Original Article

Gram Positive Bacterial Profile, On Computer Keyboards and Mice in Qassim University and Efficacy of Disinfectants to Eliminate Contamination

Seham Al-Otaibi1, Sarah Ali2*, Syed Raziur Rahman 3

1. Bachelor. Department of Medical Laboratories, College of Applied Medical Sciences, Qassim University, Buraidah, AlQassim, Kingdom of Saudi Arabia.
2. Assistant Professor Microbiology, Department of Medical Laboratories, College of Applied Medical Sciences, Qassim University, Buraidah, AlQassim.Kingdom of Saudi Arabia.
3. Medical Director, Al-Shigah PHC. Buraidah, Al Qassim, Kingdom of Saudi Arabia.

*Correspondence: **Sarah Ali,** Assistant Professor Microbiology, Department of Medical Laboratories, College of Applied Medical Sciences, Qassim University, Buraidah, AlQassim.Kingdom of Saudi Arabia. Email: dr_sarahrazi@rocketmail.com

Abstract:

Introduction: Computers are ubiquitous and have been shown to be contaminated with multiple bacteria's in some communities. There is no economical way to test all the keyboards and mice out there, but there are effective ways to prevent bacterial contamination or eliminate it if it exists.

Method: This was an observational study using the cross-sectional study design. Swab specimens were collected from surfaces of 43 computer keyboards and mice from Computer college ,Business college ,PYP and Library and plated on different bacteriological media. Organisms growing on the media were purified and identified at Qassim University Department Of Applied Medical Sciences Microbiology Laboratory by using gram stain and various biochemical tests. The second phase of sample collection done by collection of samples before and after the use of DETTOL, COLROX and DAC. It was found that all the tested computer keyboards and mice devices, were positive for gram positive bacterial contamination , and the data was analyzed using excel software. Recommendations were developed to create awareness among the students and staff of Qassim University, who used the computers during their study time.

Findings: It was found that all the tested computer keyboards and mice devices, from Computer college and Business college , PreparatoryYear Program and Library, were positive for microbial contamination. The percentages of isolated bacterial species (Staph CoN, Staph aureus, Micrococci, streptococci and Bacillus) were 46.51 %, 6.97%, 4.65%, 2.32%, and 41.8 from all colleges respectively. The average of percent of colonies reduction for DETTOL, CLOROX and DAC were (90%, 80%, and 51%).

Conclusion: Isolated bacterial species (Staph CoN, Staph aureus, Micrococci, Streptococci and Bacillus) were 46.51 %, 6.97%, 4.65%, 2.32%, 41.8 from all colleges respectively. Most effective disinfectants DETTOL(90%), CLOROX(80%) and DAC(51%).On the basis of these findings, it is suggested that routine cleaning of keyboards and mice may aid the fight against the contamination. Also, hand washing before and after contact with keyboards and mice should be practiced to significantly reduce the contamination.

Keywords: Gram positive, Computer's keyboards (CK), Computer's mouse (CM), Dettol, Chlorox, DAC

Introduction:

Most people do not realize that microbes are found on many common objects outdoors, in their offices and even in their homes; playground equipments, ATM keyboards, kitchen sinks, office desks, computer keyboards, elevator buttons and with the spread of supermarkets and hypermarkets the shopping carts handles. All of the latter objects are places that are most touched by the bare hands of people who are in various hygienic conditions. 80% of infections are spread through hand contact with hands or other objects (1-6).

Computer's keyboards and mice are the most open surface parts of computer which shows 100% contamination. It has been documented that the average number of microorganisms present on multiple-user computer keyboards was significantly greater than on single computer user. Given that computers are not routinely disinfected, the opportunity for the transmission of contaminating microorganisms is potentially great (1-3).

Out of 250 samples analyzed, a total of 148 bacteria isolates were isolated from computer keyboards and mouse. Out of which 63 Staphylococcus spp. were present; 45 of the isolates were from keyboards and 18 from mouse. 11 were Bacillus spp.; 8 of the isolates from keyboards and 3 from mouse (1).

The aim of this study was to assess the level of microbial contamination of computers in Qassim University and to find out the efficacy of disinfectants to eliminate contamination.

General objectives: To test several samples from keyboards and mice for gram positive bacteria in Qassim University and compare their microbial profile.

Secondary objectives:

- To collect samples from randomly selected computers keyboards and mice of office and teaching labs of Qassim University.

- To determine the microbial profile of all collected samples.

- To compare microbial profile of samples.

- To test the efficacy of using disinfectants to eliminate contamination.

- To suggest recommendation for creating awareness about disinfectants and hands hygiene

Methods:

Study design: This observational, cross-sectional study, was done to assess the gram positive bacterial content of CK and CM samples. It included collection of samples from Qassim university colleges and tested them in Microbiology lab of Applied Medical Science College in Qassim University. Isolation of bacterial contaminants from different objects (CK, CM) was performed through standard techniques. A single sterile swab per component (keyboard or mouse) moistened by dipping it in sterile normal saline. Moistened swabs were wiped, firmly over the entire surface of the specific object. The swabs were placed back in their holders and taken to the Microbiology laboratory of Qassim University. Then inoculated out on

blood agar, chocolate agar and nutrient agar. All samples plated within two hours of collection. Inoculated media or culture plates were incubated aerobically (growth in presence of oxygen) at 37°C for 48 hours. The isolates were, identified on the basis of Gram stain findings, colony morphology, detection of hemolysis on sheep blood agars as well as results of Biochemical test such as Oxidase test, Catalase test, Cougulase test and growth on Selective media Mannitol Salt Agar.

The effect of disinfectants was tested by repeat of swabbing operation from the same position after cleaning with moistened (2 part of disinfectant to 10 parts of water) DETTOL, DAC, CLOROX, and kept for 15 minutes before swabbing. All cotton swabs were transferred immediately to the laboratory in order to culture the samples, taken from keyboards and mouse, following the same protocol as above.

Study samples: The study was conducted in Qassim University. Sample size was, 43 samples (10 from library, 12 from Computer College, 14 from Business College, 7 from Preparatory Year Program (PYP). Inclusion Criteria: All samples from used computers only in Qassim University. Exclusion **Criteria**: Samples from non-used computers, and outside Qassim University.

Data Collection: Data collected from the randomly tested samples in Qassim University, by sterile swabs labeled with ID number, date, time, location, collector name and observation. The surfaces of 43 computer keyboards and mice randomly selected for this study. This samples were taken, during study hours featuring normal students and staff traffic at Qassim University. The single sterile swab stick moistened with sterile saline solution and moved over the surfaces (keyboard, mouse). The swab placed in 2mL of TSB and immediately transported to the laboratory. After the swab in the TSB (Tryptic soy broth or Trypticase soy broth) vortex for 1 minute in the Fisher Vortex Genie 2 on the highest (i.e., number 8) setting, 100 mL of the specimen plate onto trypticase soy agar with 5% sheep blood by use of the spread plate technique. The specimens incubate at 37C for 48 hours. Isolates identified on the basis of Gram stain finding, colony morphology, detection of haemolysis on sheep blood agar, and colony pigmentation, as well as results of biochemical tests.

Statistical analysis: The data entered in Microsoft Excel software and analyzed using descriptive statistics, with frequency and percent and the results presented using tables, pie charts and graphs. Anlytical statistics & Formal Statistics by cross tabulations, chi-square tests and test of significance.

Ethical considerations: Ethical approval for the study will be obtained from the departmental review committee. Informed consent obtained from administrators of computer Science College and preparatory-year program, Business College and library for their participation in this study with giving them information about the aim of study and its effect of f reducing contamination.

Findings:

The following bacteria were isolated: Bacillus species, Staphylococcus aureus, Coagulase negative Staphylococcus, Streptococcus species and Micrococci species. CoNStaph (46.52%) were the most isolated bacteria in Table 1.

Percentage of (StapCoN, Streptococci, Micrococci, Bacilli, Staph aureus) from all colleges were (46.52%, 2.33%, 4.65%, 39.5%, 6.98 %), respectively.

Isolated bacteria (Stap CoN, Bacilli, Staph aureus, Streptococci, Micrococci) from CK of sampled colleges were 50% ,33%,4%,4 %,0%), and from CM were 42%, 52%,10% 0%,10 %) ,respectively (Figure 1).

Figure 2 illustrates the percent of each bacterial isolate from each college, it appears that CoNStaphylococcus, was isolated from all colleges and highest percentage(87.5%, 41.6%) in PYP college& Computer college, followed by second highest Bacilli sp. (53.3% , 53%) in Computer college & Business college.

The most isolated bacteria from the keyboards of all colleges and library was Staph CoN bacteria. PYP keyboards samples showed (100%) contamination with StaphCoN bacteria. Staph aureus isolated from keyboards of Business College (25%). Only Library keyboards showed (20%) Contamination with Micrococci and Streptococci bacteria (Figure 3).

The most isolated bacteria form all colleges mouse was CoN Staph, followed by Bacilli sp. Micrococci sp. was isolated only from mouse of PYP College (33%). None of mouse sample from sampled colleges were contaminated with Streptococci sp. (Figure 4).

The most isolated bacteria species from the library was CoNStaph (40%), followed by Bacilli sp (30%). The percentage of Micrococci sp., Streptococci sp. and Staph aureus was (10%) each (Figure 5).

Table 2 showed the total number of colonies before and after the use of disinfectants, percent of colony reduction of each disinfectant and the average of reduction. The disinfectant with high efficacy of eliminate the contamination was DETTOL (90%), followed by CLOROX (80%) and DAC (51%).

Discussion:

In this study, it was found that all computer keyboards and mice were positive for microbial colonization (100% colonization respectively). Out of 43 samples analyzed, a total of five types of bacterial isolates were obtained from computer keyboards and mice from all sampled colleges. 46.5% were Staph CoN, 6.9 % Staph aureus, 41.8% are Bacillus sp, 4.6% Micrococci and 2.3 %Streptococci sp. This is in accordance, with the study of Rutala et al who reported that potential pathogens cultured from more than 50% of the computers included coagulase negative Staphylococci (100% of keyboards) (7, 8).

Most of these isolates were traditional skin flora, while, other organisms such as gram positive rods, cocci, revealed a general level of colonization of these widely used equipment. Coagulase negative

Staphylococcus, comprised a significant proportion of bacteria associated with humans.

This study reported Coagulase negative Staphylococcus, with percentage colonization of 46.5 % in multiple user computers, followed by Bacillus sp. Anastasiades et al, reported the presence of coagulase-negative staphylococci (68.5%), Staphylococcus aureus (2.1%), Gram-positive bacilli (27.1%), Micrococcus (0.6%) and fungi (1.7%) on computer keyboards and mice, indicating that Staphylococcus spp. are prevalent on computer keyboards and mice compared to other microbial communities (7). The ecologic niche for S. aureus in humans is in the anterior nares (7). One-quarter to one-third of healthy persons harbor S. aureus in the nose at any time which can easily be transferred to hands by simply rubbing the nose (7). Potential pathogens such as Staphylococcus aureus, were also isolated but in lower frequency also, similar to A. K. Al-Ghamd (5, 6).

The above results were expected due to the common vehicle of microbial transmission which is the human hands and fingers. Scott and Bloomfield (2008) suggested that, where contaminated surfaces come into even relatively brief contact with the fingers or an inanimate surface, a significant number of organisms can be transferred which can be recoverable onto an agar surface.

In our study Gram +ve bacteria were more frequently isolated from all surfaces. This could be in part due to the fact that survival of Gram +ve species on laminate surfaces is greater than that of Gram negative organisms (Scott and Bloomfield, 2008). However, both Gram +ve and Gram -ve bacteria have been shown to have similar transfer rates from laminate surfaces to fingertips (Scott and Bloomfield, 2008) (3, 11). Normal skin is inhabited with two categories of bacteria: transient and resident. Resident flora, which are attached to deeper layers of the skin, are more resistant to removal by routine washing. Coagulase-negative staphylococci and Gram +ve diphtheroids are members of this group. On the other hand, transient flora colonizes the superficial layers of the skin, and is more amenable to removal by routine hand washing (9, 10).

The disinfectants with high efficacy of elimination of contamination were DETTOL (90%) and CLOROX (80%). This is in accordance with (Farah Rami Saleh and Anyim Chukwudi et. al) who reported that Dettol and alchohol wipes were most effective in reducing bacterial colonization (4, 10).

Conclusion

In this study, it was found that there was a higher contamination of computer keyboards and mice. The use of Dettol® for the routine disinfection of computer keyboards and mice is hereby highly suggested. On the basis of these findings, it is suggested that routine cleaning of keyboards and mouse may aid in eliminate the contamination. Also, hand washing before and after contact with keyboards and mice should

significantly reduce the risk of contamination..

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Table and Charts:

Table 1. Percentage of Bacterial isolates per all the samples

Bacterial Species	Bacterial growth, From all Samples. (N=43).	%
CoN Staph	20	46.52
Streptococci sp.	1	2.33
Micrococci sp.	2	4.65
Bacillus sp	17	39.5
Staph aureus	3	6.98

Figure 1. Percentages of bacterial isolates on CK and CM from all colleges

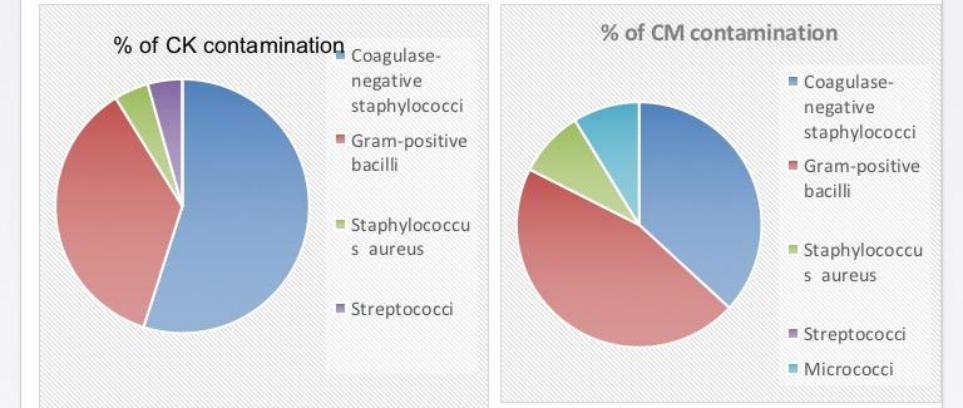

Figure 2. Comparison between the percentages of species per each colleges

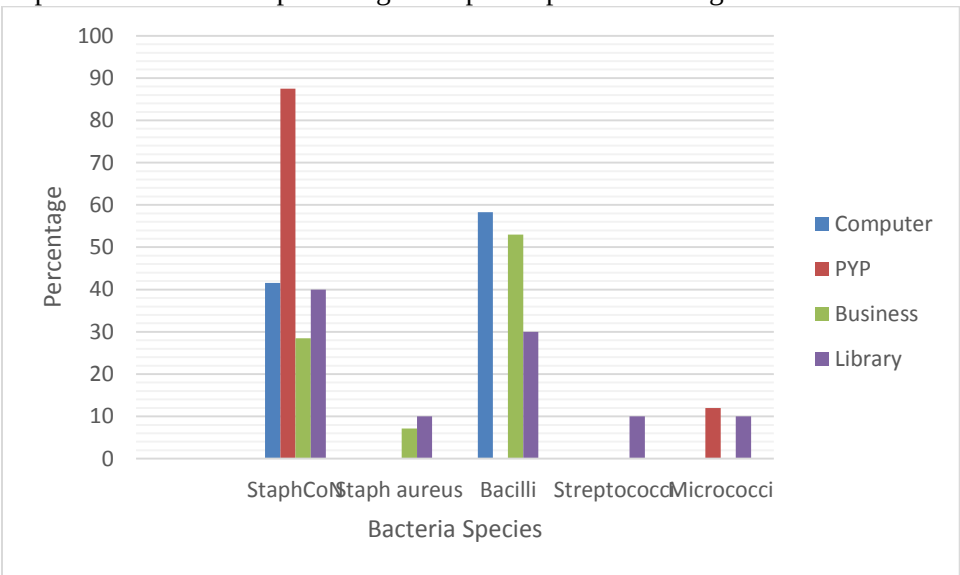

Figure 3. Comparison between the percentages of species per the keyboard of each colleges

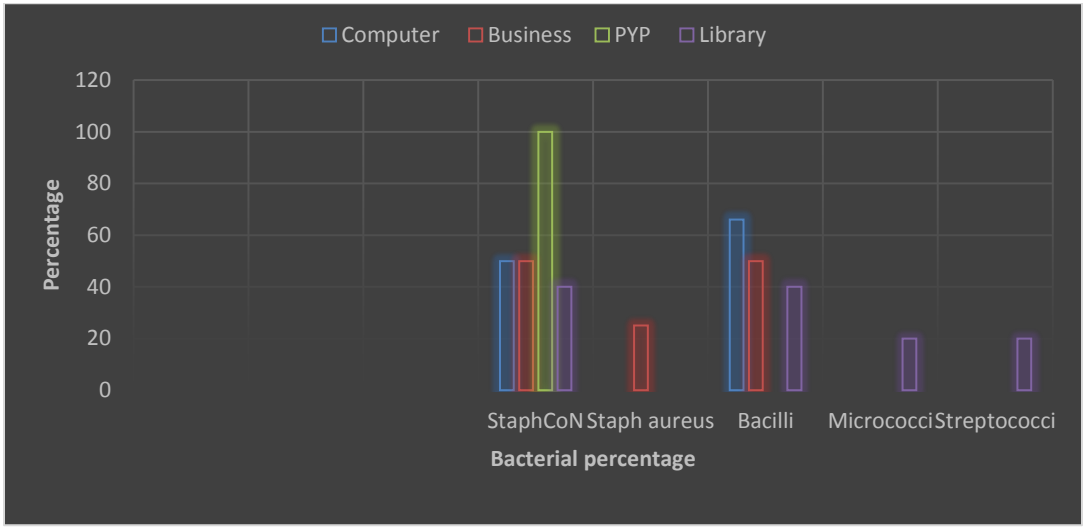

Figure 4. : Comparison between the percentages of species per the mouse of each colleges

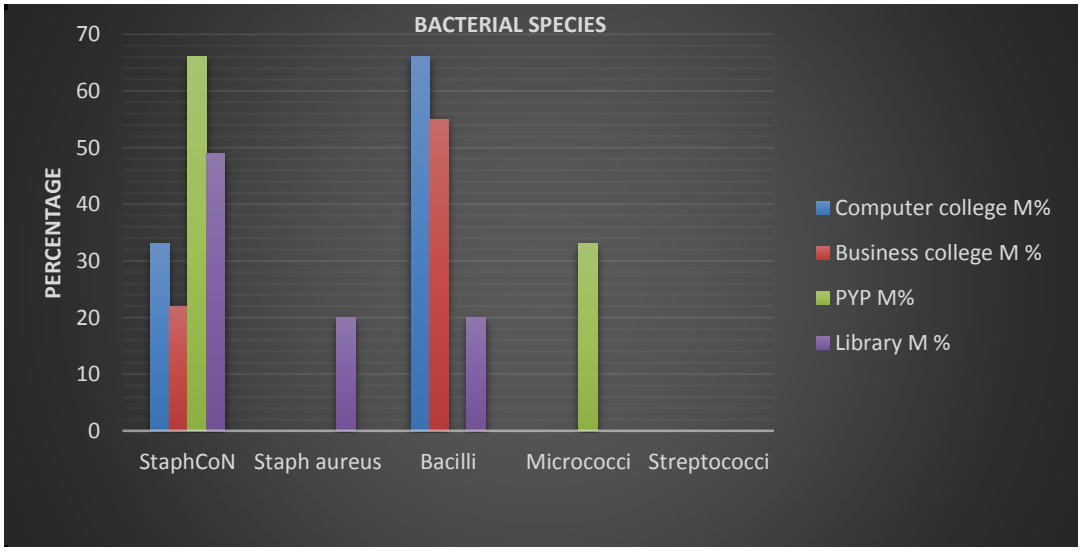

Figure 5. : Percentage of bacterial isolates per all samples from library only

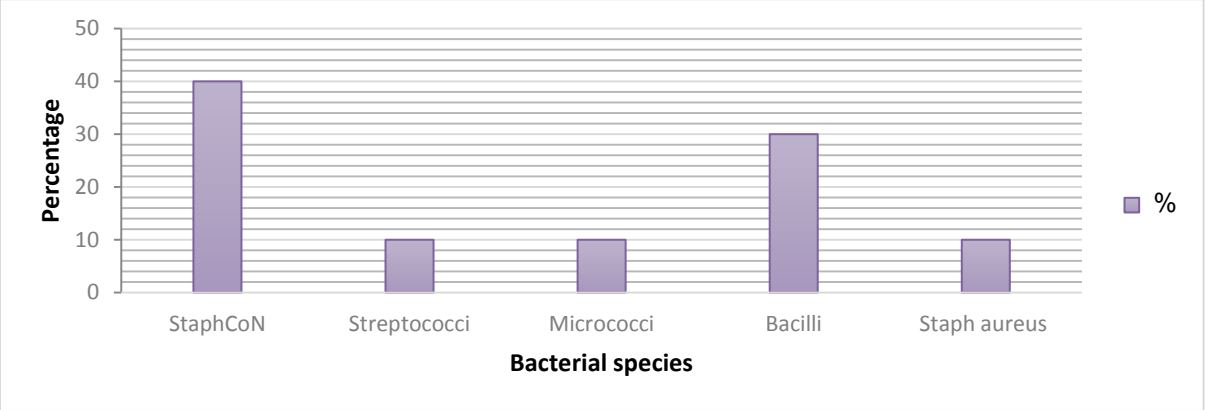

Table 2. The Efficacy of disinfectants and average of the percent of colonies reduction

Name of disinfectants	Number of colony before the disinfectants (CFU)	Number of colony after the disinfectants	% of colony reduction	Average of % colonies reduction
Dettol First sample	10	1	90	90
Dettol Second sample	13	0	100	
Dettol Third sample	30	6	80	
Clorox First sample	20	4	80	80
Clorox Second sample	38	9	76	
Clorox Third sample	7	1	85	
DAC First sample	17	10	41	51
DAC Second sample	23	8	56	
DAC Third sample	29	12	58	