Emergency Products & Research: Ambu-Stat Sterilization System

Mar 9, 2015

The Ambu-Stat system uses a handheld electrostatic fogger to dispense a proprietary solution of hydrogen peroxide, peracetic acid (aka 'peroxyacetic acid' and 'PAA') and acetic acid, along with an olfactory alert additive, to perfect the art of disinfecting infectious/toxic public health spaces. As you know, the majority amongst us, despite their training, are very unfamiliar with the process required to disinfect or sterilize surfaces and spaces, let alone basic sanitization or cleaning a space to a degree that would make Mom proud.

We have made this exercise very simple:

(a) identify everything that doesn't belong in the space (i.e., fingerprints, trash, dirt, blood, dead cats, etc.),
(b) remove the 'everything that doesn't belong,'
(c) dispense the fog,
(d) provide adequate dwell time (i.e., sanitization = 10 minutes, disinfection = 15 minutes or sterilization = 5.5 hours (100% kill of greater than a 4-log(10) CFU mL(-1) reduction in spore population),
(e) permit adequate air circulation to bring fresh air into the space and
(f) get back to business.

There are a number of competitors who are claiming success in this space, but, to be quite honest, they are proclaiming capabilities, such as "No Touch Required," and 'we handle everything from start to finish,' which are frankly irresponsible statements. As for implementation cost, they are asking for checks ranging from $7,000 to $60,000 to achieve the same goal that we can accomplish for less than $1,000.

We believe that the efficacy, safety, low tech requirements and ultra-portability of our system, along with its extreme cost-effectiveness (around $3.10/day, based on a model station comprised of 2 ambulances, crew room, bunk room, locker room, decon area and traditional bays), is going to have a significant impact on public health, by reducing the strain on the healthcare system, improving workforce readiness, reducing sick days (workforce and students), amongst a long list of other benefits.

In addition to the obvious benefit of cleaning ambulances, emergency rooms, urgent care centers, doctor's offices, etc., together with good community paramedicine practices, we have the ability of improving general ability for people to serve as contributing members of society, by identifying that infectious home (and its inhabitants) who serve as a continuous strain on the public safety and emergency services infrastructure. We believe that our system will enable public health departments to convert that situation into a win-win endeavor, by giving them a tool to get the job done – driving infection and poor hygiene out of the home and infusing it with fundamental disciplines and routines to address the brutal fact that has historically been a struggle to manage.

A Model:

(a) Respond to 9-1-1 request,
(b) Recognize that it is a frequently recurring request,
(c) Identify requesting address as infectious/toxic space,
(d) Report address to public health department,
(e) Public health department will work with owner of space to coordinate 'overhaul,'
(f) Public health department will coordinate with animal control and sanitation departments,
(g) Infectious material removed from home,
(h) Basic living furniture (chairs, sofas, mattresses, etc.) hard and soft surface cleaned and walls and nonporous surfaces cleaned,
(i) Living beings removed from space,
(j) Dehumidifier(s) positioned and activated,
(k) Windows and doors secured – except exit door,
(l) Safety sign hung on exit door,
(m)Heavy fog dispensed starting from space farthest from exit door retreating towards exit door – with heavy dose of fog applied to soft surfaces for deep and thorough penetration,
(n) Leave through exit door,
(o) Secure exit door,
(p) Permit adequate dwell time – would recommend 5.5 hours to ensure spore kill – depending on humidity and temperature, space may need to be re-entered to ensure adequate quantities of solution are in place to ensure adequate amount of dwell time for optimal kill,
(q) Permit adequate air flow to ensure safe re-entry,
(r) Return living beings and other articles, after they have been cleaned to the best degree possible,
(s) Re-introduce human inhabitants and
(t) Arrange schedule for community paramedical visits and other personnel for teaching hygiene habits and preventing infectious/toxic relapse.

With regard to efficacy, let me touch on peracetic acid.

Hydrogen peroxide and peracetic acid were first registered in the United States as pesticides in 1977 and 1985, respectively for use as disinfectants, sanitizers and sterilants. Peracetic acid is a mixture of acetic acid and hydrogen peroxide in a watery solution that has a piercing (vinegar) odor that is produced by a reaction between the hydrogen peroxide and acetic acid. Acetic acid (plus) hydrogen peroxide (equals) peracetic acid. When peracetic acid dissolves in water, it disintegrates to hydrogen peroxide and acetic acid, which will fall apart to water, oxygen and carbon dioxide – thus making it a safe and environmentally sound option. Peracetic acid degradation products are non-toxic and can easily dissolve in water. Peracetic acid is a very powerful oxidant and its oxidation potential outranges that of chlorine and chlorine dioxide. Peracetic acid is used mainly in the food industry, where it is applied as a cleanser and as a disinfectant. Since the early 1950's, acetic acid was applied for bacteria and fungi removal from fruits and vegetables.

Hydrogen-peroxide-based products work by oxidizing organic material with which they come into contact. Both hydrogen peroxide and peracetic acid are strong oxidizing agents with similar oxidizing mechanisms. Hydrogen peroxide is one in a series of reactive oxygen species characterized by structures that possess unpaired electrons. This makes them highly reactive and gives them the ability to damage cellular macromolecules, including lipids, proteins and nucleic acids. For example, lipid peroxidation is a process in which oxygen radicals react with unsaturated fatty acids in cell membrane phospholipids. Damage is produced as a chain reaction in which the oxygen radical removes a hydrogen from the fatty acid, which leaves a carbon-centered radical within the fatty acid, which then reacts with oxygen to produce a peroxy radical, which can then react with other fatty acids or proteins. There is a "background" level of hydrogen peroxide in cells as all cells, with the exception of anaerobic bacteria, produce reactive oxygen species as a normal part of cellular metabolism.

The process of cellular metabolism, known as oxidative phosphorylation, occurs in the cell mitochondria. This process converts energy released by the oxidation of nutrients to adenosine triphosphate (ADP), a useable form of energy for the cell. In this process, an electron is passed down the electron transport chain in a series of oxidation-reduction reactions in which the last electron acceptor should be oxygen, to form water. In a small percentage of cases, however, oxygen is instead prematurely and incompletely reduced to yield a superoxide radical that may then be converted to hydrogen peroxide. Other biological processes that may produce reactive oxygen species include production by white blood cells to kill invading pathogens; and production by cells exposed to abnormally low or high oxygen conditions, certain oxidizing drugs or ionizing radiation, especially in well-oxygenated tissues. Hydrogen peroxide is one of the major products formed that can set off a chain of oxidative damage. Because endogenously produced hydrogen peroxide and other oxygenated radicals may cause damage to cells, cells are protected by antioxidant protection systems, including endogenously produced antioxidant enzymes as well as antioxidant scavengers.

Three important antioxidant chemicals produced by cells include superoxide dismutase, which converts superoxide to hydrogen peroxide and water, as well as catalase and glutathione peroxidase, both of which degrade hydrogen peroxide to water and oxygen. Vitamins C and E are examples of antioxidant scavengers. The antioxidant enzyme systems are important factors in the breakdown of oxidant chemicals in the environment as well as within organisms. Like hydrogen peroxide, peracetic acid is an oxidant and damages cells by oxidation and disruption of cell membranes via the hydroxyl radical. Unlike hydrogen peroxide though, peracetic acid is not deactivated in the same way by catalase and peroxidase enzymes of microorganisms which break down hydrogen peroxide, so is quite an effective antimicrobial compound. However, once peracetic acid does break down, contingent on the degree to which the peracetic acid solution is stabilized, the hydrogen peroxide formed is broken down by these enzymes, the gradual elimination of which will ultimately affect the equilibrium of this substance in solution. Source: State of Massachusetts, Energy and Environmental Affairs

In a nutshell, peracetic acid as a disinfectant oxidizes the outer cell membranes of microorganisms and, together with hydrogen peroxide and additional acetic acid, the electrons are transferred to the microorganism much faster, causing the microorganism to be deactivated rapidly. Peracetic acid can be applied for the deactivation of a large variety of pathogenic microorganisms and it also deactivates viruses and spores.

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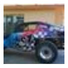

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Jason Thompson · Vice President at Emergency Products & Research - AKA EP+R
I just noticed an error in the article. When we discussed adenosine triphosphate, we provided that it is known as ADP, whereas it is actually ATP, which is known as the cell's energy currency. For those who are inspired to learn more, here is a great resource. http://www.trueorigin.org/atp.asp. Thank you for taking time to learn more about this program. Jason Thompson, VP, Strategic, Tactical & Military Medical Business Development, Emergency Products & Research. 330-552-2560 jasont@epandr.com
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