Today's Prevalent Infection Threats - A Comparison of Control and Prevention Methods for Sporting Equipment

The news has the same headlines - another big-name sports star is infected with a career-impacting disease derived from the equipment or the environment. We have all become accustomed to terms like MRSA, SARS, H1N1, *E. coli*, *C. difficile*, Legionnaire's Disease, Norwalk virus, toxic black mould and others. Most of us haven't any real understanding what these things are and have even less understanding of what to do about them. One thing is certain – the concern is increasing.

Microbes are a fact of life. We are surrounded by them – they are on our bodies, on the things that we use in everyday life, and in the air and environment that surrounds us. Most of them are irrelevant to us, neither good nor bad, but just there. No strategy to control them is needed.

However, some microbes have implications to human health and particularly to athletes because they can cause disease, exacerbate allergic and asthmatic conditions and cause toxic reactions. Skin-borne bacteria that can cause infections in cuts and abrasions – methicillin resistant *Staphylococcus aureus* (MRSA) is a well-publicised example. Athletes are more likely to get-MRSA infections due to the way it typically spreads - direct physical (skin-to-skin) contact with infected people, and indirect contact by touching objects contaminated by the infected person's skin (towels, equipment, workout areas, sports equipment).

Sporting equipment, clubhouses and playing fields, unfortunately, are little more than "germ condominiums" from the perspective of opportunistic infectious microbes, a myriad of places for bacteria and fungi to grow, reproduce or simply just survive. In the last five years this problem, previously considered only to be "stinky gear", has finally been understood and we now can associate the odours and infections that we get from sporting equipment - designed to protect us - to be the result of growth of exposure to mould and bacteria. The protection from the equipment, sadly, has not been as good as we thought that it was. A plethora of inventions, methods, strategies and programs have surfaced to kill the microbes. However, killing them is really rather simple, it's keeping them from coming back for a long enough time to be useful that is tough.

Requirements of Microbes

Microbes are not particularly demanding – they like the same environments that we do. Conditions of temperature and humidity suitable to us are also suitable to microbes.

From the perspective of athletes and sporting facilities, the s*urviva*l of microbes (ie germs) for long enough for us to make contact with them requires only a suitable surface for them to remain on. Accordingly, our efforts have correctly focussed on surfaces.

Existing Control Methods

Cleaning has been the most commonly used means to control microbes that is easily accessible to most people. Intuitively, keeping surfaces clean is paramount to reducing exposure to germs.

A huge industry has developed around this concept with most publically-available information focussing on improved and extended cleaning efforts.

The responses that we have to microbes are the result of three main factors:

- Virulence. Some microbes are simply more dangerous than others. Our control strategies can do little to address this – they are what they are.

- Susceptibility. Some people are simply more susceptible to developing heath issues with exposure. Cleaning and control strategies cannot address this either.

- Dose. This is the one factor over which we should have control – reduction of exposure by reduction of numbers of germs and other microbes accumulating on and growing on surfaces is the focus of our cleaning efforts.

As noted earlier, with all of these strategies in place and readily available to almost everybody, one would presume that the battle against the microbes is being won.

But it is not. Why?

Limitations of Existing Methods

Existing methods to control microbes suffer from a few main obstacles that limit their effectiveness. These include:

1. No lasting effect. Cleaning and surface disinfection all have this inherent limitation – the newly-cleaned surface can and will be contacted by microbes virtually immediately after cleaning and those new microbes will not be destroyed because the cleaning does not provide lasting defence, either because it evaporates or is simply removed by wiping it away. Surface disinfection and hand washing has tremendous value in removing existing germs but first contact after cleaning with a dirty surface will replace them fairly quickly. To be effective, surface disinfection would need to be done very often.

2. Lack of practicability. Some surfaces are simply not easily cleaned often enough to make much difference. We can wash our hands often, but we seldom clean our playing fields, sporting equipment and building surfaces often enough to prevent the growth of microbes and accumulation of germs.

3. Adaptation. Microbes, like all organisms, have mutations. Because of their very short reproductive periods, mutations are frequent. Some of them, unfortunately, are useful to the microbes and permit the microbes to survive in ever-increasing doses of the chemicals that we use to try to kill them. We have all heard of the term “super bugs” – this expression is simply a name that has been used to describe microbes that have developed resistance to our defence products. Most products developed to kill microbes rely on poisoning - they work by entering the organisms and being toxic to some life process. If organisms develop tolerance to this through mutations, and the tolerance is genetic, this will be passed on to future generations, reducing the effectiveness of our defence. The medical community has faced challenges with this.

4. Cost. Fighting a war against microbes can be expensive, especially if you want to win. Control of humidity, provision of fresh air, replacement of products and use of disinfectants and sanitisers all add cost to our control strategy. The cost includes both the products being used and the time required to use them. Often, the cost is prohibitive and, as a result, the defence simply isn't good enough.

Our main efforts have always focussed on:

- Removal of microbes from surfaces – principally to control bacteria and viruses that are passed about by hand contact.

- Improvement of conditions that support microbial growth - mainly for moulds and some environmental bacteria that like dampness.

- Control of microbial survival by adding toxic chemicals to our products during manufacture – this is simply not practical for use on existing surfaces.

We simply need more choices.

Unless we are genetic engineers and have the means to change the virulence of organisms, or are biochemists with formulations that can selectively neutralise microbes of concern, our control methods need to focus on reducing exposure by reducing viable populations on the surfaces that surround us, particularly the high touch and high risk surfaces. The science behind this is already here.

Microbes do not need to be controlled on surfaces by poisoning. They can also be destroyed by physical contact with surfaces that can mechanically disrupt their delicate cell membranes. Cellular membranes in most microorganisms are very susceptible to electrostatic disruption. Once the membrane has been broken the organism will die soon after. The challenge is simply to modify a building surface such that cell membranes of microorganisms that contact it can be damaged without the modification being removed by routine cleaning. We don't need to mass poison the microbes, we just need to know where to direct the efforts.

We need a way to make a surface defend itself.

Disinfectants that would be used to control the growth and survival of microorganisms in sporting applications would ideally have the following characteristics:

- easily applied to existing surfaces
- not visible (colourless and odourless)
- durable and long lasting, even with repeated washing
- no toxicity to humans
- broad spectrum of effectiveness (should destroy a variety of organisms)
- does not promote adaptation
- compatible with all other cleaning products

Disinfectants can be divided into two major categories; bound and unbound. These terms simply refer to whether or not the antimicrobial has the capacity to molecularly bond to the surface on which it is applied.

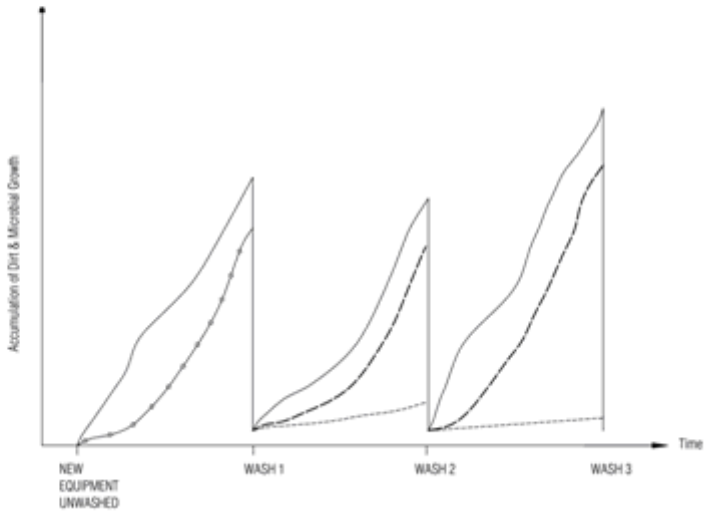
An unbound product must diffuse or leach from the treated surface and be consumed by the microorganism to be effective. Most conventional antimicrobials, such as alcohol or quat-based consumer disinfectants, are intended to kill organisms on contact while wet and dissipate (evaporate) quickly to minimise the danger to humans, animals and treated objects. Hand cleaner is good example of this. Others use the time release capsule approach and obtain a longer working life by burying the antimicrobial in a paint, glue, binder or other coating and counting on slow migration to the surface. Certain types of bathroom paints fall into this category.

Once inside the organism, the chemical agent will act like a poison, interrupting some key metabolic, or life sustaining process of the cell and causing it to die. In all cases, once the antimicrobial is depleted or washed away during regular maintenance, protection vanishes.

A bound product, like the AEGIS Microbe Shield, forms a durable chemical bond upon application and remains chemically attached to the surface on which it is applied. It functions by electrostatically interrupting the organism's delicate cell membrane. This prevents microorganisms from carrying on vital life processes. The antimicrobial acts on contact with organisms and can do so again and again. One can think of the bound antimicrobial like a sword that is capable of repeated use. In comparison, a conventional antimicrobial treatment is more like a gun with limited ammunition. Since a bound antimicrobial is fixed to the surface it continually operates at full strength.

Unfortunately, a bit of chemistry is needed here as the chemistry of surface modification technology is unique. A conventional quaternary ammonium salt, a product which is the basis of many conventional antimicrobials, is chemically spliced to a silane molecule (silanes are used to hold heat shields on spacecraft), resulting in a highly active molecule that has both tenacious bonding capabilities as well as excellent antimicrobial properties. Once applied to a target surface it bonds everywhere, resulting in the creation of a large co-polymer involving the target and the treatment. Since there is no unused chemical once the water evaporates, there is no dislodgeable residue and no odour, leaching, off-gassing, migration or diffusion of the molecule can occur. The AEGIS Microbe Shield is essentially permanent, and the problems associated with conventional chemicals are not of concern.

The AEGIS Microbe Shield is easily applied on virtually any surface by spraying or wiping. It is approved by the Pest Management Regulatory Agency of Health Canada and the Environmental Protection Agency for use on virtually all hard and soft surfaces found in building environments. It can easily be incorporated into existing cleaning and maintenance operations, providing a long-lasting defence to control the growth and survival of microbes on just about any surface. The modified surface will retain antimicrobial activity for an extended period of time, even after repeated cleanings. The graph that follows shows the impact of treatment on hockey equipment.



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……..	Microbe growth, treatment with Aegis Microbe Shield

The AEGIS Microbe Shield is available in Canada exclusively through Protect Technologies and its affiliated partners.

The AEGIS Microbe Shield allows surfaces to begin to defend themselves. It provides critical protection and reduction of exposure to dangerous microbes on frequently contacted surfaces in building environments. This protection is continuous and does not require frequent reapplication. With reductions in exposure come reductions of risk.

The AEGIS Microbe Shield is not a replacement for good building and equipment hygiene. These are important tools in the ongoing effort to reduce risk of exposure. However, effective risk management requires more than one tool. Cleaning and disinfection simply has no lasting effect. Enduring protection is provided, however, with the AEGIS Microbe Shield. Albert Einstein once said that we should use tools and ideas to solve problems that are better than those that we used to create them. It is time for new ideas and time for the AEGIS Microbe Shield.

Reference Materials

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