BACTERIOLOGICAL ASSESSMENT OF COMPUTER KEYBOARDS AND MOUSE USED IN SALEM UNIVERSITY, LOKOJA

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Abstract

The keyboards and Mice of multiple-user (students) and single –user (staff) computers located within Salem University, Lokoja Campus were sampled to assess bacteriological contaminations. A total of fifteen (15) keyboards and mice were sampled from five locations (E -library, Resource room, Dean's Secretaries, Administrative Secretaries and College officers) within the campus. The keyboards and mice had high bacteria counts: ranging from 2.0 to 87.0 X 10^5 cfu/ml for keyboards and 2.7 to 92.0 X10^5 cfu/ml for mice while the coliform count ranged between 0.8 to 87.0 X 10^5cfu/ml and 3.3 to 80.0 X10^5cfu/ml for keyboards and mice respectfully. Seven bacterial species were isolated: *Staphylococcus aureus, Streptococcus* sp*., Bacillus subtilis., Micrococcus luteus., Klebsiella* sp*., Salmonella* sp *and Escherichia coli.* The keyboards and mouse harboring potential pathogens were greater for multiple user computers than single user. Regular cleaning and disinfection of computers is recommended to reduce the bacterial load. These findings suggest high contamination of keyboard and mice with pathogenic bacteria and associated potential of transmission and infection

Keyword: Computer. Keyboards, Mouse, Microorganisms and Multiple-user

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INTRODUCTION

Computer has been described as the latest technological media which are capable of receiving and accepting data, and performing operation according to instruction (program), and providing result of the operation with great speed and accuracy (Brightman and Dunsdalc, 1986). The importance of computer had been identified in various fields such as Health, Agriculture, Finance, Education and Research institution (Onasanya, 2002). Its speed of operation has made its application in these fields inevitable. The inevitability of the computer in most of the identified fields has been a major factor for the continuous proliferation of computer usage in all of these fields. Computers continue to have an increased presence in almost every aspect of our occupational, recreational, and residential environments (Anderson and Palombo, 2009).

Owing to this indispensable nature of computer to the various activities of man in this technologically dominated society, there is increasing rate of interactions with the computer from day to day (Onansanya, 2002; Balci, *et al*., 2009 ; Anderson and Palombo,2009).

Microorganisms that cause infections can be found in any environment including soil, air, water, food, and on other organisms as well as on environmental surfaces or objects. The infections that these microorganisms cause can spread to humans in different ways; directly or indirectly via inanimate objects called fomites and/or living organisms called vectors (Neely and Sittig, 2002). A search of literature has revealed that in human environment, microorganisms colonize and contaminate environmental objects in the home (Lori et al., 2002), hospital (Brady *et al*., 2007), schools and day-care environment (Itah and Ben, 2004), and in offices (Bouillard *et al.*, 2005).

In recent times, keyboards and mice are environmental objects in constant use with the growing need for computer system applications. Keyboards and mice are components of a computer system that are used on daily basis in accomplishing various computer tasks in almost every aspect of our society. Their uses have greatly expanded and can be found in schools, banks, cybercafés, offices and hospitals. Also, contamination of keyboards and mice by bacteria with the potential to initiate an infection has been documented by some investigators (Eltablawy and Elhifnawi, 2009; Hartmann *et al*., 2004; Neely and Sittig, 2002).

Bacterial contamination of keyboards and mice pose as a threat to public health as bacteria can be transferred from person to person, by direct contact or indirect contact via an inanimate object and back again.

Having been established in literatures that computer keyboard are capable of hosting pathogenic microbes, and hence been able to act as a portal of infection. It is essential to identify the extent to which the people who continually interact with computer keyboard are aware of the risk associated with its possibilities as a portal

of infection. The outcome of some studies in the US revealed the isolation of various species of bacteria, fungi and fungal spores (William *et al*., 2009). Another study in the US revealed that computer keyboard contributes significantly to the spread of Hospital acquired infection; it was estimated to be responsible for about twenty-five percent of microbes associated with nosocomial infection (Marsden and Eng, 2009). Despite these findings the rate of interaction with computer keyboard and mouse has remained on the high side from time to time. This thus increases the risk of contacting some of the infectious organisms associated with computer keyboard surfaces. People are exposed to this risk unconsciously because of the low level of awareness among users of computersr, this thus serve as a medium to inform users of keyboard and mouse about the necessary need to be more careful as they interact with this wonderful instrument of technology.

MATERIALS AND METHODS

A total of 30 swab sample from keyboard and mouse was taken by simple random sampling technique. This was done in batches of 2 each from resource rooms of the various departments, e-library, and from individuals in Salem University [secretaries and college officers].

Preparation of Culture Media

The major media used for the isolation and characterization of bacteria isolates include: Nutrient agar, MacConkey agar, Nutrient broth and Peptone water. Appropriate grams of the agar was measured and poured into a conical flask,

dispensed into the volume of water according to the manufacturer's instruction. The mixture was heated in the autoclave for 15 minutes at 121°C.

Inoculation: Swab from sampled surfaces were inoculated in 10ml of bacteriological peptone water by cutting the swabs aseptically into the peptone water, shaking and incubating them over-night at 37^{o}C.

Quantification of Bacteria: Serial dilutions from the resulting growth from the peptone water medium were pour-plated on count agar (PCA) and incubated for 24hrs at 37^{o}C under aerobic condition. The number of estimated Colony Forming Units (CFU) for each sample was then counted using the colony counter (Gallenkomp Model).

Isolation of Organisms: All pure isolated colonies were sub-cultured onto Salmonella- Shigella agar plates, blood agar plates, Mannitol Salt agar plates and MacConkey agar plates for 24hrs at 37^{o}C for colony isolation and morphological identification.

Identification of Organisms: Pure isolated colonies were Gram differentiated and then biochemically identified using Indole, Catalase, Citrate, Oxidase, Coagulase, , Urease , Sugar fermentation tests.

All laboratory work was undertaken in the Laboratories of the Department of Biosciences Salem University, Lokoja. Kogi State Nigeria.

Statistical Analysis: Data obtained in the study were descriptively and statistically analyzed using Statview from SAS Version 5.0. The means were separated using one sample t-test ($P \leq 0.05$) is significant and ($P \geq 0.05$) is not significant.

RESULTS

The mean total bacterial count of keyboard and mouse is shown in table one, with keyboard having the bacterial count ranging between 2.0 x 10^5 – 87.0 x 10^5 cfu/ml. E-library having the highest count of 87 x 10^5 cfu/ml while the Dean secretaries keyboard having the lowest with 2.0 x 10^5 cfu/ml. The mean total bacterial count of mouse ranging from 2.7 x 10^5 – 92 x10^5 cfu/ml with E- library mouse having the highest count of 92 x 10^5 cfu/ml while college officers mouse having the lowest count of 2.7 x 10^5cfu/ml (Table 1).

Table 2 represents the mean total coliform count of keyboard and mouse in the five locations. Keyboard count range between 0.8 x 10^5cfu/ml – 87 x 10^5cfu/ml, with E-library keyboard having the highest count of 87 x 10^5cfu/ml and college officers keyboard having the lowest count of 0.8 x 10^5cfu/ml while the count for mouse ranges between 3.3 x 10^5cfu/ml- 80.0 x 10^5cfu/ml. The highest count also found in the E-library with 80.0 x 10^5cfu/ml and the lowest in the college officers room with count of 3.3 x 10^5cfu/ml.

A total of seven bacterial species were isolated from the samples and they were identified to be *Staphylococcus aureus, Streptococcus sp, Bacillus subtilis, Micrococcus luteus, Klebsiella* sp, *Salmonella* sp, and *Escherichia coli and their* distribution among locations points shown in Table 3.

Table 4 show the descriptive statistics of bacteria contaminants on keyboard and mouse from selected locations with $P > 0.05$ for e- library. Thus keyboard and mouse in E-library were more contaminated than that of offices. This could be attributed to frequency and number of users in E-library compared with that of offices.

Table 1: Mean Total Bacterial Count of Keyboard and Mouse

Location	Number of Samples	Keyboard	Mouse
E-Library x 10^5 cfu/ml	1	87.0	92.0
	2	80.0	84.0
	3	26.0	56.0
Resource Room x 10^5 cfu/ml	1	0.8	5.5
	2	19.4	25.0
	3	0.5	24.3
College Officers x 10^5 cfu/ml	1	8.4	12.3
	2	6.7	115.0
	3	30.4	2.7
Dean Secretaries x 10^5 cfu/ml	1	2.0	94.0
	2	67.0	11.5
	3	48.0	15.0
Admin Officers x 10^5 cfu/ml	1	24.2	20.0
	2	24.8	21.0
	3	18.8	18.5

Table 2: Mean Total Coliform Count of Keyboard and Mouse

Location	Number of samples	Keyboard	Mouse
E- Library x 10^5 cfu/ml	1	87.0	80.0
	2	21.0	55.0
	3	27.0	36.0
Resource Room x 10^5 cfu/ml	1	1.1	12.4
	2	3.8	4.2
	3	12.2	21.0
College Officers x 10^5 cfu/ml	1	0.8	3.3
	2	6.2	35.0
	3	30.4	10.4
Dean Secretaries x 10^5 cfu/ml	1	5.0	14.0
	2	6.2	3.5
	3	9.5	39.5
Admin Officers x 10^5 cfu/ml	1	34.4	30.0
	2	53.6	47.0
	3	32.3	31.0

Table 3: Distribution of Bacterial Isolates among locations points

Location	E- Library		Resource Room		College Officers		Dean Secretaries		Admin Officers	
	Keyboard	Mice	Keyboard	Mice	Keyboard	Mice	Keyboard	Mice	Keyboard	Mice
Isolates										
Escherichia coli	+	+	+	-	-	-	-	-	-	-
Micrococcus luteus	+	+	+	-	+	-	-	-	-	_
Staphylococcus	+	+	+	+	+	+	+	+	+	+
aureus *Bacillus*	-	+	+	+	+	-	+	-	+	-
subtilis	+	+	-	+	-	-	-	-	-	-
Salmonella sp	+	-	+	-	-	-	-	-	-	-
Klebsiella sp	+	+	+	-	+	+	-	-	+	+
Streptococcus sp										

Key: + Present

\- Absent

Table 4: Descriptive statistics of bacteria contaminants on keyboard and mice from selected locations

	Keyboard					Mice				
Descriptive Statistics	E-library	Resource Room	College Officers	Dean Secretaries	Admin Officers	E-library	Resource Room	College Officers	Dean Secretaries	Admin Officers
Number	3	3	3	3	3	3	3	3	3	3
Minimum	26.0×10^5	0.50×10^5	6.70×10^5	2.0×10^5	18.8×10^5	56.0×10^5	5.50×10^5	2.70×10^5	9.40×10^5	18.5×10^5
Maximum	87.0×10^5	19.40×10^5	30.4×10^5	6.70×10^5	24.8×10^5	92.0×10^5	25.0×10^5	12.3×10^5	15.0×10^5	21.0×10^5
Mean	64.3×10^5	6.90×10^5	15.16×10^5	4.50×10^5	22.6×10^5	77.33×10^5	18.26×10^5	8.83×10^5	11.96×10^5	19.83×10^5
S.D	33.0×10^5	10.82×10^5	13.21×10^5	2.36×10^5	3.30×10^5	18.90×10^5	11.06×10^5	5.33×10^5	2.88×10^5	1.26×10^5
P Value	0.079	0.384	0.185	0.081	0.007	0.019	0.103	0.102	0.018	0.001

($P \leq 0.05$) is significant and ($P \geq 0.05$) is not significant

DISCUSSION

Computers continue to have an increased presence in almost every aspect of our occupational, recreational, and residential environments1 whilst the contribution of hands contaminated with pathogenic and non-pathogenic microorganisms to the spread of infectious disease has been recognized for many years.(Anderson and Palombo, 2009 and Rutala *et al.,* 2006) Numerous studies have indicated that computer keyboards and mice can become contaminated with pathogenic bacteria. In health care settings, it is perhaps not unexpected that such microorganisms would contaminate these common work surfaces. However the present study showed that microbial contamination also occurs on computer equipment located in a large university environment. A particularly interesting finding was that multi- user computer (e-library) had significantly more numbers of microorganisms as well as greater numbers of potentially pathogenic species, compared with computers used by predominantly one person. However, this may simply reflect the multiple- user environment where the likelihood of contamination by individuals who are carriers of bacteria such as *staphylococcus aureus*.

Results from the study shows high levels of contamination of these surfaces with the least mean bacterial count of 0.50×10^5 cfu/ml. Depending on environmental conditions, pathogens may remain infectious on surfaces for weeks after the contamination event. In humid conditions, pathogens may actively colonize surfaces, transforming a passive reservoir into an active one. In general, the greater the concentration of the microbe, the longer it survives and survival can range from minutes to months. The longer the survival of a bacterium on a surface like the keyboard or mouse, then the odds of that

bacterium being picked up by someone becomes considerably increased.(Neely and Sittig, 2002) .

Computer keyboards have long been blamed for causing health problems. Research conducted in 2008 found they can harbour more harmful bacteria than a lavatory seat. (Paul , 2010). Bacteria get on to keyboards in a number of ways. A big factor is eating lunch at your desk. Crumbs of food lodge between the keys and encourage the growth of bacteria. Dust is also a problem as it traps moisture, creating a perfect environment for microorganisms to breed. The biggest problems ‘’Poor personal hygiene’’ are people not washing hands properly after going to the rest room or dodging hand washing after going to the lavatory and people who pick their nose as they work.

Most of the isolates were capable of causing various diseases to human health. *Staphylococcus aureus:* One in three people carry the staph infection, usually on the skin and nostrils. If the skin is broken the bacteria can penetrate and lead to boils, impetigo and other skin infections. But Staph is most dangerous when it gets in to the bloodstream. It can cause pneumonia, infections of the heart tissue that can trigger cardiac arrest or blood poisoning. *Escherichia coli* is commonly found in the lower gut of humans and other warm-blooded animals. Some strains are “friendly” – one produces vitamin K, which we need for blood clotting. But some, such as E.coli 0157, are deadly. The presence of *Klebsiella* sp and *E. coli* suggest feacal contamination which may have been carried by the sole of the shoes to the working areas.

Enteric bacteria: A family of more than 100 microorganisms which are commonly found in the stomach and intestines are a common cause of pneumonia and urinary tract

infections. Some strains can lead to pneumonia, meningitis and septicaemia. The presence of *Bacillus subtilis* is indicative of environmental contamination, which could have resulted from exposure of the keyboards and mouse to air ,dust or water used in washing hands after eating or visiting rest room.

CONCLUSION

Computers' keyboards and mouse "should be disinfected daily or when visibly soiled or if they become contaminated with food materials. Clean a computer's keyboard and mouse with a disinfecting wipe before someone else uses that keyboard and mouse. Regular clean of your keyboard and mouse is quite simple to do and could prevent your computer becoming a health hazard." Users should unplug Keyboards and turned before wiping surfaces with a damp, soft, lint-free cloth or germicide.

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