HOCl White Paper

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Introduction:

Coronavirus continues to present a serious challenge to a wide range of industries and professions seeking to maintain a safe and sustainable working environment which protects the health of staff, customers and the wider community. Yet for all of the damage which the current pandemic continues to inflict this strain of coronavirus is far from invincible. It is one of a great number of known pathogens, all of which can be eliminated within an environment through the correct application of the appropriate disinfectant solutions.

Hypochlorous acid (or HOCl) has been proven to be effective against Coronavirus in addition to 99% of all known pathogens. It is not unique in this regard – there are a range of chemical solutions which achieve the same goal. What distinguishes hypochlorous acid is that it is the least toxic, most cost-effective and most easily produced of all such disinfectants. Your body may even be producing it as you read this.

Of course, it is not entirely that simple. Like any tool, HOCl needs to be understood and deployed correctly in order to be most effective. The NHS Deep Cleaning & Advisory Service is committed to promoting this understanding and distributing this knowledge to equip all sectors with the means to introduce a comprehensive decontamination strategy into the workplace. This means educating people as to the behaviour of pathogens and the properties of the disinfectants that combat them. It means highlighting the benefits of using HOCl over more harmful or less viable products. It means empowering workforces through bespoke training programmes to conduct workplace cleaning that meets NHS standards. This combination of education and training is designed to enable the workforce to rise to the challenge that Coronavirus represents and generate an effective and lasting response to that challenge.

Pathogens and Hypochlorous acid:

A pathogen can be understood as any microscopic life-form which can cause disease. These particles can be air-borne or require direct contact or may need to be transmitted via inhaled droplets, but once transmitted to a new host they attach to cells and begin their attack. Part of what makes Coronavirus so infectious is that it can be transmitted through all of the above methods. It can survive airborne or in respiratory droplets (i.e. a sneeze or cough) for up to 3 hours, and on a surface such as a plastic table or stainless-steel bench this increases to up to 72 hours[i]. Coronaviruses, Flu and other common virus are known as enveloped viruses, meaning they are encased within a fatty envelope which they use to adhere to the host cell.

To combat infection in our bodies, white blood cells are generated to target and eliminate the pathogens. They do so through a process called phagocytosis; essentially the white blood cell engulfs the pathogen, then produces a chemical which destroys the fatty envelope around the virus, rendering it inactive. The chemical they produce is hypochlorous acid. The ability to remove this envelope also allows HOCl to remove the cell wall from organisms like bacteria which kills them. This destruction of the cell wall or fatty envelope is also known as oxidisation.

During phagocytosis it is important to note that the white blood cell first engulfs the virus particle before producing HOCl to oxidise it. The principle is the same when applying HOCl to a larger area such as a table or door handle, or even to an entire room. The hypochlorous acid solution used as disinfectant is at its most effective when evenly applied to the maximum surface area requiring cleaning. To achieve this the optimal method of application is to release the HOCl in a spray, allowing the vapour to settle in an even coat, as well as being introduced to the air. The solution remains effective in liquid form and NHS DCAS recommends a mixture of application methods when cleaning a room to take into account a range of mitigating factors e.g. clutter on surfaces. Fortunately, the matter of application presents the only real challenge when using HOCl, which is addressed in NHS DCASs training programme. The chemical reaction between HOCl and any pathogen it encounters remains simple and effective. A recent study commissioned by the University of Alberta found that immersion in HOCl was even effective against prions, a notoriously resilient and deadly group of pathogens known for their resistance to

standard disinfection protocols. The study concluded that immersion in a weak solution of HOCl was an appropriate method of sterilising surgical instruments.[ii] To consider that the same solution which is used for such exacting standards can also be applied to our schools, restaurants and offices cannot fail to be reassuring. In addition, HOCl has received numerous recommendations for use against Coronavirus, notably from the US Environmental Protection Agency.[iii]

Comparison against other disinfectants and implications of use

Hypochlorous acid is not alone in being a chemical solution known to be effective against Coronavirus and other pathogens. Bleach, alcohol, chlorine, and other solutions can be just as effective in eliminating these particles. What makes HOCl distinct from these other options is its ease of use compared to the drawbacks of its competitors.

HOCl is a weak acid, but as it is produced in our own bodies it is not harmful to us unless in a very concentrated form. The HOCl used in disinfection is therefore a weak solution which remains effective against pathogens whilst being harmless to humans. Two of its three constituent elements are hydrogen and oxygen, as with water, with the addition of chlorine (Cl) to create the disinfectant effect. Hypochlorous acid is concentrated and introduced into another solution in the production of bleach, but because HOCl can be isolated and studied as it appears in our bodies, it can be synthesised to the same harmless levels for use in cleaning. By contrast, products such as bleach can be harmful to the skin, eyes and respiratory system.

All disinfectants require some dwell time; in other words, a period in which they must remain on a surface in order to let the chemical reaction take effect. Due to the potentially harmful effects of products such as bleach for example, any surface cleaned by it becomes unusable for a period of time. If the treated surface is used too soon after cleaning, the product could adhere to other surfaces such as a tray or the palm of a hand, thus risking damage to those surfaces. Furthermore, if these products are released into the air (recall the strong smell that accompanies bleach) the entire space around the surface may be unsuitable for use for a time. Such toxicity most often prevents these products from being aerosolised, preventing the even application discussed earlier as best practice.

Furthermore, the use of more aggressive solutions such as bleach imposes restrictions upon the user responsible for decontamination. A stringent approach to safe use is essential, as is the use of various levels of PPE ranging from rubber gloves to breathing apparatus. This brings up the issue of inconvenience. It may seem frivolous to refer to such measures as being inconvenient, but inconvenience to an end-user introduces the risk of unsafe use or inadequate replacement measures in real-world situations. One ubiquitous example is the use of alcohol wipes. Alcohol wipes are sanitisers (that is, they are designed to reduce the level of pathogens on a surface to a safe level). They are not disinfectants; they do not eliminate pathogens in the manner that HOCl or bleach do. Furthermore, their function does not allow for dwell-time, and actually encourages bad practice i.e. using one wipe to clean multiple surfaces, in a single sweep or a circular pass over a surface. Such habits, easily adopted by the user, are not only ineffective, but are potentially harmful. A study published by the *Journal of Hospital Infection* compared a five-day period of using HOCl against the same period of using alcohol wipes within the setting of a care home.[iv] It found that while HOCl significantly reduced the bacterial load on treated surfaces, the alcohol wipes actually *increased* the bacterial load. Not only is the solution within the alcohol wipe not as effective on a chemical level, it dries too quickly to allow adequate dwell-time and overuse can lead to the wipe being a vehicle for the pathogens to spread further. The convenience of using the wipes therefore incurs risk.

While the hazard posed by the inconvenience factor described above is relevant across all sectors, there are other difficulties which impact on a range of industries. The need to leave sufficient dwell-time presents a challenge in sectors such as education, where decontamination needs to be rapid and space is at a premium i.e. cleaning desks in a classroom between lessons. The toxicity present in some chemicals presents a health risk in catering or hospitality i.e. disinfectant used on food preparation surfaces being transferred to the food itself. The cost of specialist equipment and PPE can put additional strain on the finances of small businesses.

This is where the advantages of HOCl as a primary disinfectant become clearly superior. At the concentration levels required to disinfect, the solution is far less toxic than the other chemicals discussed. HOCl was used to wash wounds in World War One, and is commonly used as mouth-wash and toothbrush cleaner in the dental sector[v], as well as being the active sanitising agent in most swimming pools. Its relative lack of toxicity removes many of the obstacles that other disinfectants encounter. HOCl can be given dwell-time on a surface and allowed to dry naturally as there is no risk associated with it being transferred to the skin. Desks in a classroom can be treated with HOCl – oxidisation can occur within two minutes, but the surface can go straight back into use as the HOCl poses no risk to the user. Usage requires no PPE other than the standard requirements for the environment in which the solution is being used. HOCl costs less to produce than most other solutions and manufacture produces no environmentally harmful substances.

Finally, this lack of toxicity means that HOCl can be sprayed or misted without breathing apparatus being required. This method of delivery produces even surface coverage and aids dwell-time by allowing the solution to dry quickly whilst still being fully effective. The manufacture of HOCl can be adjusted for aerosol delivery to account for the reduction in concentration that occurs in spraying. In conclusion, a recent review of HOCl by the University of Louisiana summarised its findings thus:

"It [HOCl] comprises many of the desired effects of the ideal disinfectant: it is easy to use, is inexpensive, has a good safety profile, and can be used to disinfect large areas quickly and with a broad range of bactericidal and virucidal effects."[vi]

The role of the NHS Deep Cleaning & Advisory Service

As well as being a provider of cleaning services and audits, and a supplier of HOCl, NHS DCAS is leading the way in showcasing the benefits of HOCl to as wide and broad a spectrum of users as possible. As an effective, inexpensive and environmentally responsible cleaning solution, HOCl stands well above its rivals. That said, hypochlorous acid on its own is not a miracle cure. For any tool to be effective, it has to be understood and applied using correct technique. NHS DCAS facilitates the effective use of HOCl by offering a comprehensive methodology of decontamination to our customers through our training courses. These courses follow a broad framework but we work with our customers to visit and analyse their unique environment before producing a bespoke course which is relevant to their sector, their workspace and their personnel. These courses train users in the best practice regarding decontamination in general and HOCl specifically, to the same standards expected of the NHS. In addition, our courses are accompanied by discrete audit training. This training empowers staff within a workspace to quality assure their own processes and environments.

This dual approach ensures that not only is the user's decontamination procedure effective and efficient, it is also sustainable. A workplace which can audit their own procedures to ensure it meets our standard and, by extension, the standard of the NHS. In this way, NHS DCAS hopes to educate and empower as many sectors as possible to adopt a comprehensive decontamination strategy that can be deployed to combat the current pandemic and then taken forward to safeguard their workplace in the long-term.

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[i] Van Doremalen N, Morris DH, Holbrook MG, et al: Aerosol and surface stability of HCoV-19 (SARS-CoV-2) compared to SARS-CoV1. N Engl J Med 382.1564 (2020)

[ii] Hughson AG, Race B et al: Inactivation of Prions and Amyloid Seeds with Hyopchlorous Acid. PLoS Pathogens 12(9): 1005914 (2016)

[iii] US Environmental Protection Agency List N: Disinfectants for use against SARS-CoV-2. Available at www.epa.gov as of May 2020

[iv] Meakin NS, Bowman C, Lewis MR, Dancer SJ: Comparison of cleaning efficacy between in-use disinfectant and electrolysed water in an English residential care home. J Hospital Infection 80 122-127 (2012)

[v] Lee SH, Choi BK: Antibacterial effect of electrolyzed water on oral bacteria. J Microbiol 44:417 (2006)

[vi] Block MS, Rowan BG: Hypochlorous Acid: A Review. J Oral Maxillofac Surg 78:1461-1466 (2020)

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