vioguard™

RETURN ON INVESTMENT

THE VIOGUARD SELF-SANITIZING UV KEYBOARD

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BACKGROUND

Hospital-Acquired Infections (HAIs) develop within healthcare institutions or 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; private insurance companies will likely follow. Hospitals cannot bill patients for the amount Medicare refuses to pay.

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

DIRECT COSTS OF HAIS

In a 2009 report[1], The Centers for Disease Control (CDC) estimates that 1.7 million HAIs occur annually, directly costing the U.S. economy between $28.4 and $45 billion annually.

The CDC's estimated average cost per infection ranges from $20,549 to $25,903 in 2007 dollars. The CDC estimates that approximately 20 percent to 70 percent of these infections are preventable; which would result in aggregate savings of $5.7 to $31.5 billion each year.

The Pennsylvania Patient Safety Authority has published some of the most comprehensive data on HAIs[2] to date. In 2007, the Pennsylvania Health Care Cost Containment Council reported average hospital charges of $35,168 in cases where a patient does not contract an HAI verses $191,872 in cases where a patient does contract an HAI. Cases involving an HAI also include an average increase of 15.3 days to the length of stay.

With an average reimbursement rate of 27 percent due to negotiated rates, the direct loss of revenue is around $42,310 for every patient. This does not include lost revenue due to no availability of a patient bed for the extra 15.3 days.

IMPORTANCE OF ENVIRONMENTAL CLEANLINESS

Following proper hand hygiene practices is often cited as the main strategy for reducing HAIs. Infected healthcare workers can easily transmit pathogens to a patient by directly touching them.

Many researchers cite the importance of environmental cleanliness and stress that inanimate surfaces like medical devices, clothing and computer equipment, can function as microbial reservoirs for cross-contamination of healthcare workers and patients.[345]

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 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,[6] he states that 38 percent of HAIs are a result of cross-transmission.

In effect, an inanimate object is involved with infection transmission in 38 percent of cases.

A 2003 paper[7] 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.[8][9] Many troublesome pathogens have been shown to survive for months on certain surfaces.[10] 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.[11] Consequently, there is mounting evidence that shared computer keyboards can function as a significant disease vector.

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

Dr. Peter Wilson, of the UK National Health Service, published results of a study[12] 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 computer keyboards in an intensive care unit[13] and found a colonization rate of 24 percent. Dr. Rutala, et al, found contamination rate of 100 percent for keyboards in an ICU burn unit.[14]

The computer peripheral industry recognized this opportunity and responded with a variety of computer keyboard products designed to be easily cleaned, washed or disinfected. Unfortunately, these products attempt to solve the wrong problem. The problem is not that the keyboards are too hard to clean or are not waterproof; rather, it is impractical to clean them as often as is required to avoid harmful pathogens.

MANUAL CLEANING MITIGATION

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

At most, healthcare facilities clean their shared workstation keyboards and mice three times per day (once per eight-hour shift). 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 that, due to heavy use by multiple staff members, microbial contamination builds up so quickly after each cleaning that shared workstation keyboards are still measurably contaminated the majority of the time.

SURVEY OF HOSPITAL MRSA ENVIRONMENTAL CONTAMINATION

Table One 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 One appeared in SJ Dancer's 2008 paper.[15] For comparison, data from the cited keyboard and mouse

studies is also included. 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 those 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 and (10.4 percent) x (38 percent) = 3.95 percent of all infections, using the Rutala figure of 38 percent for the portion of infections resulting from cross-contamination.

TABLE ONE- SUMMARY OF HOSPITAL ENVIRONMENTAL CONTAMINATION OF MRSA

Surface	Rampling	Boyce	Sexton	Lemmen	French	Wilson	Bures	Devine	Average	1Rank	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 UV SELF SANITIZING KEYBOARD

The Vioguard UV Self-Sanitizing Keyboard is the first and only keyboard system of its kind. It is specifically designed to reduce bacterial contamination after each use. It uses a touchless hand gesture system. The user simply places his or her hand in front of the system and the keyboard will eject.

This product features the use of safe and non-toxic germicidal ultraviolet light and has been laboratory tested to demonstrate a four-log reduction (99.99%) of four common pathogens during a 90 second disinfection cycle. 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 create new, resistant microorganisms.

The keyboard is an FDA-cleared, class-two device and has several features in place to ensure the safety of the user. This guarantees a consistent amount of light to ensure that the sanitizing process has met specified requirements.

POTENTIAL COST SAVINGS

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

The Rutala estimate of 38 percent of HAIs due to cross-contamination is multiplied by 0.104 as the calculated percentage of HAIs due to keyboards and mice, yields an estimate of 3.95 percent of all HAIs that are potentially the result of cross transmission through keyboards and mice.

(0.38) x (0.104) = (0.0395), 3.95%, HAIs due to keyboards and mice.

Below these numbers are applied to the 2007 Pennsylvania HAI statistics of 27,949 statewide infections resulting in an average financial loss of $42,310 each in 2007, this translates into a statewide savings of:

(27,949) x (0.0395) = (1104.5) less people infected, statewide. (1104.5) x ($42,310) = $46.7 million annual savings, statewide. For an individual large hospital, such as Allegheny General, with 27,451 admissions and 776 HAIs reported in 2007, this would result in an estimated 30.6 less people infected, for a total savings of:

(776)x (0.0395) = (30.6) less people infected. (30.6) x ($42,310) = $1.29 million annual savings for one large hospital

RETURN ON INVESTMENT CALCULATIONS

The cost of ownership of a Vioguard self-sanitizing keyboard, amortized over its four-year life, is summarized as follows.

Item	Cost Per Day	Cost Per Month	Cost Per Year	Notes/Assumptions
Purchase and Taxes	$0.67	$20.41	$244.98	9% sales tax, 4 year product life
Capital Depreciation	-$0.49	-$14.98	$-179.80	5 year straight line depreciation
Cost of Electricity	$0.35	$10.76	$13.28	0.12/kW-h; 5 cycles/hour
Lamp Replacement Cost	$0.35	$10.76	$129.16	Includes service tech @ 1 replacement/year at $90/hour
Out of Warranty Service Cost	$0.01	$0.26	$3.15	3% service rate in years 2-4
Total Cost of Ownership	$0.58	$17.56	$210.77	4 year operating life

Using Allegheny General as an example, with 661 beds there is an estimate of 1.5 computers per bed, based on observations of hospitals using EMR. This equates to an approximate facility count of 992 computers and keyboard/mouse workstations.

The total cost of infections saved if the keyboards were eliminated as a source of cross contamination can be divided by the estimated number of keyboards installed, giving:

($1.29 million)/ (992) = $1300 savings per keyboard per year.

With a total cost per year of $210.77 returning $1,300 in the Allegheny General example, this is a return on investment of:

($1300-210.77) / ($210.77) = 516% per year and (516%) x (4) = 2064% over a 4 year product life

COST OF MANUAL CLEANING

A Vioguard Self-Sanitizing keyboard is less expensive than a 3x per day cleaning regimen for conventional keyboards. As shown in Table Two below, we estimate the annual cost of a 3x per day cleaning to be $215.52. The cost of waste disposal of the sanitary wipes is not included.

TABLE TWO - COST OF MANUAL KEYBOARD CLEANING

Cost for Container of Wipes	$6.00
Number of Wipes per Container	70
Cleaning Frequency Per Day	3
Time for Cleaning (seconds)	20
Average Labor Cost Per Hour	$20
Number of Wipes Used Per Keyboard/Mouse	1

	One Year	Two Years	Three Years	Four Years	Five Years
Number of Wipes Used	1,095	2,190	3,285	4, 380	5,475
Cost of Wipes	$93.86	$187.71	$281.57	$375.43	$469.29
Labor (hours)	6	12	18	24	30
Labor (cost)	$121.67	$243.33	$365.00	$486.67	$608.33
Total	$215.52	$431.95	$646.57	$862.10	$1,077.62

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 state reporting data from Pennsylvania, eliminating keyboards as a cross contamination source would result in statewide savings of $46.7 million annually and a savings of $1.29 million annually at a typical large hospital such as Allegheny General. A one-year return on investment of 516 percent and four-year return of 2064 percent is realized.

Eliminating the computer keyboard and mouse as infection vectors in healthcare facilities can make a significant contribution to reducing overall infection rates with significant cost savings for hospitals.

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