It is a flammable, strong oxidant that reacts with flammable compounds and reducing agents. These characteristics must be considered during transport, storage, and use [9].

### A. Handling care and tips for use of NaOCl

Do not mix it with strong acids, amines, and ammonia. Wear protective gloves, glasses, and a PPE kit when using it. Hands should be washed properly with soap after use. It should be stored in tightly sealed containers in a cool, dark area away from direct sunlight. It should be kept out of the reach of children. If it irritates eyes and skin, wash the area immediately with water [21].

## IV. CONCLUSION

The use of sodium hypochlorite has increased drastically and has been a boon in controlling the COVID-19 pandemic. It is used abundantly in public spaces, crowded areas, and in the presence of humans and other creatures. Although it is an economical and highly effective disinfectant, specific considerations must be taken when using it, and the potential harmful effects associated with it should deter its use in excess.

## DECLARATION STATEMENT

I must verify the accuracy of the following information as the article's author.

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