

## Bacterial contamination of computer keyboards and mouse

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### Abstract

A study was carried out to isolate and identify microorganism associated with computer keyboards and mice. A total of (250) samples were collected from two different objects (150) samples from the keyboards and (100) samples from the mice. Samples were collected from different Computer centers places some computer laboratories (multiple- user) in college of medicine, Al-Batol Teaching Hospital, Al-Jamhory Teaching Hospital in Mosul City and Laptops of Single –user (staff rooms).The collected samples were inoculated on Nutrient agar,, Salmonella –Shighella agar, Blood agar, Chogulate agar ,Maconkey agar ,Brucella agar and Minnitolt Salt agar .The isolates obtained were examined and identified by colonial morphology; biochemical characteristics and Gram stain, 99.2% of total samples collected were contaminated with mixed bacterial growth. The bacteria that have been isolates includes, Gram positive bacilli, Gram negative bacilli, Staphylococcus aureus , Staphylococcus epidermis ,Enterococcus, Escherichia coli, Streptococcus.The study indicated that the number of microorganisms present on multiple-user computer keyboard and mice were greater than the single user computer keyboards and mice. The presence of pathogenic and commercial bacteria on the computer keyboards and mice indicates that they might act as environmental vehicles for the transmission of potentially pathogenic bacteria. Our data recommended that regular cleaning and disinfection of the different parts of computers must be used to reduce the microbial load especially for multiple user work station.

### Aims of the study

This study aims to identify the types of bacteria which could be the source of contamination from computer keyboards and mouse to the users.

**Keywords:**Computer keyboards, computer microorganism, computer mouse, computer bacteria contamination.

### Introduction

Human beings have a marked tendency to pick up microorganisms from environmental objects and the hand has been shown to play a role in the transmission of organisms. The ability of plastics and other inanimate objects to support viable microorganisms for a prolonged of time is well documented and such environmental surfaces and objects especially those in close proximity with persons and frequently touched , pose a threat to health and are a cause for concern [1].

Contamination of environmental objects and surfaces is a common phenomenon, most people don't realize the microbes, are found on many common objects include playground equipment, kitchen, sinks, office desks, computer keyboards, escalator handrails, elevator bottom and with the spread of supermarkets, all of the latter objects are places that are most touched by the bare hands of people who are in various hygienic conditions [2].

Computers are ubiquitous in the health care centers and have been shown to be contaminated with potentially pathogenic microorganisms [3, 4].

The computer equipment may acts as a reservoir for the transmission of potential hazardous or pathogenic microorganisms. The ability of a computer to act as

fomites has been previously documented in health care on hospital environment [5] .In fact 80 % of infections are spread throughout hand contact with hands or other objects the viability of Gram positive and some Gram negative organisms under various environmental conditions have been found to survive in dry conditions and on various fabrics utilized in the health care environment [2].

The increased availability of multiple user computers in the university setting means that these items or equipment are handed by numerous users on a daily basis given that computers are not routinely disinfected , the opportunity for the transmission of contaminating microorganisms potentially great [3, 5, 6].

### Material and Methods

#### Study area and study population

The study was conducted in Internet center, computers laboratories within college of Medicine in Mosul University, Internet centers of two hospitals (Al-jamhory teaching hospital and Al-Batol teaching hospital) in Mosul city and, personal laptops (computer on the rooms of staff) as shown in table 1.

**Table 1: study area, population and number of the samples.**

Study Area	Number of samples
Internet center within college of medicine in Mosul city(multiple users)	50
computers laboratories within college of Medicine in Mosul University, (multiple users)	50
Internet centers of two hospitals Al-jamhory teaching hospital and Al-Batol teaching hospital (multiple users)	125
personal laptops (computer on the rooms of staff , single- user )	25

### Sources of samples

A total of 250 samples; 150 computers keyboards (CK) and 100 computer mice (CM) were collected using sterile swabs.

Eight different media were used to identify specific organisms. These plates agar include (Nutrient agar, Salmonella-Shigella agar, Blood agar, Brucella agar, Chocolate agar, Macconkey agar and Minatol Salt agar), were incubated at 37°C for 72 hours, isolates were identified on the basis of cultural characteristics on growth media which include, colony size, color capacity, consistency, hemolysis on blood agar, colony pigmentation, elevation, swarming and odour.[7], microscopic examination, biochemical tests, were performed to further bacterial identification [8].

### Statistical analysis

Statistical analysis of the results was performed using Chi square ( $X^2$ ) tests to compare the results of all bacteria found on computers (mouse and Keyboard) at different places (Internet center, computers laboratories, in two hospital of Mosul city and staff room) an alpha level of 0.05 was used for all Statistical tests.

### Results and Discussion:

Our data suggest that, a total of 242 (99.2%) of samples yielded various microorganism, the following bacteria were isolated from both computer keyboards (CK) and computer mice (CM):-Gram positive bacilli, Gram negative bacilli, *Staphylococcus aureus*, *Staphylococcus epidermis*, Enterococcus, *Escherichia coli*, *Streptococcus* sp. Bacillus species were the most isolated bacteria (100) % in both (CK) and (CM). The distribution of microorganisms isolated from (CK) and (CM) are shown in table 2.

**Table 2: Microorganisms identified on computers keyboards and mice.**

Isolated bacteria	Computer keyboards and mice	
	(No =250)	%
Gram positive bacilli,	227	90.8
Gram negative bacilli,	201	80.4
<i>Staphylococcus aureus</i>	198	79.2
<i>Staphylococcus epidermis</i>	172	68.8
Enterococcus	93	37.2
<i>Escherichia coli</i>	45	18
<i>Streptococcus</i>	28	11.2

As shown in table 2 a total of 250 samples yield various microorganisms mostly the etiology was polymicrobial, the study found that all computer keyboards and mice were positive for microbial colonization (99, 2) %, most of these isolate microorganism were traditional skin flora and probably dust associated organisms especially these from keyboards.

In our study Gram positive bacilli bacteria were more frequently (90.8) % ( $X^2 = 4.9$ ,  $P < 0.05$ ) and Gram negative bacilli (80.4) isolated from all surfaces

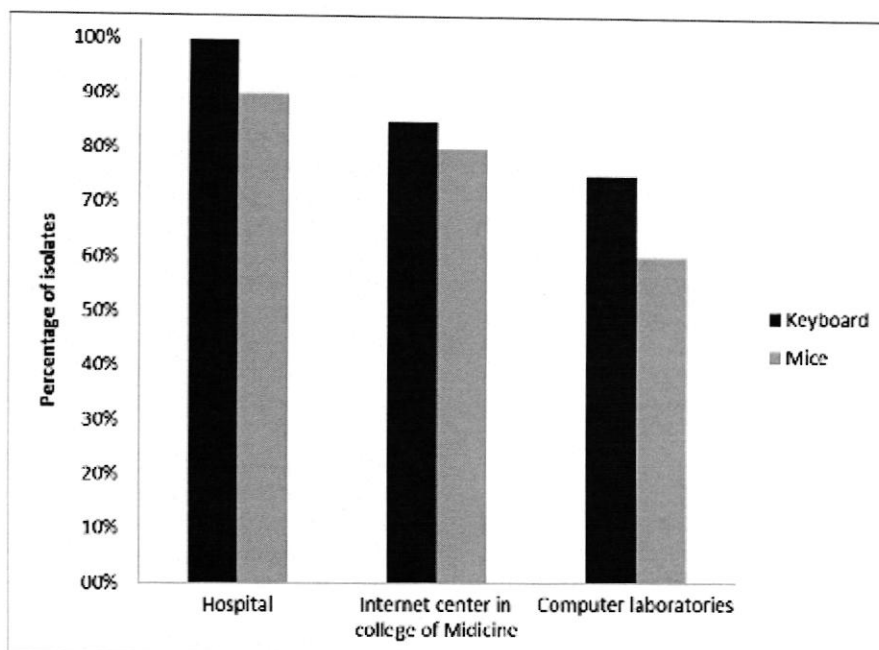
computers ( $X^2 = 6.2$ ,  $P < 0.05$ ), this could be in part due to the fact that survival of Gram positive spores on laminate surfaces is great than that of Gram negative organisms (4,2,17).

Bacteria are a part of normal life; some may end up causing disease but other bacteria a person's normal flora is benign or beneficial people pick up bacteria from environmental sources, including inanimate surfaces fomites .computer technology for the management of individual patient medical records has become an essential part in all aspect of modern medicine – consequently the computer keyboard and mouse in hospital may act a reservoir for microorganisms and contribute to the transmission of pathogens [9].

Soiling is an important factor in preserving viability of bacteria on hand surfaces thus dirty surfaces would harbor more bacteria than clean ones. This makes the process of dusting and removal of soil and distyby simple cleaning procedures of paramount influence on the reduction of surface contamination [3, 4, 10].

In this study *staphylococcus aureus* isolated from keyboards and mice (79.2) % ( $X^2 = 3.2$ ,  $P < 0.05$ ), this microorganism is part of the normal microbial of human skin and of nasal passages, it is known to be associated with numerous disease condition. The ecologic hygiene for *staphylococcus aureus* in humans is in the anterior nares [11]. One – quarter to one – third of healthy persons harbor *staphylococcus aureus* in the nose at any time which can easily be transferred to hands by simply mobbing the nose [2, 12]. Pathogens maybe transferred via the hands of a user to subsequent users of the same computer leading to infections, it has been known to cause various pus forming infections in human such as impetigo steomyelitis, toxic- shock syndrome [5]. A contaminated personal computer has been implicated in transmission of methicillin – resistant *staphylococcus aureus* to a nurse [10, 13]. Other potentially pathogenic bacteria were also isolated from the multiple – user and single –user from keyboards and mouse the isolation of bacteria *Staphylococcus epidermis* was (68, 8) %, it is a normal habitat of the skin but can occasionally assume an opportunistic pathogenic role in causing human infection such as endocarditis [5], my finding are similar with those of Hartmann *et al* (2004), who isolated *Staphylococcus epidermis*, from keyboards in intensive care units on multiple – user computers the also revealed that the highest rate of colonization in patients rooms in a screened hospital was found on computer keyboards.

Other potentially pathogenic bacteria were also isolated from the multiple – user and single – user computer keyboards and mice was the isolation of bacteria belong to the Enterobacteriaceae (37.2) % family, including *Escherichia coli* (18) % in which is indicative of fecal contamination, [6], the isolation of *Streptococcus* species (11.2)% indicates the possibility of mouth contamination [10,13].



**Figure 1: comparison between percentage isolates from computer keyboards and mice from three different places (Internet center within college of medicine, computers laboratories and Internet centers of two hospitals).**

As shown in figure 1 computer keyboards and mice of hospital exhibited the highest percentage of pathogenic organisms (100) % was significantly higher ( $X^2=4$ ,  $P<0.05$ ) compare with internet center (90) while the computer laboratories shows (70) % of pathogenic organisms, surface bio-contamination is a problem that has been shown to aid outbreaks of community acquired nosocomial infections through episodic fomite transmission of disease and persistent fomites reservoirs [10]. Pathogens maybe transferred via the hands of personnel to the patient causing nosocomial infections [14, 15]. Computer keyboards are one of the most commonly touched and shared surfaces today. By inference any time a keyboards is shared of infection thus keyboards have become reservoirs for pathogens especially in hospitals and school [16]. The ability for computers to act as fomites has been previously documented in hospital and health care environment [6], one should also note that a reason for the increased percentage of contamination of computers is the difficulty of cleaning and disinfection [2].

The hands of health care workers may become persistently colonized with such bacteria and consequentially spread it to others outside the health care premises through touching various objects such as computers [11].

Long survival time of potentially pathogenic microorganism particularly on plastics contributes to the hypothesis of computers acting as reservoirs of nosocomial infections hence the process of correct hand disinfection is still the mainstay of any prevention measure for the reduction of hospital acquired infection [9]. Hospital computers keyboards and mice should be disinfected daily or when visibly soiled or if they become contaminated with blood, this might help prevent the spread of infection during cold and flu season [3, 17, 12]. As shown in figure 1 keyboards and mouse of internet center in college of medicine in Mosul city exhibited the highest percentage of pathogenic (90 %) in internet centers computers components that attract a wide user interface cannot be ruled out as a potential etiologic agent for some of these organisms going by the unhygienic practices of users vis-visa sneezing, nose picking, unhygienic use of rest rooms, eating, habits [10, 14]. The increased availability of multiple-user computers in the internet center of college of medicine in Mosul city means that these items of equipment are handled by numerous users on a daily basis given that computers are not routinely disinfected the opportunity transmission of contaminating microorganisms potentially great [6].

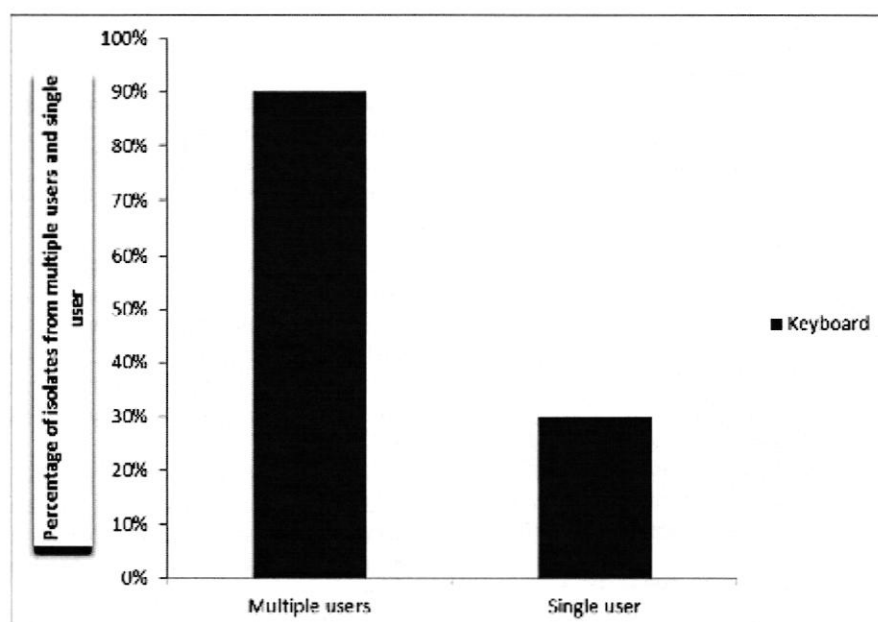


Figure 2: comparison between percentage isolates from multiple-user and single user of computers

As shown in figure 2 the keyboards of multiple – user (student) and single- user (staff) computers located on internet center, hospital and some laboratories of computers in college of medicine in Mosul University were sampled to assess microbial contamination, the number of microorganisms present on multiple- user computer keyboards and mice (90 %) was greater than on single-user, keyboards and mice (30 %) that were generally handled by individual, the number of keyboards harboring potential pathogen was also greater for multiple-user computers [6,18].

### Conclusion

Computer keyboards can harbor different pathogenic microorganisms which we use in our daily life so a wariness of appropriate hand hygiene is important in order to prevent the transmission of these pathogenic

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and multiday resistant organisms to patient [9, 19]. This study, found that there was a high colonization rate of computer-user interfaces like keyboard and mouse, the colonization pathogenic and non-pathogenic rates of bacteria was higher soon the basis of this finding it is suggested that routine cleaning of keyboards and mice on transparent plastic covers may aid the fight against infection . Also hand washing before and after contact with keyboards and mice should be practiced to significantly reduce the risk of infection and cross transmission.

According to Rutala 2006, several recommendations were gradually adopted including that computers should be disinfected daily and when visibly soiled should not touch computer keyboard with contaminated hands.

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## تلوث بعض أجزاء الحاسبة الالكترونية لوحدة المفاتيح والفارة بالبكتيريا

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### المخلص:

تم في هذه الدراسة عزل وتشخيص أنواع من الجراثيم الملوثة لأجهزة الحاسبة الالكترونية وخاصة Mice و Keyboard جمعت 250 عينة من أجهزة الحاسوب (150) عينة أخذت من Keyboard و 100 عينة أخذت من Mice أخذت العينات من مناطق مختلفة شملت مركز الانترنت في كلية طب الموصل / جامعة الموصل، قسم من مختبرات الحاسبة الالكترونية المستخدم من قبل الطلاب والأساتذة لتدريس مادة الحاسوب ، من مستشفى الجمهوري التعليمي، مستشفى البتول التعليمي، مستشفى الموصل، وبعض أجهزة الحاسوب الشخصي (Laptops). لقحت العينات التي تم جمعها على أوساط زرعية شملت: Nutrient agar, Salmonella Shighella agar, Blood agar, Chogulate agar, Maconkeyagar, Brucella agar Minnitel Salt agar، تم تشخيص الأنواع البكتيرية بالاعتماد على الصفات الشكلية والمزرعية والاختبارات البايوكيميائية وعلى صبغة كرام .

أظهرت نتائج الدراسة أن 99.2 % من العينات كانت ملوثة بأنواع مختلفة من بكتيريا ,Gram positive bacilli, Gram negative bacilli, Staphylococcus aureus, Staphylococcus epidermis ,Enterococcus, Escherichia coli, Streptococcus . كما بينت الدراسة أن أعداد البكتيريا المعزولة من أجهزة الحاسوب المستخدم من قبل أعداد كبيرة من الأشخاص هي أكثر تلوثاً من أجهزة الحاسوب ذات الاستخدام المفرد أو ذات الاستخدام الشخصي.