Pure Stable HOCl for Hospital Applications

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Background:

The recent emergence of stabilized hypochlorous acid (HOCl) for surface disinfection in healthcare institutions represents one of the most important advances in hospital infection control in decades.

Over-use of antimicrobial agents in patient care, environmental sanitation, and livestock supplements now threatens to return medicine to a pre-antibiotic era. Over the past half-century microbes have adapted and evolved resistance to conventional therapies, and new tools against infectious agents have now become a critical need for the safe and successful management of hospitalized patients.

HOCl is a small antimicrobial molecule naturally generated through oxidative processes within activated human neutrophils and tissue phagocytes. The molecule was discovered long ago in the late 19th century, but another 100 years passed before scientists recognized that natural selection has placed HOCl on the very front lines of the human body's defense reactions to invasion and injury. However, physiologic HOCl is very short-lived, and its production outside the body has been technically challenging. Despite decades of research and more than 200 papers in the literature, HOCl remained unavailable for use in a stable, purified form until recently.

Chemical engineering techniques have changed that. HOCl is now available in safe, effective, stable, and pure form. Healthcare professionals can now deliver this natural, and extremely effective, disinfectant safely and conveniently to sites of infection and environmental contamination. **Using HOCl, 99.999% of a very wide range of human pathogens are killed within 10-20 seconds in the absence of blood or other bioburdens, which only slow the killing process down somewhat**. **Experimentally many microbes show signs of damage in less than a second, significantly exceeding the disinfection performance of bleach, chlorhexidine, ethylene oxide, and peroxyacetic acid. Pure, stable HOCl is potent without precedent, and offers enormous advantages to healthcare professionals in dealing with the resistance profiles of 21st Century pathogens.**

The Technology:

Within the human body, inflamed tissues generate immunological signals that recruit neutrophils to the site of infection. Those neutrophils produce intracellular hypochlorous acid through an oxidative respiratory burst, retaining its power within phagosomes that contain microbes taken up by the cell, and they also release it locally into the extracellular matrix. Physiologic HOCl, , in this pure potent form is capable of killing a very wide range of human pathogens, and in the process reverts to its original components, salt and water, within a few seconds.

Only in the last few years has it been possible to make this natural substance outside the body. HOCl formulations can be manufactured at large scale that surpass existing standards for purity

and stability. HOCl solutions are available that can destroy infectious organisms, not just in wounds but also on surfaces, and on instruments that are sources of nosocomial and iatrogenic infection (1).

HOCl is a small uncharged molecule, mobile and quick-acting, with a short half-life once exposed to the air, environment or to human skin or tissues. No residual contaminants remain from its use; the elements of its composition revert to harmless chloride ions and sodium counter-ions coming from the physiological saline background in the active solution. The final end-product of use is therefore a very mild salt solution.

The Performance of Pure Stable HOCl:

HOCl shows extraordinary power and speed in independent third party testing in academic and contracted microbiology laboratories. Particularly significant are the findings of powerful inactivation of the toughest environmental forms of disease agents: **spores** – both bacterial and fungal. There is across-the-board effectiveness against microbes expressing even the most dangerous antibiotic resistance, including NDM-1, MRSA, and others.

Safety profile

HOCl contact disinfection performance is **superior to many of the most powerful, traditional hospital disinfectants and sterilants, such as ethylene oxide (EtO), ozone, and peroxyacetic acid, but is distinguished from all of them by its safety.** Exposure of human patients to EtO, zone, peroxyacetic acids, etc., is rapidly lethal. Full-strength HOCl, on the other hand, can be sprayed into human eyes with no adverse effects whatsoever, and it can be inhaled as a mist with no irritation, no adverse effects, and effective elimination of influenza virus from the soft palate.

Hospital uses:

***Environmental hygiene*:** HOCl is an effective replacement for conventional disinfectants with lesser power and safety, such as quaternary ammonium compounds, phenols, and iodophors, some of which have generated microbial resistance in recent years. A protocol of routine use of HOCl as a surface disinfectant can be further supplemented with overnight misting of spaces that experience heavy staff and patient use during daytime hours. This adds to the efficiency of decontamination measures in high-risk exposure zones.

***Hospital room sanitation*:** Residual organism persistence in rooms recently vacated by patients with MRSA, *Acinetobacter* or *C. dificile* infections can be mitigated by aerosol misting of HOCl 2). Efficient penetration can be confirmed with oxidant-detection colorimetric assays to ensure complete biological elimination. HOCL used for this purpose overcomes the inconveniences of conventional generation of HOCl on site (2), and its stability and potency represent a significant opportunity for improved management of contaminated facilities.

***Instrument decontamination*:** Protocols have been established and proven for the use of HOCl as an instrument decontaminant after thorough baseline cleaning procedures have been performed. Studies with older, less stable, and less pure forms of HOCl substantiate the efficiency of this approach. Pure , stable HOCl brings added security in the purity of the active

chemical component, and the result can be a prolonged shelf life – saving money and reducing the risk of patient harm.

***Wound cleansing*:** Infected wounds benefit not only from the direct antimicrobial properties of HOCl, but also from:

1. the topically effective **enhancement of blood clotting** by HOCl;
2. the local specific **immune response** triggering mechanisms;
3. **speedier closure of epithelial breaches** encouraged by faster growth and movement of superficial epithelial cells.

All are well-documented effects of HOCl.

The age-old success of Dakin's bleach solutions applied to wounds can be reproduced reliably using HOCl, but without the risk of toxic and irritating local effects and the deterioration of healing that commonly complicates its use.

Summary: Hospital Infection Control would benefit from the adoption of pure stable HOCl. Its use will reliably impact contamination hazards, reduce risks to patients and personnel, and contain the costs associated with institutionally-acquired infections. No other innovation is so readily accessible, so well-proven, or so cost-effective. There are no environmental or staff, or patient exposure downsides. Because of the biochemical nature of the HOCl killing process there are no risks of generating new resistant biological strains unresponsive to HOCl or other antimicrobial agents.