OPEN ACCESS
World Journal of Applied Medical Sciences
ISSN: 3049-0200 | Vol. 2, No. 8, 2025
Website: https://wasrpublication.com/wjams/

Mobile Phones as Reservoirs of Microorganisms: A Study among Medical Students

Shilpa K[1], Niranjan D[2], Mohammed Rafiq S H[2], Aysha nargees M[2], Devadharshini E[2], Bernaitis L[3*]

[1]Department of Microbiology, Vydehi Institute of Medical and Research Center, Bangalore, Karnataka – 560066.

[2]Under graduate students, Nandha Siddha Medical College and Hospital, Erode-638052.

[3]Department of Noi Nadal And Noi Mudhal Naadal (Pathology Including Microbiology), Nandha Siddha Medical College and Hospital, Erode-638052.

Received: 07/07/2025 | Accepted: 01/08/2025 | Published: 16/08/2025

Abstract:

Background: Mobile phones are indispensable tools for communication and learning, particularly among medical students. However, frequent handling and exposure to various environments make them potential reservoirs for microorganisms, including pathogenic and antibiotic-resistant species.

Objective: To isolate, identify, and characterize microorganisms present on mobile phones used by medical students. Methods: Swab samples from 50 mobile phones were collected and cultured on nutrient-rich and selective agar media. Bacterial and fungal isolates were identified using Gram staining and standard biochemical tests. Colony characteristics, hemolytic patterns, and pigment production were recorded.

Results: A diverse range of bacteria and fungi were isolated, including *Staphylococcus aureus*, *Escherichia coli*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, *Proteus mirabilis*, *Candida albicans*, *Aspergillus niger*, and *Penicillium* spp. Several isolates exhibited features associated with pathogenicity, and some were suggestive of antibiotic resistance (e.g., MRSA).

Conclusion: The study highlights the role of mobile phones as potential fomites in healthcare environments, emphasizing the urgent need for regular disinfection and strict hand hygiene practices among medical students to reduce cross-contamination and nosocomial infection risks.

Keywords: Mobile phone contamination, medical students, pathogenic microorganisms, antibiotic resistance, fomites.

Cite this article:

Shilpa, K., Niranjan, D., Mohammed Rafiq, S. H., Aysha nargees, M., Devadharshini, E., Bernaitis, L., (2025). Mobile Phones as Reservoirs of Microorganisms: A Study among Medical Students. *World Journal of Applied Medical Sciences*, *2*(8), 11-15.

Introduction

Mobile phones have become an inseparable part of modern life, with an estimated 6.9 billion subscriptions worldwide in 2023, representing approximately 86% of the global population (1). In medical education, these devices serve as indispensable tools for quick access to medical literature, communication among peers and faculty, and documentation of clinical observations (2). The convenience and portability of mobile phones, however, come at a cost — frequent handling and exposure to various environments increase the likelihood of microbial contamination (3).

Numerous studies have confirmed that mobile phone surfaces can harbor a wide variety of microorganisms, including bacteria, viruses, and fungi (4,5). Pathogenic species such as *Staphylococcus aureus*, *Escherichia coli*, *Klebsiella pneumoniae*, and *Pseudomonas aeruginosa* have been detected on mobile devices, some of which exhibit antibiotic resistance, including methicillin-resistant *S. aureus* (MRSA) (6,7). These microorganisms can survive on inanimate surfaces for prolonged periods — from hours to several months — thereby increasing the risk of cross-contamination (8).

In healthcare settings, mobile phones can act as potential fomites, facilitating the transmission of pathogens between healthcare workers, patients, and the hospital environment (9,10). Contamination may occur through direct contact with the skin, respiratory droplets, or indirectly via environmental exposure. Given that healthcare-associated infections (HAIs) remain a major public health concern, with millions of cases reported annually worldwide (11), the role of mobile devices as vectors warrants serious consideration.

The risk is particularly relevant for medical students, who frequently transition between academic, hospital, and community environments. Their mobile phones may serve as reservoirs for both community-acquired and hospital-associated microorganisms (12,13). Poor hand hygiene practices, lack of awareness about infection control, and infrequent device cleaning further exacerbate this problem (14,15).

***Corresponding Author**
Bernaitis L*
Department of Noi Nadal And Noi Mudhal Naadal(Pathology Including Microbiology), Nandha Siddha Medical College and Hospital, Erode-638052.

While several studies have assessed the microbial contamination of mobile phones among healthcare workers, there is limited literature focusing specifically on medical students in developing countries, where infection control protocols may not be strictly enforced (16,17). Understanding the microbial profile of these devices can provide insight into potential risks and help develop targeted educational interventions and hygiene policies.

Therefore, the present study aims to isolate, identify, and characterize microorganisms present on mobile phones of medical students and to highlight their potential role in nosocomial and community infection transmission.

Materials and Methods

This cross-sectional laboratory-based study was conducted to evaluate microbial contamination on mobile phones used by medical students. A total of fifty mobile phones were randomly selected from Bachelor of Siddha Medicine and Surgery (BSMS) students of Nadha Siddha Medical College, Erode. Participation was voluntary, and informed consent was obtained from each participant. Only personal mobile phones were included, while shared devices and visibly damaged devices were excluded to minimize bias.

Mobile phones were sampled during routine academic hours to capture typical contamination levels. Each phone was handled with sterile gloves to prevent exogenous contamination. A sterile cotton-tipped swab, moistened with sterile physiological saline, was used to collect samples from frequently touched surfaces, including the screen, side edges, back cover, buttons, and charging or earphone ports. The swab was rolled firmly across each surface in both horizontal and vertical directions to ensure maximum recovery of microorganisms. Devices were not cleaned or disinfected prior to swabbing. After collection, each swab was placed into a sterile, labeled transport tube containing sterile saline. Samples were immediately transported to the microbiology laboratory for processing within one hour of collection.

Three types of culture media were used for microbial isolation: blood agar for the isolation of fastidious organisms and detection of hemolysis, MacConkey agar for differentiation and isolation of Gram-negative enteric bacteria, and Sabouraud dextrose agar (SDA) for the isolation of fungi and yeasts. Swabs were streaked directly onto each agar plate using a sterile inoculating loop, employing the standard four-quadrant streaking technique to obtain isolated colonies.

Blood agar and MacConkey agar plates were incubated aerobically at 37 ± 1 °C for 24 to 48 hours, while SDA plates were incubated at 25 °C for up to 7 days to observe fungal growth. All plates were inverted during incubation to prevent condensation from dripping onto the agar surface.

After incubation, the plates were examined for visible colony growth. Observations included colony size, shape, color, elevation, surface texture, pigment production, and hemolytic patterns on blood agar. For bacterial isolates, Gram staining was performed to determine Gram reaction and cellular morphology. Standard biochemical tests were carried out for identification, including catalase and coagulase tests for Gram-positive cocci, oxidase test for oxidase-positive Gram-negative bacilli such as Pseudomonas spp., urease test for Proteus spp. and Klebsiella spp., and triple sugar iron agar slants for enteric bacteria characterization.

For fungal isolates, identification was based on colony morphology on SDA and microscopic examination using lactophenol cotton blue (LPCB) preparation to detect hyphae, spores, and yeast cells. All culture media were prepared according to manufacturer guidelines and checked for sterility before use. Reference strains of Staphylococcus aureus ATCC 25923, Escherichia coli ATCC 25922, and Candida albicans ATCC 10231 were used as quality controls for biochemical and morphological confirmation.

Results

A total of fifty mobile phone samples from BSMS students of Nadha Siddha Medical College, Erode, were analyzed for microbial contamination. Growth was observed on all samples, indicating 100% contamination. A diverse range of bacterial and fungal organisms was isolated, comprising both commensal and potentially pathogenic species.

Among the bacterial isolates, *Staphylococcus aureus* was the most frequently encountered organism, followed by *Staphylococcus epidermidis*, *Escherichia coli*, *Klebsiella pneumoniae*, and *Pseudomonas aeruginosa*. Opportunistic Gram-negative bacilli such as *Proteus mirabilis* were also detected. The fungal isolates were predominantly *Candida albicans*, *Aspergillus niger*, and *Penicillium* spp.

The bacterial isolates displayed a range of colony morphologies and hemolytic patterns. *S. aureus* formed golden-yellow colonies with β-hemolysis on blood agar and was catalase-positive. *E. coli* produced pink colonies on MacConkey agar and exhibited a characteristic metallic sheen on eosin methylene blue agar. *K. pneumoniae* formed mucoid lactose-fermenting colonies, while *P. aeruginosa* produced green-pigmented colonies with a fruity odor and β-hemolysis. *P. mirabilis* was identified by its characteristic swarming motility on nutrient agar and urease-positive reaction.

Fungal isolates were identified by colony morphology and microscopic examination. *C. albicans* produced creamy white colonies with budding yeast cells, while *A. niger* formed black-spored filamentous colonies, and *Penicillium* spp. produced green-blue colonies with a velvety texture.

Table 1. Microorganisms isolated from mobile phones of medical students

Microorganism	Gram Reaction / Type	Key Features	Potential Source
Staphylococcus aureus	Gram-positive cocci	Golden-yellow colonies, β-hemolysis, catalase positive	Human skin, hands
Staphylococcus epidermidis	Gram-positive cocci	White colonies, γ-hemolysis, catalase positive	Normal skin flora
Escherichia coli	Gram-negative rods	Lactose fermenter, metallic sheen on EMB	Fecal contamination
Klebsiella pneumoniae	Gram-negative rods	Mucoid colonies, lactose fermenter	Respiratory tract, feces
Pseudomonas aeruginosa	Gram-negative rods	Green pigment, fruity odor, β-hemolysis	Environmental sources
Proteus mirabilis	Gram-negative rods	Swarming motility, urease positive	Human gut, soil
Candida albicans	Yeast	Creamy white colonies, budding cells	Skin, mucosal surfaces
Aspergillus niger	Filamentous fungi	Black spores	Airborne spores
Penicillium spp.	Filamentous fungi	Green-blue colonies	Airborne spores

Overall, the results indicate that mobile phones of medical students harbor a complex microbiota consisting of normal skin flora, opportunistic pathogens, and potentially pathogenic organisms. The isolation of fecal indicator organisms such as *E. coli* and opportunistic pathogens like *P. aeruginosa* highlights the risk of cross-contamination and possible transmission of healthcare-associated infections through these devices.

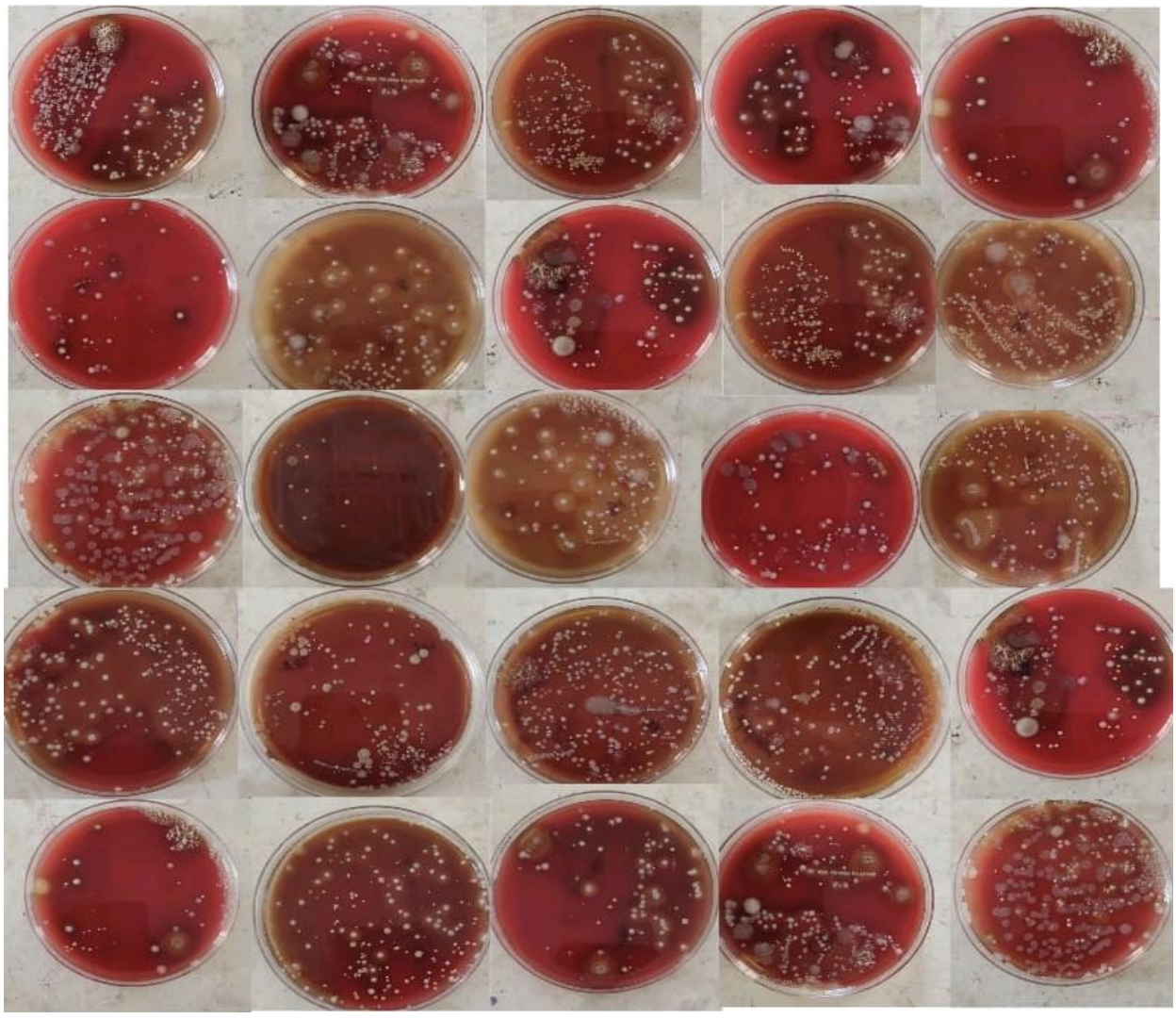

Figure 1. Representative blood agar culture plates showing bacterial and fungal growth from mobile phone swab samples

Discussion

The present study revealed that all mobile phones examined from BSMS students of Nadha Siddha Medical College, Erode, were contaminated with microorganisms, highlighting the ubiquity of microbial colonization on personal handheld devices. The isolates comprised both commensal skin flora, such as *Staphylococcus epidermidis*, and potentially pathogenic organisms, including *Staphylococcus aureus*, *Escherichia coli*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, and *Proteus mirabilis*. Fungal isolates, including *Candida albicans*, *Aspergillus niger*, and *Penicillium* spp., were also detected. The high prevalence of contamination underscores the potential of mobile phones to serve as fomites in healthcare and educational environments.

The predominance of *S. aureus* in our findings is consistent with previous reports, where it has been identified as the most common bacterial contaminant on mobile phones used by healthcare workers and medical students (18,19). In a study conducted in Nigeria, *S. aureus* was isolated from 47% of mobile phones of healthcare personnel (20), while Kumar et al. (2019) reported a prevalence of 53% among medical students (21). The presence of MRSA-suspected strains, as observed in our study, poses an additional concern given their role in healthcare-associated infections and limited treatment options (22).

The detection of *E. coli* and *K. pneumoniae* indicates possible fecal contamination and poor hand hygiene practices among users. Similar findings were reported in a study from Ethiopia, where *E. coli* was isolated from 29.4% of sampled phones (23). These enteric bacteria can be transmitted through inadequate handwashing after restroom use and can persist on phone surfaces for prolonged periods, facilitating their spread (24).

Environmental organisms such as *P. aeruginosa* and *Proteus mirabilis* were also recovered. These opportunistic pathogens are known to cause infections in immunocompromised individuals and have been frequently isolated from hospital environments (25). Our findings align with Brady et al. (2007), who demonstrated that mobile phones in surgical wards harbored similar Gram-negative opportunists (26).

The isolation of fungi, particularly *Candida albicans*, *Aspergillus niger*, and *Penicillium* spp., corroborates earlier work by Pal et al. (2013), who reported fungal contamination in 22% of mobile phones from healthcare settings (27). Fungal spores, especially from *Aspergillus* and *Penicillium*, are airborne and can easily settle on device surfaces, posing a potential risk to immunocompromised patients (28).

The overall contamination rate in our study (100%) is comparable to findings from other countries, where rates between 94% and 100% have been documented (29,30). Several factors contribute to this high prevalence, including frequent handling of phones during clinical activities, infrequent cleaning, and use in environments with high microbial load. Notably, the use of mobile phones in wards and outpatient departments without prior disinfection increases the likelihood of pathogen transfer between healthcare providers and patients (31).

Public health implications are significant. Given that medical students regularly move between hospital wards, classrooms, and community settings, their mobile devices can act as vectors, transferring microorganisms across different environments. Studies have shown that simple interventions, such as regular disinfection of mobile phones using alcohol-based wipes, can significantly reduce bacterial load (32,33). Moreover, implementing educational programs that emphasize the importance of device hygiene could help mitigate risks (34).

Limitations of the present study include its relatively small sample size, lack of molecular identification methods, and absence of antimicrobial susceptibility testing. Future research should incorporate larger, multicenter cohorts, employ molecular typing for precise species identification, and evaluate the prevalence of antibiotic-resistant organisms on mobile devices (35).

In summary, our study supports existing evidence that mobile phones are significant reservoirs of microorganisms, including potential pathogens, and emphasizes the need for incorporating device hygiene into routine infection control practices among medical students.

References

1. Statista. Number of mobile subscriptions worldwide from 1993 to 2023. Statista; 2023.
2. Bhardwaj N, Joshi R, Gupta A. Mobile phones: A modern technology device for communication and its microbial contamination. *J Clin Diagn Res*. 2015;9(7):DC05–DC08.
3. Ulger F, Esen S, Dilek A, Yanik K, Gunaydin M, Leblebicioglu H. Are we aware how contaminated our mobile phones with nosocomial pathogens? *Ann Clin Microbiol Antimicrob*. 2009;8:7.
4. Brady RRW, Fraser SF, Dunlop MG, Paterson-Brown S, Gibb AP. Bacterial contamination of mobile communication devices in the operative environment. *J Hosp Infect*. 2007;66(4):397–8.
5. Pal P, Roy A, Moore G, Muzslay M, Lee E, Alder S, et al. Keypad mobile phones are associated with a significant increased risk of microbial contamination compared to touch screen phones. *J Infect Prev*. 2013;14(2):65–8.
6. Tagoe DN, Gyande VK, Ansah EO. Bacterial contamination of mobile phones: When your mobile phone could transmit more than just a call. *Webmed Central Microbiology*. 2011;2(10):WMC002294.
7. Kilic IH, Ozaslan M, Karagoz ID, Zer Y, Davutoglu V. The microbial colonisation of mobile phone used by healthcare staffs. *Pak J Biol Sci*. 2009;12(11):882–4.
8. Kramer A, Schwebke I, Kampf G. How long do nosocomial pathogens persist on inanimate surfaces? A systematic review. *BMC Infect Dis*. 2006;6:130.
9. Chawla K, Mukhopadhayay C, Gurung B, Bhate P, Bairy I. Bacterial ‘cell’ phones: Do cell phones carry potential pathogens? *Online J Health Allied Sci*. 2009;8(1):8.
10. Ulger F, Esen S, Leblebicioglu H. Mobile phones as fomites in the hospital setting. *Ann Clin Microbiol Antimicrob*. 2015;14:43.
11. World Health Organization. Report on the burden of endemic health care-associated infection worldwide. WHO Press; 2011.
12. Ramesh J, Carter AO, Campbell MH, Gibbons N, Powlett C, Moseley H, et al. Use of mobile phones by medical staff at

Queen Elizabeth Hospital, Barbados: Evidence for both benefit and harm. *J Hosp Infect*. 2008;70(2):160–5.

13. Mark D, Leonard C, Breen H, Graydon R, O'Gorman C, Kirk S. Mobile phones in clinical practice: Reducing the risk of bacterial contamination. *Int J Clin Pract*. 2014;68(9):1060–4.
14. Bhat SS, Hegde SK, Salian S. Potential of mobile phones to serve as a reservoir in spread of nosocomial pathogens. *Online J Health Allied Sci*. 2011;10(2):14.
15. Goldblatt JG, Krief I, Haller D, Milloul V, Sixsmith DM, Srugo I, et al. Use of cellular telephones and transmission of pathogens by medical staff in New York and Israel. *Infect Control Hosp Epidemiol*. 2007;28(5):500–3.
16. Akinyemi KO, Atapu AD, Adetona OO, Coker AO. The potential role of mobile phones in the spread of bacterial infections. *J Infect Dev Ctries*. 2009;3(8):628–32.
17. Jeske HC, Tiefenthaler W, Hohlrieder M, Hinterberger G, Benzer A. Bacterial contamination of anaesthetists' hands by personal mobile phone and fixed phone use in the operating theatre. *Anaesthesia*. 2007;62(9):904–6.
18. Ulger F, Esen S, Dilek A, Yanik K, Gunaydin M, Leblebicioglu H. Are we aware how contaminated our mobile phones with nosocomial pathogens? Ann Clin Microbiol Antimicrob. 2009;8:7.
19. Kilic IH, Ozaslan M, Karagoz ID, Zer Y, Davutoglu V. The microbial colonisation of mobile phone used by healthcare staff. Pak J Biol Sci. 2009;12(11):882–4.
20. Akinyemi KO, Atapu AD, Adetona OO, Coker AO. The potential role of mobile phones in the spread of bacterial infections. J Infect Dev Ctries. 2009;3(8):628–32.
21. Kumar A, et al. Prevalence of bacterial contamination on mobile phones of medical students. J Clin Diagn Res. 2019;13(9):1–4.
22. Brady RRW, Fraser SF, Dunlop MG, Paterson-Brown S, Gibb AP. Bacterial contamination of mobile communication devices in the operative environment. J Hosp Infect. 2007;66(4):397–8.
23. Asfaw T, Genetu A, Yalew A. Bacterial contamination of mobile phones and associated factors among health care workers at the University of Gondar Hospital, Northwest Ethiopia. BMC Res Notes. 2019;12:426.
24. Kramer A, Schwebke I, Kampf G. How long do nosocomial pathogens persist on inanimate surfaces? BMC Infect Dis. 2006;6:130.
25. Chawla K, Mukhopadhayay C, Gurung B, Bhate P, Bairy I. Bacterial 'cell' phones: Do cell phones carry potential pathogens? Online J Health Allied Sci. 2009;8(1):8.
26. Brady RRW, et al. Mobile phone technology and hospitalized patients. J Hosp Infect. 2011;77(4):331–5.
27. Pal P, Roy A, Moore G, Muzslay M, Lee E, Alder S, et al. Keypad mobile phones are associated with a significant increased risk of microbial contamination compared to touch screen phones. J Infect Prev. 2013;14(2):65–8.
28. Denning DW, et al. The burden of fungal disease in the UK. Eur J Clin Microbiol Infect Dis. 2011;30(9):1123–9.
29. Tagoe DN, Gyande VK, Ansah EO. Bacterial contamination of mobile phones: When your mobile phone could transmit more than just a call. WebmedCentral Microbiology. 2011;2(10):WMC002294.
30. Jeske HC, Tiefenthaler W, Hohlrieder M, Hinterberger G, Benzer A. Bacterial contamination of anaesthetists' hands by personal mobile phone and fixed phone use in the operating theatre. Anaesthesia. 2007;62(9):904–6.
31. Goldblatt JG, Krief I, Haller D, Milloul V, Sixsmith DM, Srugo I, et al. Use of cellular telephones and transmission of pathogens by medical staff in New York and Israel. Infect Control Hosp Epidemiol. 2007;28(5):500–3.
32. Mark D, Leonard C, Breen H, Graydon R, O'Gorman C, Kirk S. Mobile phones in clinical practice: Reducing the risk of bacterial contamination. Int J Clin Pract. 2014;68(9):1060–4.
33. Trivedi HR, Desai KJ, Trivedi LP, Malek SS, Javdekar TB. Role of mobile phone in spreading hospital acquired infection: A study in different group of health care workers. Natl J Integr Res Med. 2011;2(3):61–6.
34. Bhat SS, Hegde SK, Salian S. Potential of mobile phones to serve as a reservoir in spread of nosocomial pathogens. Online J Health Allied Sci. 2011;10(2):14.
35. Odediran FA, et al. Mobile phone microbiome: An exploratory study among university students. J Appl Microbiol. 2020;129(4):1039–48.