



## MAN & MACHINE



### Introduction

Hospital-acquired infections (“HAI”) are increasing at alarming rates creating a growing financial burden on the health care system. New laws and regulations are shifting responsibility and financial burdens to hospitals which must quickly implement solutions or face onerous expenditures. One area coming to the forefront in the battle with HAI are computer keyboards and mice. These ubiquitous devices are in hospital operating rooms, patient rooms, nursing stations, laboratories, and other clinical and non-clinical facilities.

Standard keyboards and mice are near impossible to disinfect. A plethora of solutions are offered but many fail to meet the demanding needs of hospitals battling HAI.

### The Problem

Hospital-acquired infections are defined as medical related issues not associated with the patient’s original diagnosis that typically surface 72 hours after admittance. HAI are usually bacteria but may also be viruses, fungi, or parasites. All may be difficult and expensive to treat and add additional cost to the hospital. According to the University of Michigan Health Systems, the most common HAI sources of infection in their hospital are urinary catheters, central venous (in the vein) catheters, and endotracheal tubes (tubes going through the mouth into the stomach). Additional causes include passage for drug resistant germs from patient to patient, unclean hands and clothing and inadequately cleaned equipment. More vigilance is imperative to properly clean hospitals; especially in high-risk clinical areas. A 2007 study by Boston University researchers indicated hospital cleaning staff overlooked half the objects that should have been disinfected in the operating rooms at four New England hospitals.

The full scope of the problems caused by these microscopic menaces is not known because the federal governments does not yet require hospitals to report the number or the nature of HAI. To date, five bills have been introduced to establish a national infection reporting law, but none have yet to be established. Many states require some type of HAI reporting but presently only five have issued reports; Florida, Pennsylvania, Missouri, South Carolina and Vermont. The Commonwealth of Pennsylvania has issued one of the most comprehensive HAI reports. According to the 2006 Pennsylvania Health Care Cost Containment Council study, out of 1,574,170 hospital stays, 30,237 patients contracted an infection during their hospitalization, a rate of 19.2 per 1,000 cases.

The most challenging HAI is the proliferation of expensive-to-treat MRSA (“methicillinresistant Staphylococcus aureus”) an antibiotic resistant superbug. MRSA infections have grown from fewer than 2000 in 1993 to an unprecedented quarter million in 2005 according to the Agency for Healthcare Research and Quality. All indicators point to MRSA infections multiplying to over a million a year within the next few years.

According to Dr. Julie Gerberding, director of Centers for Disease Control and Prevention, MRSA infections represent only 8% of hospital infections. Add a broad number of other bacterial infections (Acinetobacter, Pseudomonas aeruginosa, Klebsiella) that cause fever, lethargy, headaches, skin boils or abscesses and in some cases pneumonia, toxic shock or even death and the HAI problem becomes staggering.

## **The Cost**

The cost of treating HAI can be overwhelming. A single case of HAI related pneumonia that requires the patient to use a ventilator can cost the hospital \$30,000 in additional treatment.

In the state of Pennsylvania alone, the median cost for a HAI in 2006 was \$61,132. With 30,237 cases reported, the total expenditure was approximately \$1.85 billion. According to *boston.com* the annual cost of treating HAI in Massachusetts is 473 million. These numbers do not take into account indirect costs related to patient pain, illness, time spent in the hospital and possible litigation. It is estimated by the Consumer Union that HAI causes 90,000 deaths per year. More people die each year from HAI than from homicides and auto accidents combined.

U.S. hospitals will have to absorb the brunt of treating HAI at a staggering rate of \$30.5 billion a year according to the Committee to Reduce Infection Deaths. As of October 1, 2008, unless presented at the time of hospital admission, the Centers for Medicare and Medicaid Services (“CMS”) stopped paying hospitals for the treatment of eight patient HAI. These are referred to as “never” events because they should never have happened.

According to the Consumer Union, several states have adopted similar policies for their Medicaid programs, numerous private insurers have announced they will no longer pay for these hospital-acquired conditions, and some hospitals are no longer charging for the services associated with them. The Commonwealth of Pennsylvania estimated 68 percent of the State’s HAI cases had been paid by Medicare and Medicaid. Additionally, hospitals no longer are allowed to bill patients for what Medicare doesn’t pay.

## **Keyboards and Mice Can Spread HAI**

One area often overlooked in the fight against HAI are keyboards and mice. Hospitals have seen an explosion of computers used for both office and patient related services.

Keyboards and mice go hand-in-hand with computers and these devices are especially susceptible to collecting germs.

Keyboards and mice require continuous disinfecting and cleaning, especially in clinical areas exposed to aerosol, splatter and fluid contamination. Standard keyboards and mice cannot be completely disinfected. They contain open gaps around keys and cracks in seams where fluids and dirt can collect and build up over time. Germs enter the keyboard and remain trapped under the keys making it impossible to wash with liquid cleaner or reach with a scrubbing tool. Attempting to use liquid disinfectants may kill some surface germs but may also destroy the host keyboard. It’s as though keyboards and mice were designed to collect and incubate bacteria.

Until recent years, little thought had been given to the economic cost associated with the potential transfer of infectious disease through computer keyboards and mice.

Northwestern Memorial Hospital in Chicago, IL reports in a 779 bed study, harmful bacteria can last for prolonged periods of time on computer keyboards and keyboard covers in hospitals. It was found

that keyboards can contaminate the bare or gloved fingers of healthcare workers who then may transfer bacteria to patients including the MSRA superbug. According to Gary A. Noskin, MD, medical director of healthcare epidemiology and quality at Northwestern Memorial, “The problem is especially important in hospitals and other healthcare environments where patients are at risk for contracting bacterial infections from healthcare providers who use computers.”

In an abstract entitled *Computer Keyboards and Mouse as a Reservoir of Pathogens in an Intensive Care Unit*, it is concluded, “The colonization rate for computer keyboard and mouse of a PDMS (patient data management system) with potentially pathogenic microorganisms is greater than that of other user interfaces in a surgical ICU. These fomites may be additional reservoirs for the transmission of microorganisms and become vectors for cross-transmission of nosocomial infections (HAI) in the ICU setting.”

UK microbiologist James Francis conducted an experiment by swabbing 33 keyboards, a toilet door handle and a toilet seat. Four of the keyboards had “warning” levels of staphylococcus aureus, which could make a person sick, and one had 150 times the safe limit of bacteria, which was 5 times greater than the toilet seat. In a study conducted by University of Washington, public keyboards located in the Odegaard Undergraduate Library and Mary Gates Hall had shown high levels of bacteria found in fecal matter.

### **Not All Keyboards and Mice are Created Equal**

A number of manufacturers and distributors claim to have keyboards and mice suitable for clinical areas of hospitals. Many of these devices are waterproof and some claim they can be cleaned in a dishwasher. But dishwashers are for dishes and washing alone is not enough to insure proper disinfection.

If the keyboard allows for the pooling of blood or other contaminants under and around the keys and seams, then rinsing with a disinfectant will not dislodge all of the bacteria.

A quality medical keyboard is waterproof with no hidden areas to let bacterial grow. It allows liquid disinfectants to sit on all exposed surfaces for approximately ten minutes (depending on disinfectant’s instructions) while killing germs. However, additional scrubbing may be required to dislodge any hardened contaminants.

### **Non-Clinical Keyboards**

Where hospital staff is not exposed directly to any patients, a base model waterproof keyboard or mouse is an acceptable choice. Because these devices are not in a clinical area they do not require to highest standards of sanitation. However, it is better to have some protection than none at all. Contaminants will collect in these devices and occasional rinsing and surface disinfecting may keep administrative hospital workers from getting sick and passing on infections to the medical staff.

### **Keyboards Skins/Sleeves/Condoms**

Keyboard skins, sleeves and condoms are the weapons in the arsenal against bacteria, designed to be placed over and around standard keyboards and mice to prevent microbes from entering the device, much the way a prophylactic prevents sexually transmitted diseases. These devices may be adequate for non-clinical areas but are inappropriate for infection control use. Unless any of these devices can be 100% sealed, the keyboard or mouse is likely to receive some contamination over time. The skin

may be disinfected depending upon its material composition. However, unless cleaned or replaced after each patient use, it may offer little protection in a clinical environment. When considering a skin-like device, evaluate where it is going to be used, if it fully seals the computer peripheral and if the material can be disinfected.

## **Keyboard and Mice Additives**

In recent years it has become a common practice to add toxic microbe resistant coatings and additives to hundreds of common household products. The long term health and environmental consequences of the additives is not known. Now manufactures of keyboards and mice are adding these same toxins to their products. Let's examine two more common forms of these additives.

A number of keyboard manufacturers have begun to market keyboards and mice featuring Microban® (also known s Triclosan) as a disease fighting solution. According to Microban's own website "Microban® antimicrobial protection is effective against most common bacteria, yeasts, molds and fungi that cause stains, odors and product degradation.

## **Microban technology is not designed to protect users from disease causing microorganisms."**

Microban is a class of chemicals suspected of causing cancer in humans. It is registered as a pesticide with the Environmental Protection Agency. Long-term and repeated exposure to patricides can damage the liver, kidneys, heart and lungs and cause paralysis, sterility, hormonal disruption and immune suppression. The EPA considers Microban® a high risk for human health and the environment.

Silver has been used for centuries to kill bacteria. In recent years it has been added to common items in a nanoparticle configuration under the name AGion®. This form of pesticide may kill bad bacteria but it also may be killing good bacteria. According to Zhiqiang Hu, assistant professor of civil and environmental engineering in 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 wastewater treatment. It basically halts the reproduction activity of the good bacteria." As a result, more harm than good my come from these products.

The long-term consequence of keyboard additives on the environment is unknown. What happens when these coatings wear off? Even if the surface layer of bacteria is killed, additional layers of virulent bacteria may grow on top of the dead layers. Neither Microban® nor AGion® silver nanoparticles eliminates the need for properly disinfecting keyboards and mice.

## **The Solution**

The very best keyboards and mice for clinical areas have multiple features and benefits. The single most important factor is the ability to disinfect all surfaces of the keyboard and mice. This means the device *cannot have any* exposed seams or openings around the keys where blood and other contaminants can hide and multiply. Examine the top, sides and bottom of the device closely, looking for any cracks or crevices where germs can hide. Check how the seams are fitted together. Are they tight with no cracks or crevices?



Try to lift the edge of the keyboard and see if the exterior material is sealed from edge to edge. If the keyboard has a touch pad, check for any gaps between the touch pad and the keyboard. Look for any openings around connectors. If the keyboards and mice pass these tests then consider the following:

- Are products 100% Latex Free to avoid allergic reactions?
- Is the product free of Microban® and AGion® silver nanoparticles?
- Can keys be locked for cleaning (avoids the need to unplug device from the computer during the cleaning process)
- Tactile feedback - This is how the keyboard feels when typing. Do you need to type in the center of the key or can the key be struck at a slight angle?
- Ergonomic design – Does it have a flat design, the best for avoiding carpal tunnel syndrome?
- Can the keyboard be mounted hygienically at various angles? (avoid Velcro® which cannot be disinfected)
- Are cable length options available? (may be important in certain mounting situations such as hospital carts)
- Is the device plug and play? (needs no special drivers to operate)
- Is the keyboard quiet when typing?
- Are wireless Bluetooth keyboards and mice available?
- Is backlighting available for low light applications?
- Are hygienic white keyboards available to see obvious contamination?
- Is the device IP 68 Certified? (Indefinite submersion to 50 feet)
- Is the device EN60601-1 Certified? (Electrical Equipment for Medical Use)
- Does the company stand behind its products with a long term warranty?

## Conclusion

Many reasons exist for the growing number of HAI cases. The financial burden is shifting away from Medicare, Medicaid, insurance companies and patients and landing squarely on the shoulders of the treating hospital. It is imperative that hospitals take immediate steps to reduce the cost from exposure to HAI. In evaluating elements of a comprehensive HAI fighting program, keyboard and mice should be included. Just because a keyboard or mouse is presented as a “medical” device, it is important to examine if the computer accessory can actually be disinfected. Once the right equipment is in place, it must be disinfected on a regular basis. It is better to pay a little now than a lot later. This is the cure for the common keyboard.

## About the Author

Clifton Broumand is the founder and CEO of Man & Machine, Inc., an international provider of leading edge computer accessories focusing on medical, governmental, industrial and general office environments. Products include waterproof keyboards and mice, mobile keyboards for the RIM Blackberry, LCD privacy monitors for HIPAA compliance and financial security, and customized products to meet client’s unique applications. The company was founded in 1982 outside of Washington, DC with satellite offices in New York, Tennessee, Florida, Netherlands and China. Man & Machine, Inc. adheres to a strict environmental code for the sustainability and protection of our environment.

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