International Journal of Academic Health and Medical Research (IJAHMR)
ISSN: 2000-007X
Vol. 2 Issue 5, May – 2018, Pages: 1-5

Elevator Buttons: An Unrealized Potential Health Hazard

Ranim Kassir and Tarek Nawas*
Natural Sciences Department, School of Arts and Sciences
Lebanese American University
Beirut, Lebanon

Abstract: *The isolation of many potential pathogens from many sources commonly used by the public, raised awareness on needed measures to avoid such a hidden danger. In this study another commonly used surface, namely the elevator buttons of public elevators located in the busy Ras Beirut area in Beirut, the capital of Lebanon, were studied for bacterial contamination. Eight of the 12 public elevators sampled (67%) grew more than one bacterium, the buttons of the remaining 4 elevators (33 %) grew only one bacterial organism. The isolated organisms included: coagulase-negative staphylococci isolated from the buttons of 75 % of the sampled elevators, Staphylococcus aureus from 67 %, Klebsiella pneumoniae (sub sp. pneumoniae 1) from 17 %, Enterobacter aerogenes from 8 %, and Rahnella aquatilis also from 8 %. Due to the frequency of use of public elevators, people usually do not note the threat posed by these elevators. As hands remain the major method of transmission of pathogenic bacteria, this study concludes that elevator buttons can be dangerous fomites that can harbor pathogenic bacteria from carriers as much as they can be dangerous fomites that spread serious agents of disease.*

Keywords—elevator buttons; health awareness; potential pathogens; Staphylococcus aureus; Enterobacteriaceae

***Corresponding author: Tarek Nawas, Email: tnawas@lau.edu.lb, 009611867618**

1. INTRODUCTION

Microbes are present everywhere. The human hands were proved to serve as a major method of transmission of these microbes from the site they inhabit to other, sometimes distant, locations. In fact, 80% of all infections were found to spread through hand contact with hands or other objects (1). Several studies have proved that numerous items, used on daily basis, in homes, offices and public areas can serve as fomites to spread many groups of potential pathogens (2). Fomites such as buttons of ATMs and vending machines, door handles, computer screens and mice, telephones, library and class desks and other commonly used items, were proved to serve as a source of organisms that can cause different types of infections (1, 3, 4, 5).

People often come in contact with elevator buttons without recognizing that many microbes may be residing or even growing on these buttons. Elevator buttons, like all open surfaces, are also expected to harbor microbes. In a study by Al-Ghamdi et al. in 2011, the bacterial contamination of computer keyboards and mice, elevator buttons and shopping carts was compared and the fomites that were found to be mostly contaminated (97 %) were the elevator buttons (6). Other studies have shown that pathogenic bacteria like *Staphylococcus aureus* can also be present on elevator buttons (7, 8).

Another common misconception is that as long as a surface (including elevator buttons) is dry, then it imposes no danger. It has been established, however, that surfaces with no pores or small openings are able to catch more bacteria than other surfaces (9), and that although drying may reduce the number of bacteria on a surface, it rarely eliminates them (10).

The aim of this study was to check for the possible contamination of the buttons of elevators used by the public and accordingly determine if the isolated bacteria may be potential pathogens.

2. MATERIALS AND METHODS

2.1 Selection of elevators:

Twelve elevators were randomly selected for the study. All the elevators were located in public and nonresidential buildings in Ras Beirut, a busy area of the city of Beirut the capital of Lebanon.

2.2 Sample collection

Sterile cotton swabs, inserted in trypticase soy broth (TSB) were used to collect the specimens. One swab was used for each elevator. Each moistened swab was used to scrub the internal buttons of the elevator. The swab was then put back in the TSB tube and was immediately transported to the microbiology laboratory, in a period not exceeding 20 minutes.

2.3 Processing of samples

Upon arrival to the laboratory, each swab was inoculated on the following media: Tryptic Soy Agar (TSA), Mannitol Salt Agar (MSA), MacConkey Agar (MA), and Cetrimide Agar (CA). Moreover, the swabs were then returned to the TSB broth. The different plates and TSB media were all incubated for 24 hours at 35^{o}C. The plates were then checked for growth and all colonies growing on any of the media were isolated on TSA for definitive identification. If no growth appeared, the same plates were further incubated for 24 more hours and a new set of plates, was inoculated from the TSB and checked after 24 and 48 hours and dealt with in the same manner.

2.4 Identification of isolates

The isolated colonies were then identified as per recommended methods (11, 12). After Gram staining, Gram-positive organisms were identified by using the following biochemical tests: catalase, DNase, and coagulase production (in addition to growth on MSA). For the Gram-negative organisms, a preliminary set of biochemical tests including: catalase and oxidase production was done. The final identification of these organisms was performed using the API 20E strips (Biomerieux- France).

3. RESULTS

Table 1 summarizes the results of this study. Potential pathogens were isolated from the buttons of all the 12 elevators tested. Whereas the buttons of 8 of the 12 public elevators sampled (67%) grew more than one bacterium, the buttons of the remaining 4 elevators (33 %) grew only one bacterial organism. The isolated organisms included: coagulase-negative staphylococci isolated from the buttons of 75 % of the sampled elevators, *Staphylococcus aureus* from 67 %, *Klebsiella pneumoniae* (sub sp. pneumoniae 1) from 17 %, *Enterobacter aerogenes* from 8 %, and *Rahnella aquatilis* also from 8 %.

Table 1: The organisms isolated from the buttons of the elevators included in the study.

Elevator number	Organisms isolated
1	*Staphylococcus aureus* Coagulase negative *staphylococcus*
2	*Staphylococcus aureus*
3	*Rahnella aquatilis* Coagulase negative *staphylococcus*
4	Coagulase negative *staphylococcus*
5	Coagulase negative *staphylococcus*
6	*Enterobacter aerogenes* Coagulase negative *staphylococcus* *Staphylococcus aureus*
7	*Klebsiella pneumoniae* (subspecies*: pneumoniae 1*) Coagulase negative *staphylococcus*
8	*Klebsiella pneumoniae* (subspecies*: pneumoniae 1*) *Staphylococcus aureus*
9	*Staphylococcus aureus* Coagulase negative *staphylococcus*
10	*Staphylococcus aureus* Coagulase negative *staphylococcus*
11	*Staphylococcus aureus* Coagulase negative *staphylococcus*
12	*Staphylococcus aureus*

4. DISCUSSION

Elevators, are nowadays probably, one of the most commonly used machines. They have become part of the life of all people as they are important vehicles that help us reach our destination; whether that be home, work, university or even an amusement center. The elevator buttons are touched by different people with different sanitary habits and many times during a day. Moreover, each person may need to use many elevators in different places in the same day. Different fomites were shown to harbor potential pathogens (3, 4, 5, 6), including elevator buttons in hospitals (2), it was decided to perform this study to check for the possible contamination of the buttons of public elevators. The chosen elevators were public elevators that were cleaned daily as per a regular schedule set by the authority in charge of the building, where the elevator was located.

The results of this study confirm the results obtained in previous studies (2, 6, 7, 8, 13) that elevator buttons are actually contaminated with potential pathogens. Whereas the rate of contamination of the buttons was high (97%) in the study reported by Al-Ghamdi et al. in 2011 (6) and which included residential and shopping mall elevators, the results of this study showed that the buttons of all the elevators tested were contaminated (100%). Another minor difference in the results of this study was that unlike the results in other studies (2, 8), in which the buttons of all the elevators tested grew more than one organism, the buttons of 8 of the 12 public elevators sampled (67%) grew more than one organism, while, the buttons of the remaining 4 elevators (33%) grew only one organism. The organisms isolated from the different studies were, however, very similar to the ones isolated from this study (2, 6, 7, 8, 13).

The Gram-positive organisms isolated were Staphylococcus aureus that grew from 67% of the tested elevators and coagulase-negative staphylococcus spp. that grew from 75% of the elevators. Almost 30% of people carry S. aureus, and most of the time it does not cause any harm, however, it may be dangerous in some cases especially in health-care settings where it may cause: bacteremia or sepsis, pneumonia, endocarditis and/or osteomyelitis (14). It should be noted that anyone can develop a S. aureus infection, although people with a weakened immune system, have recently undergone a medical surgery, or that suffer from diabetes, cancer, eczema and lung diseases are all more prone to such infections as they are at a greater risk than others. The virulence of S. aureus infections is significant and knowing that the organism, in a carrier, most commonly colonizes the nares, axillae, vagina, or pharynx, infections are initiated when a breach of the skin or mucosal barrier, allowing the organism access to adjoining tissues or the bloodstream (15, 16, 17, 18).

The coagulase-negative staphylococci, on the other hand, are known to normally reside on the skin and the mucous membranes of humans and animal. They possess fewer virulence properties than S. aureus with regards to their disease spectrum. However, these organisms are very important in nosocomial primary bloodstream infections, foreign body-related and other nosocomial infections worldwide. In the community, they also can be pathogenic for immunocompromised hosts (19, 20, 21, 22).

The Gram-negative bacteria isolated in this study were all members of the family Enterobacteriaceae, the biggest family of Gram-negative organisms, the members of which are the most commonly isolated organisms from clinical specimens (12). Klebsiella pneumoniae subsp. pneumoniae 1, grew from 17 % of the tested elevators, Enterobacter aerogenes from 8 % and Rahnella aquatilis also from 8 % of the tested elevators.

K. pneumoniae is a common cause of nosocomial urinary tract infections, pneumonia, and intraabdominal infections (23, 24). K. pneumoniae may be found initially in the human gut, where it may not be pathogenic, however, it can be dangerous to immunocompromised patients as it may also be transmitted through the respiratory route, and thus be a potential community pathogen (25). Both Klebsiella and Enterobacter species are of the most common pathogens in causing nosocomial pneumonias (23). Members of the genus Enterobacter share common features with the Klebsiella spp. as they usually colonize the skin and gastrointestinal tract of humans, can cause severe nosocomial urinary tract infections, lower respiratory tract infections, skin and soft tissue infections, bacteremia, endocarditis, intra-abdominal infections, septic arthritis, and osteomyelitis, but also can be responsible for opportunistic infections in immunosuppressed individuals (26, 27).

The last organism isolated in this study was Rahnella aqautilis, also a member of the family Enterobacteriaceae, whose natural habitat is water and yet still not very well understood given that it biochemically has no single distinguishing feature to differentiate it from other members of its family (12). R. aquatilis has been associated with causing bacteremia, sepsis, respiratory tract, urinary tract and wound infections in immunocompromised patients and infective endocarditis in patients with congenital heart disease (28, 29, 30, 31). R. aquatilis has been isolated from blood, surgical wounds, urine, sputum, bronchial washings, and stool (31).

There can be several causes for the presence of the organisms isolated in this study on the buttons of the different elevators tested. Hands contaminated with these organisms are probably the first and most plausible cause, contamination that can happen by regular direct interaction with other people (like in shaking hands) or through contact with many other contaminated inanimate objects. Another cause may be the direct contamination through normal human activities like sneezing, coughing, or scratching as the isolated organisms can me members of the normal microbial flora of humans (16). A third cause may be the air currents that may at times help in carrying organisms to the internal chamber of the elevator. No matter what the cause was, the use of the buttons can help transfer pathogens from one location to the other.

The elevators chosen for the study were in public facilities, that imposed regular daily cleaning of the elevators, yet the buttons were demonstrated to be contaminated. This confirms the results of previous studies, that reported that even with proper sanitary measures, it would be extremely difficult to completely eliminate all bacteria from surfaces (9). All people, including those who are for some reason immunosuppressed, use the elevators and are at risk of not only acquiring, but also spreading disease causing organisms. It is a well known fact that 80% of infections are spread through hand contact with hands or other objects (1).

Most people avoid “dirty” material in fear of getting in contact with dangerous microbes. What they do not realize is that the items they are regularly using, like the elevator buttons, and that may look “clean”, may be more dangerous than the items they are avoiding. Therefore, we should not underestimate the importance of regular sanitary cleaning of the elevators, but the more efficient remedy would be proper personal hygiene, of prime importance of which is proper regular cleaning of the hands (32).

REFERENCES

[1] Reynolds K., Watt, P., Boone, S., & Gerba, C. (2005). Occurrence of bacteria and biochemical markers on public surfaces. International Journal of Environmental Health Research. 15(3): 225-234. Available online at: http://dx.doi.org/10.1080/09603120500115298

[2] Kandel, C. E., Simor, A.E. & Redelmeier, D.A. (2014). Elevator buttons as unrecognized sources of bacterial colonization in hospitals. Open Medicine. 8(3): e81-e86. Available online at: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4242253/

[3] Hamzeh F., & Na’was T. (2015). Computer Mice in Public Centers: A Source of Pathogenic Bacteria. ARPN Journal of Science and Technology. 11(5), 1-3. Available online at: http://www.ejournalofscience.org/archive/vol5no11/vol5no11_2.pdf

[4] Dakroub, R. & Na’was, T. (2017). Vending machine buttons and touch screens: a surface colonized by

pathogenic bacteria. International Journal of Innovative and Applied Research. 5(5), 82-88. Available online at: http://www.journalijiar.com/uploads/258_IJIAR-2125.pdf

[5] Fakhoury, S. & Nawas, T. (2018). Contamination of the Internal Handles/Knobs of Public Restroom Doors with Potentially Pathogenic Bacteria. International Journal of Current Microbiology and Applied Sciences. 7(3): 3434-3440. doi: https://doi.org/10.20546/ijcmas.2018.703.395

[6] AL-Ghamdi, A., Abdelmalek, S., Ashshi, A., Faidah, H., Shukri, H., & Jiman-Fatani, A. (2011). Bacterial contamination of computer keyboards and mice, elevator buttons and shopping carts. African Journal of Microbiology Research. 5(23), 3998-4003. Available online at: http://www.academicjournals.org/journal/AJMR/article-full-text-pdf/0C6929214156

[7] Davis M.F., Iverson S.A., Baron P.,Vasse A.,Silbergeld E.K., Lautenbach E.,& Morris D.O. (2012), Household transmission of meticillin-resistant Staphylococcus aureus and other staphylococci. The Lancet. 12: 703-16. Available online at: http://pmpathway.wustl.edu/files/2016/08/Davis-Lancet-ID-Household-transmission-of-MRSA-2012.pdf

[8] Roberts, M.C., Soge, O.O., No, D., Helgeson, S.E., & Meschke, J.S. (2011). Characterization of Methicillin-resistant Staphylococcus aureus isolated from public surfaces on a University Campus, Student Homes and Local Community. Journal of Applied Microbiology. 110(6), 1531-1537. doi: 10.1111/j.1365-2672.2011.05017.x

[9] Nwankwo E.O. & Offiah J.C. (2016). Bacterial Contamination of User Interface of Automated Teller Machines (ATM) of Various Banks in Umuahia Metropolis, Abia State, Nigeria. International Journal of tropical disease & Health. 13(3), 1-9. doi: 10.9734/IJTDH/2016/22812

[10] Lowbury, J., & Fox, J. (1953). The influence of atmospheric drying on the survival of wound flora. Medical Research Council Industrial Injuries and Burns Research Unit, Birmingham Accident Hospital. 51(2),1-12. Available online at: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2217722/pdf/jhyg00160-0062.pdf.

[11] Cowan, S.T. and Steel, K.L. (1974). Cowan and Steel manual for the identification of medical bacteria. Cambridge University Press, London.

[12] Farmer, J. J., III, B. R. Davis, F. W. Hickman-Brenner, A. McWorther, G. P. Huntley-Carter, M. A. Asbury, C. Riddle, H. G. Wathen-Grady, C. Elias, G. R. Fanning, A. G. Steigerwalt, C. M. O'Hara, G. K. Morris, P. B. Smith, & D. J. Brenner. (1985). Biochemical identification of new species and biogroups of Enterobacteriaceae isolated from clinical specimens. Journal of Clinical Microbiology. 21:46-76.

[13] Mohammadi, A., Ebrahimi, A., & Nemati, S. Bacterial and Fungal Contamination of Elevator Buttons in University Schools of Isfahan University of Medical Sciences, Isfahan, Iran. Health Scope; 2016, 5(4), 1-5. doi: 10.17795/jhealthscope-34428.

[14] Centers for Disease Control and Prevention 2011. Staphylococcus aureus in Healthcare Settings. Health-care associated infections. CDC. Atlanta. GA. Available online at: https://www.cdc.gov/hai/organisms/staph.html

[15] Lowy, F.D. (1998). Staphylococcus aureus infection. New England Journal of Medicine. 339:520-532

[16] Itah, A.T. & Ben A.E. (2004). Incidence of enteric bacteria and Staphylococcus aureus in day care centers in AkwaIbom state, Nigeria. Southeast Asian Journal of Tropical Medicine and Public Health. 35(1):202

[17] Wertheim, H.F., Melles, D.C., Vos, M.C., van Leeuwen, W., van Belkum, A., Verbrugh, H.A. & Nouwen, J.L. (2005). The role of nasal carriage in Staphylococcus aureus infections. Lancet Infectious Diseases. 5:751–762. doi:10.1016/S1473-3099(05)70295-4

[18] Tong, S.Y.C., Davis, J.S., Eichenberger, E., Holland, T.L. & Fowler V.G. (2015). Staphylococcus aureus Infections: Epidemiology, Pathophysiology, Clinical Manifestations, and Management. Clinical Microbiology Reviews. 28(3):603-661. doi:10.1128/CMR.00134-14.

[19] Rogers, K.L., Fey, P.D. & Rupp, M.E. (2009). Coagulase-negative staphylococcal infections. Infectious Disease Clinics of North America. 23:73- 98.

[20] Uyanik, M.H., Yazgi, H., Ozden, K., Erdil, Z., & Ayyildiz, A. (2014). Comparison of Coagulase-Negative Staphylococci Isolated from Blood Cultures as a True Bacteremia Agent and Contaminant in Terms of Slime Production and Methicillin Resistance. The Eurasian Journal of Medicine. 46(2), 1-5. doi: 10.5152/eajm.2014.26

[21] Becker, K., Heilmann, C., & Peters, G. (2014). Coagulase-Negative Staphylococci. Clinical Microbiology Reviews. 27(4):870–926.

[22] Rubino, C., Brongo, S., Pagliara, D., Cuomo, R., Abbinante, G., Campitiello, N., Santanelli, F. & Chessa, D. (2014). Infections in breast implants: a review with a focus on developing countries. Journal of Infections in the Developed Countries. 12: 1089-1095. doi: 10.3855/jidc.3898

[23] Guentzel, M.N. (1996). Escherichia, Klebsiella, Enterobacter, Serratia, Citrobacter, and Proteus. In: Medical Microbiology. Chapter 26. (4rth ed.). The University of Texas Medical Branch at Galveston. Bookshelf ID: NBK8035. PMID: 21413290

[24] Yu, W.L. & Chuang, Y.C. (2017). Clinical features, diagnosis, and treatment of Klebsiella pneumoniae infection. UpToDate. Wolters Kluwer. Calderwood, SB (editor).

[25] Ko, W., Paterson, D., Sagnimeni, A., Hansen, D., Gottberg, A., Mohapatra, S., Yu, V. (2002). Community-Acquired Klebsiella pneumoniae Bacteremia: Global Differences in Clinical Patterns. Emerging Infectious Diseases. 8(2), 1-7. doi: 10.3201/eid0802.010025

[26] Arpin, C., Coze, C., Rogues, A., Gachie, J., Bebear, C., & Quentin, C. (1996). Epidemiological Study of an Outbreak

Due to Multidrug-Resistant Enterobacter aerogenes in a Medical Intensive Care Unit. Journal of Clinical Microbiology. 34(9), 1-7.

[27] Davin-Regli, A. & Pagès, J.M. (2015). Enterobacter aerogenes and Enterobacter cloacae; versatile bacterial pathogens confronting antibiotic treatment. Frontiers in Microbiology. 6: 392.

[28] Alballaa, S.R., Qadri, S.M.H., Al-Furayh, O. & Al-Qatary, K. (1992). Urinary tract infection due to Rahnella aquatilis in a renal transplant patient. Journal of Clinical Microbiology. 30:2948–2950

[29] Maraki, S., Samonis, G., Marnelakis, E. & Tselentis, Y. (1994). Surgical wound infection caused by Rahnella aquatilis. Journal of Clinical Microbiology. 32:2706-2708.

[30] Chang, C., Jeong, J., Shin, J., Lee, E., & Son, H. (1999). Rahnella aquatilis Sepsis in an Immunocompetent Adult. Journal of Clinical Microbiology. 37(12), 1-2.

[31] Tash, K., (2005). Rahnella aquatilis Bacteremia from a Suspected Urinary Source. Journal of Clinical Microbiology. 43(5), 1-3. doi:10.1128/JCM.43.5.2526–2528.2005

[32] Centers for Disease Control and Prevention. Guideline for Hand Hygiene in Health-Care Settings. (2002). Recommendations of the Healthcare Infection Control Practices Advisory Committee and the HICPAC/SHEA/APIC/IDSA Hand Hygiene Task Force. MMWR, 5: No. RR-16. Available online at: https://www.cdc.gov/mmwr/PDF/rr/rr5116.pdf