MAN & MACHINE

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Silver May Protect You From Vampires
But It Won't Protect You or Your Patients From Microbes on Keyboards and Mice.

Introduction

The healthcare industry has moved to implement Electronic Medical Records ("EMR") and has computerized more of it's data. It has become evident to Infection Control Practitioners and IT professionals that the use of keyboards, mice and touchscreens is a source of cross contamination that can increase Hospital Acquired Infections ("HAIs") also now known as Hospital Acquired Conditions ("HACs"). The level of dangerous microbes that impact Infection Control and Patient Safety has become a major concern.

One potential solution to minimize these microbes and possibly decrease HACs is the use of silver antimicrobial agents in the surfaces of the IT equipment, especially in the high touch areas such as keyboards, mice and touchscreens. Silver is a proven anti-bacterial element that has been used for centuries. Silver and nanosilver are promoted for their antibacterial qualities, including in "antibacterial coatings" on computer peripherals shared by multiple users, like hospital and healthcare environments. The claim is that silver minimizes cross-contamination and can reduce the alarming growth of HACs.

But, do silver and nanosilver coatings really protect patients and users from bacteria on touch surfaces in real-world settings, or are they simply expensive and potentially dangerous placebos?

The Problem

Hospitals and other healthcare environments are under great pressure to find cost-effective solutions to HAIs that have created a health crisis and a staggering financial burden.

According to a study published in JAMA in 2013, the cost of HAIs was almost $10 billion, with C difficile infections alone costing $1.5 billion per year at an individual cost of $11,285 per infection. [1]

Annually, almost 2 million patients suffer HAIs in the USA, resulting in an estimated 90,000 deaths. The overall direct cost of HAIs to hospitals ranges from $28 billion to $45 billion. While this range is wide, HAIs are clearly expensive. [2]

Keyboards and mice are high-touch areas and with multiple users, they become ideal places for bacteria to linger, hide and multiply. With the mandatory use of Electronic Medical Records ("EMR"), healthcare workers admit patients every 15 minutes, using keyboards continuously in areas of high infection vulnerability.

Robert G. Hill Jr, MD, from St. Luke's University Health Network, Allentown, Pennsylvania and his colleagues analyzed time use in their emergency department and found that physicians spent 43% of their time, on average, performing data entry, or roughly twice as much as that spent on direct patient care. Their study was published online in the *American Journal of Emergency Medicine*. [3]

Many concerned professionals in the Infection Control arena, the Informatics and IT departments have recognized that computer devices can serve as fomites for the harboring and transfer of microbes and infections in patients. [4]

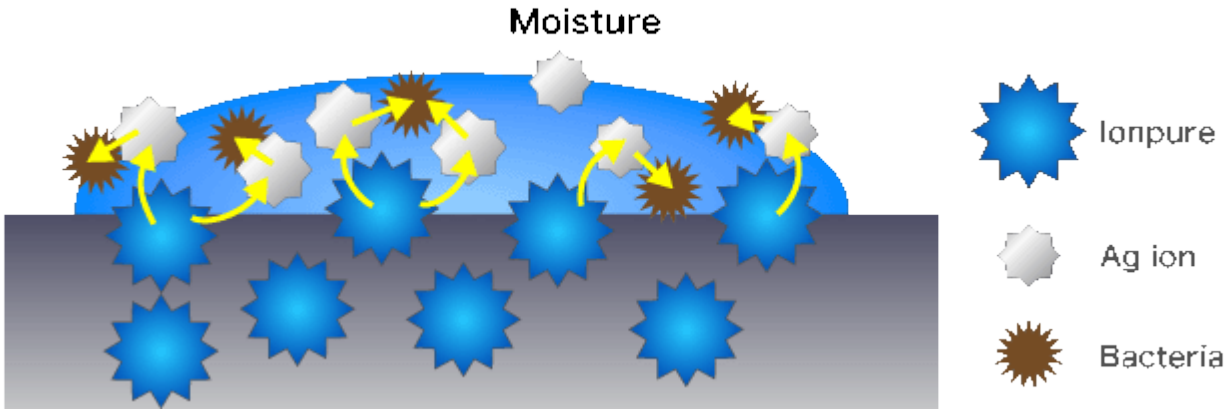
Manufacturers of silver antibacterial additives and keyboards and mice treated with these silver additives advertise that they provide protection from bacteria and consequently minimize transmission of HAI's. Under the assumption of cleanliness, consumers buy these devices and become less attentive to proven cleansing protocols for hygienic keyboards and mice.

Are consumers being misled? The answer lies in how silver works…and doesn't work.

How silver can effect microbes.

According to the manufacturers and academia, silver antimicrobial additives and agents kill microbes by the release of ions in the presence of moisture. These ions disrupt the membrane walls of the bacteria and viruses. Ishizuka of Japan manufactures a silver-glass antimicrobial. They describe the process below....

With the presence of moisture, IONPURE releases a few Ag ions gradually. Ag ion has an ability to strongly bind to cellular enzyme of microbes and inhibit enzyme activity of cell wall, membrane, and nucleic acids. In a word, as microbes charged with minus on their surface, Ag ions that have plus are drawn toward microbes, and disturb their electric balance, so that microbes are burst their cell wall and extinguished.
Otherwise as Ag ions are taken into microbes, they react and bond to the cellular enzyme microbes, this inhibits enzyme activity and multiplication of microbes, thus extinguishing the microbes. [5]



How silver anti-microbial products are tested. And are the tests really true?

The present method to test the efficacy of silver anti-microbial products is a Japanese standard developed years ago, JIS 2801. Silver antimicrobials require a host of particular circumstances in order to kill bacteria. The JIS 2801 is the test standard that was developed in conjunction with the anti-microbial manufacturers to endorse their claims. In the test, the microbes are put into a broth suspension over a test sample and covered with a protective film that keeps the sample moist. The sample is not allowed to dry. The test protocol requires the samples to be kept at 35ºC (95ºF) and 95% Relative Humidity (RH) over 24 hours. It must maintain a moist environment and 100% contact with the surface to allow the transport of the silver ions to effectively kill the microbes.

The JIS 2801 standard was developed to prove that antimicrobials work. This standard is the "best-case" test for many products. [6] But it has many weaknesses.

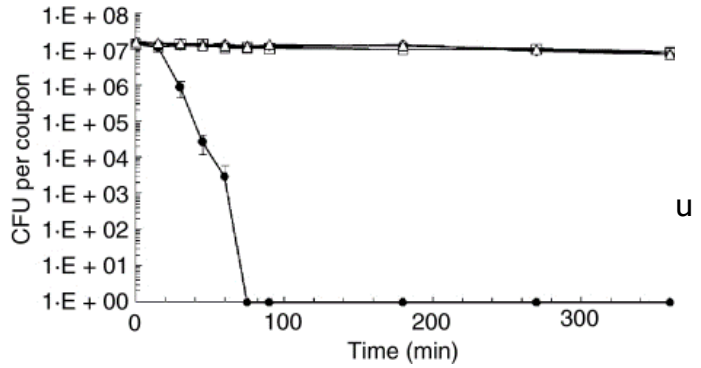
1. It requires a relative humidity ("RH") of over 95%. Most work environments have about 40% RH. Since silver requires moisture to work, this alone almost eliminates any true action against microbes.

2. It requires 35ºC for the test. The higher temperature allows the ions to accelerate the disruption of the microbes. Since most hospital settings are about 17ºC, this skews the results to allow them to look better.

3. The test run lasts 24 hours. Since new patients are seen every 15-20 minutes, the JIS protocol does not really show what the antimicrobials can do in a short time frame found in hospitals.

4. The dilute liquid microbial inoculum is spread evenly over the treated surface. Since in the real world, soil, feces, blood and flesh are 3 dimensional, a large part of the potential hazard will never be in direct contact with the treated surface, or the silver ions.

As noted in a study published in *Letters in Applied Microbiology. 2009 Aug; 49(2): 191–195*. that discusses the effectiveness of silver in eradicating MRSA (methicillin-resistant Staphylococcus aureus), one of the most prevalent HAIs, they found that "silver showed no significant response at lower temperatures and humidity levels typical of indoor environments." [7]



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MSRA viability at ~22ºC and ~50% RH on C11000 copper (•), two silver-ion containing materials Ag-A (Δ) and Ag-B (◊) ...

In typical indoor environments, where temperature and humidity never reach silver's effective bacteria killing zone, silver antimicrobial keyboards and mice are no different than any other keyboard and mouse.

What manufacturers can claim in regards to efficacy of their products.

EPA regulation PR Notice 2000-1 requires manufacturers of products that claim to be anti-microbial to state in their literature:

"This product does not protect users or others against bacteria, viruses, germs or other disease organisms. Always clean this product thoroughly after each use." [8]

But the manufacturers typically do not mention this....

What we don't know about silver can hurt us.

Additional concerns abound. What happens when silver and nanosilver coated peripherals are washed? Several lab studies have found that the coating can leach out, depositing particles into the waste stream. As no long-term studies exist, the consequences remain unknown.

However, scientists and EPA officials conclude that "there is clear evidence that silver, and in particular nanosilver, is toxic to aquatic and terrestrial organisms and to cells from mammals in laboratory research." [9]

A nanoparticle configuration of silver called AGion ® has been added to a number of common items in recent years. Known to kill certain bad bacteria there is concern it may be killing good bacteria as well. According to Zhiqiang Hu, assistant professor of civil and environmental engineering at the University of Missouri College of Engineering, "we found that silver nanoparticles are extremely toxic. The nanoparticles destroy the benign species of bacteria that are used for waste water treatment. It basically halts the reproduction activity of the good bacteria." As a result, more harm than good may come of these products. [10]

Consequences to our environment, and our bodily welfare can't be specifically addressed. Yet, the implication of danger is present.

Solution

Protection from HACs exists with routine disinfection of Medical Grade waterproof keyboards and mice.

The proper keyboard and mouse should be FIT FOR PURPOSE. These devices and their surfaces should be properly cleaned as recommended by organizations such as APIC, and the CDC. The correct method to clean keyboards and mice are with the use of proper surface disinfectants such as 10% bleach, quaternary chemicals, alcohol, hydrogen peroxide and other chemicals that remove soils and hazards mechanically. **Silver antimicrobial additives might protect the product, but it will not protect the user or patient.**

There are extremely high-quality, fully-sealed keyboards and mice on the market today that, with regular disinfection, offer exceptional prevention from cross contamination in bacteria laden environments. The most crucial feature of a keyboard or mouse for use in clinical areas is its ability to be disinfected on all surfaces. This means the device can have no exposed seams or openings around the keys where blood and other contaminates can hide and multiply. No visible cracks or crevices. No gaps between the keyboard and its touch pad. Also, there should be no openings around connectors. Other considerations for the Medical Grade products include:

- Can keys be locked for cleaning? (This avoids the need to unplug the device from the computer during the cleaning process)
- Does it have tactile feedback? (This is how the keyboard feels when typing. Do you need to hit the key in the center or can it be struck at a slight angle?)
- Is the design ergonomic? Does it have a flat design, the best for avoiding carpal tunnel syndrome?
- Can the keyboard be mounted at various angles without the use of Velcro? (Velcro® cannot be disinfected and can harbor dangerous germs)
- Various cable length options available? (Certain situations such as mounting on hospital carts make this desirable)
- Is the device plug and play? (No special drivers are needed to operate)
- During typing, is the keyboard quiet?
- Is backlighting available for use in low light environments?
- Is hygienic white available to highlight obvious contamination?
- Is the device IP 68 Certified? (Indefinite submersion up to 1 meter)
- Does the company stand behind its products with a long-term warranty?

Manufacturers of devices with these characteristics provide hospitals and healthcare workplaces with invaluable tools, including disinfection protocols that are genuinely effective and realistic solutions for the HAIs epidemic that plagues today's healthcare workplace.

Conclusion

In the attempt to curb the high cost of HACs, hospitals and healthcare environments seek out devices that will help contain the transmission of these ever-growing infections. As high-touch areas with multiple users, keyboards and mice are cross contamination zones in clinical environments. Manufacturers of keyboards and mice are eager to capitalize on the antibacterial trend that promises to curb the growth of HACs and their accompanying financial burdens. But while adding antibacterial materials to their devices, they diminish the importance that routine disinfection plays in keeping these devices safe in clinical areas. In addition, the consequences of such antibacterial additives such as silver are potentially hazardous in the long-term. In light of these implications, fully-sealed Medical Grade waterproof keyboards and mice, used with proper disinfection protocols, remain the safest protection against cross-contamination of HACs in hospitals and healthcare environments.

About the Author

Clifton Broumand is the founder and CEO of Man & Machine, Inc. He received his BS in Engineering from Purdue in 1978 and Master of Mechanical Engineering from The Catholic University of America in 1981. His focus in engineering was in Human Factors Engineering, Ergonomics, and Aerospace Engineering.

In his free time, Clifton is a world traveler and a dedicated soccer fan. He has been to over 9 World Cups tournaments all across the globe. In addition to his World Cup travels, Clifton has been called on by Washington D.C. politicians to advise on matters of small business policy. When not traveling the world, he can be found near the Man & Machine headquarters in Landover, MD, in Ft. Lauderdale, FL, or his home town of Indianapolis, IN.

Footnotes:

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