vioguard™

RETURN ON INVESTMENT

THE VIOGUARD DEFENDER

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BACKGROUND

Hospital-Acquired Infections (HAIs) are produced by organisms acquired during a stay at a healthcare facility.

They are largely viewed as medical errors and costs of treatment are increasingly being transferred from insurance companies to healthcare providers.

In 2008, the Centers for Medicare and Medicaid Services began denying payment for certain types of HAIs. Hospitals cannot bill patients for the amount Medicare refuses to pay. Private insurance companies have followed with various Performance Improvement Plan (PIP) initiatives tied to financial awards given to hospitals for success in preventing HAIs.

Several states require the public disclosure of infection rates; others have similar legislation in progress. The result is more media coverage and awareness of MRSA, antimicrobial resistance and rising infection rates.

DIRECT COSTS OF HAIs

In a 2002 report[1], The Centers for Disease Control (CDC) estimates 1.7 million HAIs occur annually, directly costing the U.S. economy between $28.4 and $45 billion each year. Another CDC paper in 2009[4] looks at multiple studies and conservatively places the average hospital cost attributable to an HAI at between $16,359 to $25,903 per HAI. The CDC estimates up to 70 percent of these infections are preventable.

Table One contains averages for U.S. hospitals based on information found by the American Hospital Association (AHA)[2] and the CDC's "Multistate Point-Prevalence Survey of Health Care-Associated Infections."[3]
From the data in Table One, the following information is derived:

A typical hospital in the U.S. experiences an average of 129 HAIs per year, ***(721,800 HAIs in U.S. hospitals / 5,564 hospitals in the U.S. = 129 HAIs per year in an average U.S. hospital).***

That typical hospital has HAI expenses of $2,110,311 to $3,341,487, ***(129 HAIs per year x $16,359 to $25,903 per HAI = $2,110,311to $3,341,487 HAI cost per year).***

TABLE ONE - U.S. HOSPITAL AND HAI DATA

Registered Hospitals in the U.S.[2]	5,564
Registered Staffed Hospital Beds in the U.S.[2]	897,961
Number of HAIs in U.S. Hospitals[4]	721,800
Average Hospital Cost Per Patient Attributable to an HAI[4]	$16,359-$25,903
Calculated Average Number of Beds in an Average U.S. Hospital	161

IMPORTANCE OF ENVIRONMENTAL CLEANLINESS

Proper hand hygiene is often cited as the main strategy for reducing HAIs. Infected healthcare workers can transmit pathogens to patients through direct contact.

Many researchers cite the importance of environmental cleanliness. Inanimate surfaces like medical devices, clothing and computer equipment, can function as microbial reservoirs for cross-contamination of healthcare workers and patients.[5,6,7]

The benefits of good hand hygiene can rapidly erode in a contaminated environment, in which the freshly-washed hands of a healthcare worker quickly become re-contaminated.

William Rutala PhD, MPH, is an acknowledged expert on disinfection and sterilization and a member of the University of North Carolina Medical Center faculty. In a hand hygiene presentation,[8] he states that 38 percent of HAIs are a result of cross-transmission.

In effect, inanimate objects are involved with infection transmission in 38 percent of cases.

A 2003 paper[9] by Alice Neely, PhD, references a five-year study where a burn hospital instituted changes in their cleaning procedures. One procedure included implementing the use of disposable medical waste containers instead of reusable medical waste containers, to decrease the possibility of a microbial transfer from the infectious waste containers to the patients.

The study found that 99 percent of the reusable containers were contaminated with bacteria or fungi, vs. 10 percent for disposable containers. In the 2.5 years after the institution of these changes, infection rates dropped from 5.8 to 3.2 per 100 burn patients ($P<0.05$).

This 44.8 percent reduction ocurred after minimizing a single environmental contamination issue in the hospital.

ROLE OF COMPUTER KEYBOARDS IN INFECTION TRANSMISSION

Numerous studies have shown that computer keyboards are reservoirs for pathogenic bacteria, both in healthcare and in public settings.[10,11] Many troublesome pathogens have been shown to survive for months on certain surfaces.[12] Moreover, a growing number of organisms are becoming increasingly resistant to antibiotics.

The Centers for Disease Control (CDC) published a paper that traced an outbreak of norovirus in an elementary school to a single, shared computer keyboard.[13] There is mounting evidence that shared computer keyboards can function as significant disease fomites.

With rapidly increasing use of electronic medical records, healthcare workers are required to enter all patient data and observations into computers. The threat of antibiotic-resistant pathogens will increase as the frequency of shared workstations and keyboard use increase.

Dr. Peter Wilson, of the UK National Health Service, published results of a study[14] in 2005 which found the keyboards and mice in a central London teaching hospital were touched an average of 34.5 times per hour after patient or environmental contact. Meanwhile, the same study showed hand hygiene was performed prior to keyboard or mouse contact only 3.2 times per hour.

Dr. Bures, et al, studied the nosocomial pathogen contamination rate of keyboards in an intensive care unit[15] and found a colonization rate of 24 percent. Dr. Rutala, et al, found a contamination rate of 100 percent for keyboards in an ICU burn unit.[16]

The computer peripheral industry recognized this opportunity and responded with a variety of keyboard products designed to be easily cleaned, washed or disinfected. Unfortunately, these products attempt to solve the wrong problem. It's not that the keyboards are too hard to clean or are not

waterproof; rather, it is impractical to clean them after every use as is required to avoid cross-contamination with pathogens.

MANUAL CLEANING 3X PER DAY WAS INEFFECTIVE AND YIELDED NO MEASURABLE EFFECT ON THE AVERAGE BACTERIAL CONTAMINATION LEVELS FOUND ON KEYBOARDS UNDER ACTUAL USE CONDITIONS.

MANUAL CLEANING MITIGATION

Manual cleaning of keyboards and mice is not effective, according to a study conducted at a major Seattle, Washington hospital. Manual cleaning three times per day was ineffective and yielded no measurable effect on the average bacterial contamination levels found on keyboards under actual use conditions.

At *most*, typical healthcare facilities clean their shared workstation keyboards and mice once per eight-hour shift or, three times per day (in practice, the incidence of manual cleaning is often far less). However, they are touched frequently and quickly become re-contaminated. Wilson, et al, counted an average of 20.8 keyboard contacts per hour and 10.5 mouse contacts per hour in a UK intensive care unit, or more than one contact every three minutes.

The results clearly show, due to heavy use by multiple staff members, microbial contamination builds up so quickly after each cleaning, shared workstation keyboards are still measurably contaminated the majority of the time.

While the data shows that manual keyboard cleaning is woefully ineffective, it is also expensive.

COST OF MANUAL CLEANING

Table Two below shows the assumptions and calculations for the cost to clean one keyboard three times per day.

TABLE TWO - COST OF MANUAL KEYBOARD CLEANING

Cost for Container of Wipes	$6.00
Number of Wipes per Container	70
Cost Per Wipe	$0.09
Number of Wipes Per Cleaning*	3
Cleaning Frequency Per Day	3
Cost of Wipes Per Day	$0.77
Time for Cleaning (minutes)	2
Average Loaded Labor Cost Per Hour	$25
Average Loaded Labor Cost Per Minute	$0.42
Number of Minutes Per Day to Clean One Keyboard	6
Labor Cost to Clean One Keyboard Three Times Per Day	$2.49
Labor and Wipe Cost Per Day Per Keyboard	$3.26
Total Annual Cost to Manually Clean a Keyboard	**$1,189.90**

*Most cleaning wipe manufacturers specify that the surface to be disinfected remain wet with the disinfecting solution for 2 to 10 minutes to properly disinfect a surface. This typically requires 3 wipes for a keyboard and mouse set.

Vioguard's direct observation shows that a typical hospital has an approximate 1.5 keyboards per staffed bed. This yields 242 computer keyboards in an average hospital ***(1.5 keyboards per bed x 161 beds = 242 keyboards).***

The cost to clean the 242 keyboards in the average hospital, three times a day for a year is $287,955 ***(242 keyboards x $1,189.9 annual cleaning cost per keyboard = $287,955 per year to clean all 242 keyboards).*** **Manually cleaning these keyboards just three times per day is ineffective, yet requires 4-5 FTEs.**

SURVEY OF HOSPITAL MRSA ENVIRONMENTAL CONTAMINATION

Table Three below uses findings from MRSA contamination studies to assess the potential impact on infection rates of shared workstation computer keyboards and mice in a hospital environment.

Most of the data from Table Three appeared in SJ Dancer's 2008 paper.[17] For comparison, merged data from the cited keyboard and mouse studies is also included and listed by the last name of each researcher. For each surface, the contamination level found in the cited studies was averaged and then the 13 surfaces were stack ranked from most often found contaminated to least often found contaminated.

For each surface, the average contamination frequency was used to calculate a contribution factor, assuming all 13 surfaces together contribute nearly 100 percent of the MRSA infections that originate from cross-contamination.

The computer keyboard and mouse stack ranked fourth most likely to spread infections, contributing 10.4 percent of cross-contamination-related infections. Using the Rutala figure of 38 percent for the portion of infections resulting from cross-contamination, about 4 percent of all nosocomial infections can be attributed to the computer keyboard and mouse (10.4% x 38% = 3.95%).

TABLE THREE - SUMMARY OF HOSPITAL ENVIRONMENTAL CONTAMINATION OF MRSA

Surface	Rampling	Boyce	Sexton	Lemmen	French	Wilson	Bures	Devine	Average	Rank	Proportion
Bed Linen	-	38-54%	44%	34%	-	-	-	-	41%	1	0.111
Patient Gown	-	40-53%	-	34%	-	-	-	-	40.5%	2	0.110
Over Bed Table	-	18-42%	64-67%	24%	-	-	-	-	40%	3	0.108
Computer Keyboard and mouse	-	-	-	-	-	35%	46%	8-42%	38.3%	4	0.104
Floor	9%	50-55%	44-60%	24%	-	-	-	-	34.5%	5	0.094
Bed or Side Rails	5%	50-55%	44-60%	24%	-	-	-	-	27%	6	0.073
Furniture	11%	-	44-59%	195	-	-	-	-	27%	7	0.073
Sink Taps or Basin Fitting	-	-	-	14%	33%	-	-	-	23.5%	8	0.064
Room Door Handle	11%	4-8%	-	23%	59%	-	-	-	21.5%	9	0.058
Flat Surfaces	7%	-	32-38%	-	-	-	-	-	21.5%	10	0.058
Blood Pressure Cuffs	13%	7-18%	-	30%	-	-	-	-	21%	11	0.057
Infusion Pump Button	13%	7-18%	-	30%	-	-	-	-	19%	12	0.052
Bathroom Door Handle	-	8-24%	-	12%	-	-	-	-	14%	13	0.038

THE VIOGUARD DEFENDER

The Vioguard Defender is the first and only FDA cleared device of its kind. It is specifically designed to reduce pathogen contamination after *each keyboard use*. It uses a touchless system to eject or retract the keyboard into an enclosure where it is exposed to a germicidal dose of UV-C radiation that reduces pathogens on the keyboard by 99.99%.

This product features the use of germicidal ultraviolet light and has been laboratory tested to demonstrate a four-log reduction (99.99%) of four common pathogens (p.aeruginosa, s. aureus, e.coli, k. pneumoniae). UV-C light has been proven to destroy the DNA of microorganisms, making them unable to reproduce. The Vioguard solution is one-of-a-kind and will not allow for new, resistant microorganisms.

The system is an FDA-cleared, class-two device with multiple safety features in place. It guarantees a consistent dose of UV-C light to ensure the sanitizing process has met specified requirements.

THE VIOGUARD DEFENDER IS ONE-OF-A-KIND AND WILL NOT CREATE NEW, RESISTANT MICROORGANISMS.

POTENTIAL COST SAVINGS

The following is an estimate of potential cost savings if the keyboard and mouse were eliminated as fomites for cross contamination where there are shared computer workstations in a healthcare facility.

The Rutala estimate of 38 percent of HAIs due to cross-contamination is multiplied by 10.4% as the calculated percentage of HAIs due to keyboards and mice. This yields an estimate of almost 4% of all HAIs that are potentially the result of cross transmission through keyboards and mice.

This data indicates that the average hospital (161 beds) could reduce its incidence of nosocomial infections by 5 incidents per year with the use of the Vioguard Defender, ***(129 HAIs per year x a 4% reduction due to sanitary keyboards = 5 fewer HAIs per year).***

The data also indicates that the use of Vioguard Defenders could save the average hospital from $81,795 to $129,515 per year in HAI related expenses, *(5 HAI reduction x $16,359 to $25,903 expense per HAI = $81,795 to $129,515 saved).*

COST OF OWNERSHIP

The cost of ownership of a Vioguard Defender, amortized over its five-year life, is summarized as shown in Table 4.

TABLE FOUR - VIOGUARD DEFENDER COST OF OWNERSHIP*

Cost of Vioguard Defender Per Unit	$999
Sales Tax (9% assumed)	$89.91
Total Purchase Price	$1,088.91
Maintenance Over Five Years	$723.95
Electricity Over Five Years (assumes U.S. average cost of $0.05 per KWH)	$13.70
Total Cost of Ownership Per Unit Over Five Years	$1,826.55
Average Number of Beds in an Average U.S. Hospital	161
Average Number of Computer Keyboards in an Average U.S. Hospital**	242
Total Cost of Ownership of 242 Units Over Five Years	**$442,025.00**

*Individual unit cost may vary due to order volume, accessories, etc.
**Vioguard's direct observation shows that a typical hospital has an approximate 1.5 keyboards per staffed bed

TABLE FIVE - ROI

Cost to Manually Clean 242 Keyboards for Five Years	$1,439,775
Five Year HAI-related Costs Caused by Unsanitary Keyboards	$408,975 to $647,575
Total Current Cleaning and HAI Expense for an Average Hospital	$1,848,750 to $2,087,350
Total Cost of Ownership of 242 Vioguard Defenders over Five years	$442,025
Total savings with Adoption of the Vioguard Defender	**$1,406,725 to $1,645,280**

CONCLUSION

Environmental bacterial contamination is increasingly recognized by researchers as a reservoir for cross contamination in a healthcare environment.

By analyzing study data of MRSA contamination rates of a variety of hospital surfaces, we can stack rank the computer keyboard among 12 other hospital surfaces and estimate their overall contribution to HAIs at about four percent.

Using national data on hospital average size and HAI rates, eliminating keyboards as a cross-contamination source saves $369,750 to $414,470 per year for the average hospital (161 beds) in the U.S. This strong return on investment results in the total purchase cost of the Vioguard Defender recouped in less than 12 months.

Eliminating the computer keyboard and mouse as infection fomites in healthcare facilities can make a significant contribution to reducing overall infection rates resulting in significant cost savings for hospitals and significantly better outcomes for patients.

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