

## **Bacterial Contamination of Computer Keyboards in Pharmacy College / Baghdad University and Al-Rasafa Internet Centers**

**Janan M. Al-Akeedi<sup>(1)</sup>, Alaa Hussain Hassan<sup>(2)</sup> and Mustafa A. J. Alhiti<sup>(3)</sup>**

<sup>(1)</sup>PhD in Immunology and Microbiology in Al-Farabi College / Baghdad / Iraq.

<sup>(2)</sup>PhD in Virology and Microbiology in Medical Laboratory Techniques in Al-Farabi College / Baghdad / Iraq.

<sup>(3)</sup> BSc. Agri. Molecular Genetic In Pathological Analysis Laboratory, In Biotechnology & Environmental Center, In University of Fallujah /Bagdad / Iraq.

\*corresponding author: [Jananmajeed934@gmail.com](mailto:Jananmajeed934@gmail.com)

### **Summary:**

The study detects microbial contamination of computer keyboards in Pharmacy College /Baghdad University and several internet centers in Baghdad/Resafa side. Samples were collected from 20 computers in Pharmacy College and 80 computers from (5) internet centers. The swabs revealed the growth of Staph. Aureus isolates (70). Ecoli (85), Candida albicans (70), Streptococcus viridian's (67), Bacillus cereus (55), Proteus spp. (52) and Pseudomonas aeruginosa (18). The isolates demonstrate that the computer keyboard considers as a reservoir for pathogenic microorganisms and can transmit diseases from one person to another, this study referred to the importance of cleaning hands or using disinfectants before using the computers.

### **Introduction:**

All around the world, machines are used in medical facilities in a variety of ways, from ordering labs to documentation, to testing even to general accounting and also ordering of supplies (1). The results of the latest university study show that 92.1 percent of students have internet connectivity, and 73.3 percent utilize the internet often(2)

Contamination of bacteria for hospitals and internet center also shown that staff at electronic work desks spend so much time typing, increasing the risk of some death and illness. The growth in the number of machines and keyboards means the number of pathogens in our environment is on the rise (3). To several inquiries, it has been reported that keyboards could potentially spread germs due to people's interaction with them (4)

Many researches isolated different types of micro-organisms such as *Staphylococci* spp., *diphtheroid*,*micrococcus* spp, *Bacillus* spp. *ORSA* (*oxacillin-resistant Staphylococcus aureu*), *Pseudomonas* and non-fermentative *gram-negative rods* (5)

Microbes found in the air as spores of *Bacillus* spp and *Clostridium*,*Ascospores of yeasts*, fragments of mycelium and spores of molds and *protozoan cysts*, *Streptomyetacae pollen*, *algae*, *Corynebacterium*, *micrococcus*, etc. (6)

Our palms, fingernails, and skin are prone to the spread of bacteria (7). People going in and out of institutions such as hospitals and universities introduce fresh germs, which can enter the keyboard through the breeze or through physical touch (8)

### **Materials and Methods:**

The study was conducted at the University of Baghdad/ Pharmacy College & (5) Internet centers in Resafa side of Baghdad where there are totally examined 100 computers. Specimens were collected from 20 computers that were located in Pharmacy College and 80 computers are in the five internet centers. The microbial contamination detected by sterile swabs moistened with trypticase soy broth (TSB) was wiped over the keyboard surface and the mouse. The swabs were placed in 2ml of TSB and immediately transported to the Pharmacy College lab and specific lab. After the swabs were taken plated onto trypticase soy agar with 5% sheep blood, MacConkey agar, Sabouraud's agar, and mannitol salt agar and they were held at 37 °C for the duration of 48 hours. the colonies were classified on the basis of Gram staining, morphology, tube cupidity, and pigmentation due to Staphylococcus hemolytic colonies, plus tube coagulization on blood agar result (8)

### **Results:**

From a total of 100 swabs from the keyboards of 20 swabs from Pharmacy College and 80 swabs from different internet centers, these swabs revealed growth of facultative aerobic, and opportunistic pathogens as demonstrated in the table (1). The highest contamination rates were found in the samples of internet centers in Baghdad. In water, these microbes can live for over 24 hours. Furthermore, they are more likely to spread the infection in the environment.

### **Discussion:**

Different sources of machine keyboard contamination can result in different levels of keyboard contamination. In this case, frequent typing on the keyboard and using the computer leads to an increase in bacterial growth on hands. (9). Of the individual, also sweating causes moisturized environment which helps in surviving bacterial contamination (10). In general liquid drinks like coffee, Beer, soda are usually acidic (4.0-5.0), 11 drinks are spilled on the computer keyboard will provide a huge amount of moisture to the keyboard. Although much of the nutritious value of a beverage comes from the key ingredients, water and protein and carbohydrates, the final products have only small amounts of each (if milk is added). Lactose is utilized by bacteria the fastest of all the non-essential nutrients. Some bacteria will attack proteins and decompose them for their own use (11).

Improper form hand hygiene can help control the spread of machine germs. Clorox disinfectants such as *Pseudomonas aeruginosa* can be used, as well as alcohol and Quaternium compounds for *Pseudomonas* species. Disinfection must be daily to prevent bacterial contamination besides washing hands before computer using (12).

This study suggests daily cleaning of the computer keyboard with suitable disinfectants In this study *Staphylococci aureus* (90 isolates) were isolated in great numbers from the keyboard, then *E-coli* (85 isolates), *Candida albicans* (70 isolates), *Streptococcus viridian's* (67 isolates), *Bacillus cereus* (55 isolates), *Proteus* (52 isolates) and *Pseudomonas aeruginosa* (18 isolates), these isolates showed that contamination of computer keyboards due to the bad behavior of the users and this will lead to contamination of the computer keyboard with pathogenic bacteria some times. Microbial contamination can occur on the computer keyboards of large universities which about (145) different types of isolates. While in internet centers where 392 different types of isolates. (13)

In this study, the higher incidence of isolates was for *Staphylococcus aureus* which can cause pyogenic wounds infection, pneumonia and may cause bacterial toxication if entered the mouth by releasing its toxin (14). Other infections caused by this pathogen include endocarditis ,septicemia ,osteomyelitis, meningitis, various types of skin infection, gastroenteritis, and toxic shock syndrome (15).

*E-coli* is gram-negative bacilli belong to the Enterobacteriaceae family which is indicative of fecal contamination which can contaminate the hands and then to the digestive tract to cause gastrointestinal tract problems (16).

*Bacillus cereus* isolations are common soil bacterium, these isolates are evidence of environmental contamination. Similarly, the identification of *Candida albicans* on all keyboards is indicative of the ubiquitous nature of these fungi in the airborne environment and besides. *Candida albicans* consider as normal flora of the skin and reproductive system of female (17)

*Streptococcus viridians* are gram-positive inhabit the mouth and consider as oral normal flora of the mouth. Respiratory bacteria are found in the air-in droplets, saliva, and mucus droplets which get into the lungs when people cough, laugh, or sneeze. their success depends on both on where the keyboard is located as well as on available nutrients being given to the bacteria (18).

Temperature, pressure, pH, moisture, etc are physical conditions that influence the bacterial contain components. Though handwarmers can help speed up the development of microorganisms, usage of hot ones aids in cooking results in a small rise in temperature.

You will change the pH of the keyboard by passing your fingertips over it. of sweating, the pH of sweat could vary from acidic (below 5) to slightly alkaline (7)

Location Of keyboard	No.of samples	Pseudo aerug	E.coli	Staph aureus	Strept viridians	Proteus	B. cereus	C. Albicans
Dean office	4	1	-	-	-	-	3	-
Pharmacy College Internet	4	2	5	4	10	2	7	10
Different Places in Pharmacy college	12	3	20	6	17	10	17	10
Intetnet center	80	12	60	80	40	40	30	50

**Table (1): Demonstrate the number of swabs from different places and the number of isolates from these places**

### Conclusions:

Computer contamination caused by the user's hands, so washing hands with disinfectant will prevent the transmission of many pathogenic bacteria.

### References:

1. Evans, R. S. (2016). Electronic health records: then, now, and in the future. *Yearbook of medical informatics*, (Suppl 1), S48.
2. Anderson, G., & Palombo, E. A. (2009). Microbial contamination of computer keyboards in a university setting. *American journal of infection control*, 37(6), 507-509.
3. Schultz, M., Gill, J., Zubairi, S., Huber, R., & Gordin, F. (2003). Bacterial contamination of computer keyboards in a teaching hospital. *Infection Control & Hospital Epidemiology*, 24(4), 302-303.
4. Enemuor, S. C., Apeh, T. A., & Oguntibeju, O. O. (2012). Microorganisms associated with computer keyboards and mice in a university environment. *African journal of microbiology research*.
5. Rutala, W. A., White, M. S., Gergen, M. F., & Weber, D. J. (2006). Bacterial contamination of keyboards: efficacy and functional impact of disinfectants. *infection control and hospital epidemiology*, 27(4), 372-377.
6. Fang, Z., Ouyang, Z., Zheng, H., Wang, X., & Hu, L. (2007). Culturable airborne bacteria in outdoor environments in Beijing, China. *Microbial Ecology*, 54(3), 487-496.
7. Koscova, J., Hurnikova, Z., & Pistl, J. (2018). Degree of bacterial contamination of mobile phone and computer keyboard surfaces and efficacy of disinfection with chlorhexidine digluconate and triclosan to its reduction. *International journal of environmental research and public health*, 15(10), 2238.
8. Tagoe D.N., Gyande V.K., Ansah E.O. Bacterial contamination of mobile phones: When your mobile phone could transmit more than just a call. *Webmed Cent. Microbiol.* 2011;2:WMC002294.
9. Al-Ghamdi, A. K., Ashshi, S. A. A., Faidah, H., Shukri, H., & Jiman-Fatani, A. A. (2011). Bacterial contamination of computer keyboards and mice, elevator buttons and shopping carts. *African Journal of Microbiology Research*, 5(23), 3998-4003.
10. Baker, L. B. (2019). Physiology of sweat gland function: The roles of sweating and sweat composition in human health. *Temperature*, 6(3), 211-259.
11. Michaelsen, K. F., Weaver, L., Branca, F., & Robertson, A. (2000). Feeding and nutrition of infants and young children. *WHO regional publications, European Series*, 87, 288.
12. Rutala, W. A., & Weber, D. J. (2008). Guideline for disinfection and sterilization in healthcare facilities, 2008.
13. Anderson, G., & Palombo, E. A. (2009). Microbial contamination of computer keyboards in a university setting. *American journal of infection control*, 37(6), 507-509.
14. Taylor, T. A., & Unakal, C. G. (2017). *Staphylococcus aureus*.

15. Gnanamani, A., Hariharan, P., & Paul-Satyaseela, M. (2017). Staphylococcus aureus: Overview of bacteriology, clinical diseases, epidemiology, antibiotic resistance and therapeutic approach. *Frontiers in Staphylococcus aureus*, 4, 28.
16. Cabral, J. P. (2010). Water microbiology. Bacterial pathogens and water. *International journal of environmental research and public health*, 7(10), 3657-3703.
17. Altayar, M., & Sutherland, A. D. (2006). Bacillus cereus is common in the environment but emetic toxin producing isolates are rare. *Journal of applied microbiology*, 100(1), 7-14.
18. Dhotre, S., Suryawanshi, N., Selkar, S., & Nagoba, B. (2015). Viridans group streptococci and the oral ecosystem. *European Journal of General Medicine*, 13(2), 145-148.