

# Bacterial Contamination of Computer Keyboards and Mice in a University Setting

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## Abstract

In order to investigate the status of bacterial contamination of computer components, 50 samples (25 from keyboards and 25 from mice) were collected from the main internet center located in Al-Mustansiriyah University, Baghdad, Iraq. Depending on the cultural, microscopic and biochemical examinations, a total of 59 isolates comprising 9 bacterial species were recovered from these samples, the frequencies of occurrence of the species were; *Bacillus* spp. (25.42%), *Staphylococcus aureus* (18.64%), *Staphylococcus epidermidis* (10.17%), *Pseudomonas aeruginosa* (16.95%), *Shigella* spp. (15.25%), *Klebsilla* spp. (5.1%), *Salmonella* spp. (3.39%), *Proteus* spp. (3.39%), and *Citrobacter* spp. (1.7%). These results indicate that the computer keyboards and mice might act as environmental vehicles for the transmission of potentially pathogenic bacteria in the university settings and also indicate the need for increasing awareness among computer users on cleaning of such surfaces or disinfection and adequate hand-washing hygiene.

**Keywords:** Bacterial contamination, computer keyboards, computer mice, university setting, Iraq.

## 1. Introduction

People believe that microbes are only present in research labs or in hospitals and clinics and thus they have a misleading feeling of security in other places. Lack of knowledge about where germs prowl could be the cause of health problems. In fact 80% of infections are spread through hand contact with hands or other objects (Al-Ghamdi *et al.* 2011).

The presence of viable pathogenic bacteria on inanimate objects has been reported by earlier investigators. Several studies of the human environment have demonstrated colonization and contamination of objects such as door handles, faucets, phones, money, fabrics and plastics (Oluduro *et al.* 2011). Computers continue to have an increased presence in almost every aspect of our occupational, recreational, and residential environments. In the university environment, students have indicated that 100% have access to computers, 92.1% regularly use the Internet, and 73.3% regularly use e-mail. To accommodate the extensive use of computer technology, universities have developed multiple-user "computer laboratories" on campus for general student access (Anderson & Palombo 2009).

The increased availability of multiple-user computers in the organization setting means that these items or equipment are handled by numerous users on a daily basis. Given that computers are not routinely disinfected, the opportunity for the transmission of contaminating microorganisms is potentially great. Our understanding of the ubiquity of microorganism in the environment is developing, but the risk or hazard of contamination posed by the computer keyboards and mouse is not yet fully understood. No clear legislation or even widely recognized guidelines have been formulated on the hazard caused by computer components (Kumar & Srivastava 2012). This is not in the best interest of campus students especially that computer keyboards and mice could spread significant number of pathogens (Enemuor *et al.* 2012).

To our knowledge, there are no works that have been reported on bacterial contamination on computer equipment (keyboard and mouse) used in university settings in Iraq. So the present study aimed to investigate the presence of bacteria on computer keyboards and computer mice that are frequently used by students in the main internet center of Al-Mustansiriyah University, Baghdad.

## 2. Materials and Methods

A total of 50 samples were collected from keyboards (25 samples) and mice (25 samples) of multiple-user computers used in the main internet center of Al-Mustansiriyah University, Baghdad, Iraq.

A sterile normal saline moistened swabs were wiped firmly over the entire surface of the specific object. Each swab was placed in 1 ml of brain heart infusion broth (Hi-Media / India) and incubated overnight at 37°C, vortexed for one minute and serial ten-fold dilutions were made, 100 µl from the last dilution (10<sup>-6</sup>) was plated on nutrient agar and incubated overnight at 37°C. Each colony was plated on blood agar, MacConkey agar, eosin methylene blue agar and mannitol salt agar (Hi-Media / India) then incubated aerobically at 37°C for 24 h. The pure colonies of isolates were identified and characterized using standard microbiological techniques (Forbes *et al.* 2007).

### 3.Results and discussion

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(Anderson & Palombo 2009). The present study showed that the bacterial contamination also occurs on computer equipment located in a large university environment.

Depending on microscopic, cultural examinations and biochemical tests, 32 isolates of Gram positive bacteria were identified ; 15 of *Bacillus* spp., 11of *Staphylococcus aureus* and 6 of *Staphylococcus epidermidis* and 27 isolates of Gram negative bacteria were identified ; 10 of *Pseudomonas aeruginosa* , 9 of *Shigella* spp., 3 of *Klebsilla* spp., 2 isolates for both *Salmonella* spp.and *Proteus* spp. and one isolate for *Citrobacter* spp. (table 1).

Table 1. Numbers of bacterial isolates from computer keyboards and mice

Bacterial isolates	No. of bacterial isolates from keyboards	No. of bacterial isolates from mice	Total No. of bacterial isolates
<i>Bacillus</i> spp.	9	6	15
<i>Staphylococcus aureus</i>	3	8	11
<i>Staphylococcus epidermidis</i>	6	-	6
<i>Pseudomonas aeruginosa</i>	8	2	10
<i>Shigella</i> spp.	2	7	9
<i>Klebsilla</i> spp.	3	-	3
<i>Salmonella</i> spp.	-	2	2
<i>Proteus</i> spp.	1	1	2
<i>Citrobacter</i> spp.	1	-	1
Total No. of bacterial isolates	33	26	59

The isolation percentage of Gram positive bacteria was 54.24% while the isolation percentage of Gram negative bacteria was 45.76% (figure 1). However, both Gram +ve and Gram -ve bacteria have been shown to have similar transfer rates from laminate surfaces to fingertips (Scott & Bloomfield 2008).

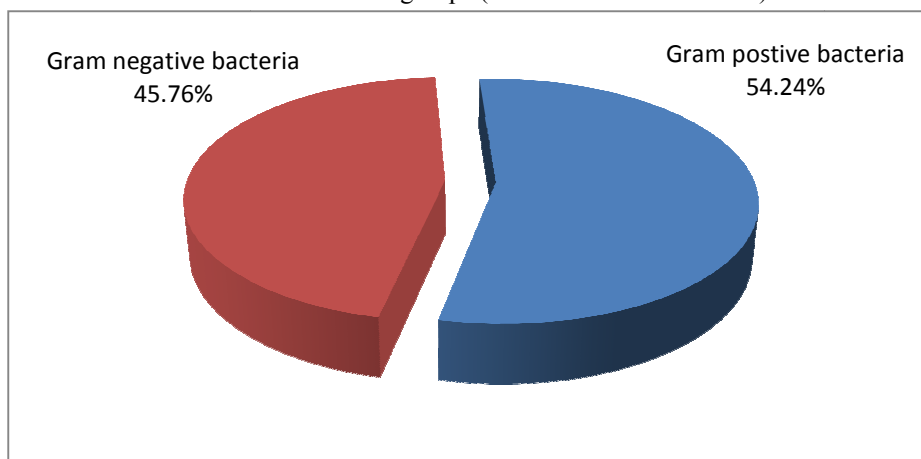


Figure 1. Isolation percentages of Gram positive and Gram negative bacteria from computer keyboards and mice.

As shown in figure 2, frequencies of occurrence of the species were; *Bacillus* spp. (25.42%), *S. aureus*(18.64%), *S. epidermidis*(10.17%), *P. aeruginosa* (16.95%), *Shigella* spp. (15.25%), *Klebsilla* spp. (5.1% ), *Salmonella* spp. (3.39% ), *Proteus* spp. (3.39% ), and *Citrobacter* spp. (1.7%).

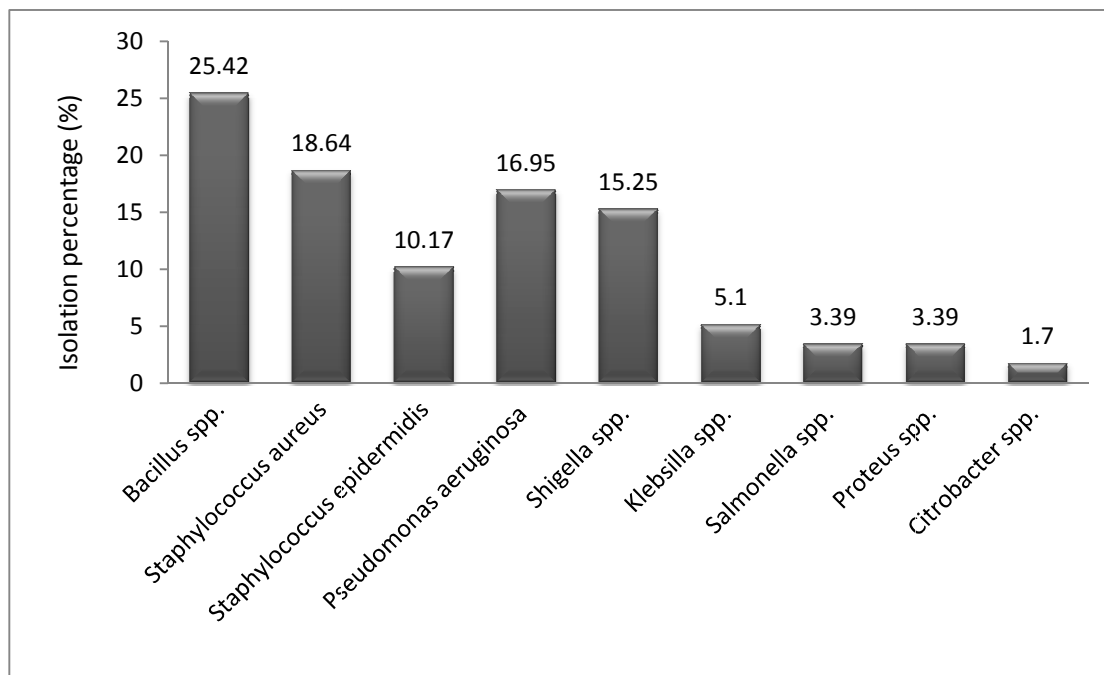


Figure 2. Percentages of bacterial isolates from computer keyboards and mice.

Overall *Bacillus* spp. was the predominant isolate followed by *S.aureus*. The isolation of *Bacillus* spp. confirms the ubiquitous nature of this bacteria giving it greater colonization ability as well as the ability of its spores to resist environmental changes, withstand dry heat and certain chemical disinfectants for moderate periods (Tagoe & Kumi-Ansah 2011). *S. aureus* is a major component of the normal flora of the skin and nostrils, which probably explains its high prevalence as a contaminant, as it can easily be discharged by several human activities, including sneezing, talking and contact with moist skin. It has also been associated with numerous infectious disease conditions and nosocomial infections. It follows that since users constantly touch interfaces and often sneeze, there is every chance of introducing *S. aureus* on to the interface in use. Also, airborne organisms can be transported from users or passers-by (Oluduro *et al.* 2011). On the other hand, *S.epidemidis* which was only isolated from keyboards samples is a normal habitat of the skin but can occasionally assume an opportunistic pathogenic role in causing human infection such as endocarditis (Anastasiades *et al.* 2009).

Of particular interest was the isolation of *P. aeruginosa* and bacteria belonging to of the Enterobacteriaceae family, including *Shigella* spp., *Klebsilla* spp., *Salmonella* spp., *Proteus* spp. and *Citrobacter* spp. Most enteric bacteria, such as *E. coli*, *Klebsiella*, *Citrobacter* and *Proteus*, are ubiquitous and that these organisms can be shed from the body, clothing, beddings, nostrils and carried in the dust particles to other surfaces (Itah & Ben 2004), hence their presence on the computer keyboards and mice. However, in places where there are a lot of people moving in and out, such as offices and internet cafés, there is likely to be a good number of people sick, and through them comes new bacteria that will eventually settle on the keyboard through air or from physical contact (Tagoe & Kumi-Ansah 2011).

In conclusion, the isolation of the bacteria from computer keyboards and mouse is a clear indication that the sterilization/aseptic procedures/methods adopted by the operators if at all, is not effective in significantly reducing the level of the organism on these surfaces to an acceptable level (Kumar & Srivastava 2012). As well as, the level of knowledge among the computer users in computer centers about the possibility of microorganisms on the keyboard and mouse is very poor. Microbes are everywhere, including the air around us, it is therefore greatly recommended that hand-washing hygiene should be adopted before and after using the computers to reduce the microbial transmission. Computer keyboards and mice should also be cleaned with alcohol or other disinfectants on a regular basis (Enemuor *et al.* 2012).

#### Acknowledgment

We would like to thank the staff members of the main internet center in Al-Mustansiriya University to allow sampling of the computers.

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