Microbial Contamination and Mobile Phone Hygiene Awareness: A Study Among Medical Students at Universitas Pattimura

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Abstract: Mobile phones are widely used by medical students as communication and learning tools but may act as potential vectors for pathogen transmission. This study aimed to assess microbial contamination of mobile phones and the hygiene awareness of medical students at the Faculty of Medicine, Universitas Pattimura. This study involved 117 respondents. Data on phone hygiene practices were collected through a structured questionnaire, while swab samples from phone surfaces were cultured and evaluated semi-quantitatively for colony growth and morphology. Results showed that although most students acknowledged that microbes can live on mobile phones and considered phone hygiene important for health, their actual practices were suboptimal. Frequent behaviors included bringing phones into bathrooms, using them while eating, and rarely washing hands before use. Laboratory analysis revealed that all phone samples yielded microbial growth with diverse colony morphologies, indicating the potential presence of both bacterial and fungal contaminants. These findings highlight a gap between knowledge and behavior among medical students, emphasizing the need for targeted educational interventions to improve phone hygiene practices and reduce the risk of microbial transmission in healthcare settings.

1 INTRODUCTION

A large portion of the global population uses mobile phones (cell phones) due to their various applications and benefits, especially among students and healthcare professionals for fast communication and access to information. Mobile phones contribute to the education system, enabling distance learning across countries and reducing the use of paper-based materials. In addition to improving an individual's quality of life, mobile phones also serve as potential vectors for infection transmission, as they are ideal habitats for the colonization of microorganisms. Widespread mobile phone use, particularly among medical students and healthcare professionals in hospitals, laboratories, intensive care units, and operating rooms, can also contribute to the risk of nosocomial transmission of infections from patient to patient through contaminated hands, which can lead to high rates of mortality and morbidity in hospitals (Sadiq et al., 2021).

Mobile phones are frequently contaminated surfaces that people come into contact with every day because every square inch of a mobile phone screen contains about 25,000 germs (Sriprapun et al., 2022). The most common bacterial species found on mobile phone screens is *Staphylococcus aureus*, the number one pathogen causing nosocomial infections (Ratthawongjirakul & Thongkerd, 2016). In addition, mobile phones are confirmed to contain ten times more microorganisms than toilet seats because mobile phones are carried to many different places so they are easily contaminated with microorganisms (Ahmad et al., 2021).

Studies show that the most frequently isolated pathogens from mobile phones are Gram-positive bacteria including Coagulase negative *Staphylococci* (CoNS), *Staphylococcus aureus* (*S. aureus*), *Micrococcus* spp., *Bacillus* spp. and Gram-negative bacteria especially *Escherichia coli* (*E. coli*), *Proteus* spp., *Pseudomonas aeruginosa* (*P. aeruginosa*), *Klebsiella* spp., *Acinetobacter* spp. (Bodena et al., 2019). In addition to being a habitat for bacterial pathogens, mobile phones have also been implied as a potential risk factor for contamination with viral pathogens such as Severe Acute Respiratory Syndrome Coronavirus (SARS–CoV), Middle East Respiratory Syndrome Coronavirus (MERS-CoV), metapneumovirus, Respiratory Syncytial Virus (RSV), influenza virus, rotavirus and norovirus (Kampf et al., 2020).

With the increasing intensity of mobile phone use, there are potential health risks that require attention, particularly related to microbial contamination. Previous research has shown that mobile phones can be an ideal medium for the growth of microorganisms, including pathogens that have the potential to cause infection. Medical students, as future medical professionals, should have a high level of awareness of hygiene and health aspects. However, numerous studies have shown that awareness of mobile phone hygiene remains low. Habits such as using mobile phones in public places, including classrooms and laboratories, can increase the risk of microbial spread, which in turn can affect the health of individuals and those around them.

The urgency of this research lies in the need to understand the distribution patterns of microbes on medical students' mobile phones and their level of

awareness of the importance of maintaining mobile phone hygiene. The results are expected to provide insight into habits and behaviors that potentially contribute to microbial contamination, as well as educate students about good hygiene practices. By identifying factors that influence mobile phone hygiene, this study aims not only to increase hygiene awareness among students but also to contribute to infection prevention efforts in medical settings. The results of this study are expected to form the basis for the development of more effective health education programs and the implementation of better hygiene practices among medical students.

2 METHOD

This study was a descriptive observational study. This study aims to describe the contamination of microorganisms on the surface of mobile phones of students of the Faculty of Medicine, Pattimura University and the profile of their mobile phone usage behavior.

This research was conducted at the Faculty of Medicine, Pattimura University, Ambon, in August 2025. The study population: all students of the Faculty of Medicine, Pattimura University who agreed to participate. A total of 117 student cell phones were included as the study sample. The sampling technique used was consecutive sampling.

Data were obtained in two ways: (1) taking swabs from the surface of students' cell phones using sterile cotton, then planting them in a microorganism growth medium to identify any contamination, and (2) completing a questionnaire regarding the cell phone usage behavior of the students concerned. In this study, the swab results were not paired individually with the questionnaire so that the analysis carried out was descriptive.

3 RESULTS AND DISCUSSION

The results of the questionnaire showed that most students at the Faculty of Medicine, Pattimura University, have cell phone usage habits that have the potential to increase the risk of microbial contamination. Some prominent behavioral factors include the habit of taking mobile phones into the bathroom and placing them in various, less-than-clean places (Table 1). Furthermore, some students still use their phones while eating, rarely wash their hands before touching their phones, and frequently lend their phones to others. These factors indirectly create opportunities for the transfer of microorganisms from the environment and individuals to the surface of the phone.

In terms of awareness, most respondents stated they were aware that microbes can live on the surface of mobile phones and believed that mobile phone cleanliness was important for health. However, a gap was evident between this level of knowledge and daily practice. Although students were aware of the potential for contamination, not all of them regularly and correctly cleaned their phones. Cleaning methods also varied, from simply wiping with a cloth to using cleaning fluids, but most did not meet standards that effectively kill microorganisms. This emphasizes that increasing hygiene awareness needs to be accompanied by education on correct and consistent mobile phone cleaning practices.

Table 1. Characteristics and Hygiene-Related Behaviors of Respondents (n = 117)

Variable	Category	n
Age (years)	17	18
	18	26
	19	48
	20	16
	21	7
	Not specified	2
Year of Study	2nd year	105
	3rd year	11
	4th year	1
	5th year	0
Duration of Mobile Phone Use	< 1 month	0
	1 month – 1 year	25
	>1 year – 2 years	30
	>2 years	62
Phone Placement/Storage	Pants pocket	44
	Inside a bag	48
	On the table	21
	Anywhere	1
	Bed	2
	Held in hand	1
Bringing Phone to Bathroom	Yes	48
	No	69
Using Phone While Eating	Yes	94
	No	23
Frequency of Phone Cleaning	Daily	22
	Weekly	39
	Monthly	44
	Never	12
Phone Cleaning Method	Wipe on clothes	22
	Dry tissue	70
	Antibacterial wet tissue	21
	Hand sanitizer	3
	Never cleaned	1
Aware Microorganisms Can Live on Phones	Yes	96

Variable	Category	n
	No	21
Believe Phone Cleanliness is Important	Yes	114
	No	3
Handwashing Before Using Phone	Always	6
	Sometimes	54
	Rarely	40
	Never	17
Lending Phone to Others	Yes	57
	No	60
Sneezing/Coughing Before Touching Phone	Yes	96
	No	21

Laboratory test results on mobile phone swab samples support the questionnaire findings, where all samples showed the growth of microorganism colonies, both bacteria and fungi (Figure 1). Furthermore, each colony, both bacterial and fungal, exhibited diverse morphological features, including color, shape, and size (Figure 2).

These findings align with previous research that suggests that mobile phones are frequently in contact with hands and the environment, making them susceptible to microbial contamination. A study by Dubljanin et al., (2022) found fungal contamination on 32.11% of medical students' mobile phones, suggesting a link between mobile phone cleanliness and the risk of contamination. More broadly, Olsen et al., (2021) metagenomic study identified thousands of microbes, including bacteria, fungi, viruses, and even protozoa, on medical personnel's mobile phones, along with antibiotic resistance genes and virulence factors, suggesting that mobile phones could be a serious reservoir for pathogens.

Bacterial colony morphology is influenced by various factors (Doh et al., 2019), including environmental conditions, genetic determinants, and physiological conditions. These factors can result in diverse colony shapes and structures, which are not only important for bacterial identification but also have implications for understanding bacterial behavior and adaptation. Furthermore, bacterial colony morphology can also be influenced by nutrient availability, physical stress, genetic expression, and environmental interactions, each of which contributes to the unique characteristics observed in different bacterial species. Similar to bacteria, fungal colonies are influenced by complex interactions between genetic, environmental, and physiological factors. These factors allow fungi to adapt to a wide range of conditions, which influence their growth, survival, and pathogenicity (Kowalski & Cramer, 2020).

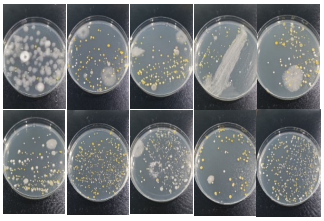

Figure 1. Representation of the results of microbial isolation from mobile phones

The diversity of microorganisms isolated from mobile phones is influenced by several factors, including the environment in which the phone is used, the user's hygiene practices, and the frequency and manner of phone use. Mobile phones serve as reservoirs for a wide variety of microorganisms, including bacteria, fungi, viruses, and bacteriophages, which can vary significantly based on these factors. Public telephones tend to have higher microbial loads than private phones due to the high number of users and diverse environments. For example, public telephones in business centers exhibit a higher diversity of microorganisms than private phones, which are typically used by a single user (AlOmani et al., 2020). Mobile phones used in healthcare settings are exposed to a wider spectrum of microorganisms, including antibiotic-resistant strains, due to the hospital environment and the nature of medical work.8 Cleaning frequency also significantly impacts microbial diversity.

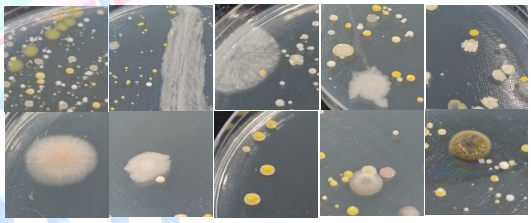

Figure 2. Morphological diversity of microbes from mobile phones

AlOmani et al (2020) in their study found that the majority of users never clean their mobile phones, which leads to higher levels of contamination. Regular cleaning can reduce the number and diversity of microbes . The hygiene of mobile phone users also plays an important role. Poor hand hygiene can lead to higher levels of contamination on mobile phones, as hands are the main vector for the spread of microorganisms on mobile phone surfaces (Martina et al., 2019). The way mobile phones are used, such as using them in the bathroom or while eating, can carry various microorganisms. A study noted that 46% of healthcare workers use their mobile phones in the bathroom, which contributes to microbial diversity (Olsen et al., 2022). While the factors mentioned above contribute to the diversity of microorganisms on mobile phones, it is important to consider the broader implications of these findings. The presence of diverse and potentially pathogenic microorganisms on mobile phones highlights the need for improved hygiene

practices and routine decontamination to prevent the spread of infections.

4 CONCLUSIONS

The results of the study showed that although the level of student knowledge regarding the potential for microbial contamination on mobile phones was quite good, the hygiene practices carried out were still not optimal. Most respondents have habits that can increase the risk of contamination, such as taking their cell phones to the bathroom, using them while eating, infrequent hand washing, and not routinely cleaning their phones effectively. Laboratory swab results support these findings, as all samples showed the growth of colonies of microorganisms (both bacteria and fungi) with diverse morphologies. Therefore, it can be concluded that less hygienic mobile phone usage behavior is closely related to high levels of microbial contamination on students' mobile phones.

REFERENCES

Ahmad, Q., Zubair, F., Ameena, Asif, A., Khan, J. K., & Imran, F. (2021). Microbial contamination of mobile phone and its hygiene practices by medical students and doctors in a tertiary care hospital:A cross-sectional study. *Computer Methods and Programs in Biomedicine Update*, *1*(October), 100038. https://doi.org/10.1016/j.cmpbup.2021.100038

AlOmani, M. A., Anwer, R., Sandoqa, A. M., Alshareef, F. G., Almuzayrie, A., Alluhadan, O., AlShammari, A. A., Alghamdi, M. A., Almarri, F. K., & Abdulrahman, K. Bin. (2020). Elucidation of practices of mobile phone hygiene and identification of the microorganisms: A perspective study from riyadh, Saudi Arabia. *Journal of Pure and Applied Microbiology*, *14*(3), 1761–1768. https://doi.org/10.22207/JPAM.14.3.14

Bodena, D., Teklemariam, Z., Balakrishnan, S., & Tesfa, T. (2019). Bacterial contamination of mobile phones of health professionals in Eastern Ethiopia: Antimicrobial susceptibility and associated factors. *Tropical Medicine and Health*, *47*(1), 1–10. https://doi.org/10.1186/s41182-019-0144-y

Doh, I. J., Sturgis, J., Sarria Zuniga, D. V., Pruitt, R. E., Robinson, J. P., & Bae, E. (2019). Generalized spectral light scatter models of diverse bacterial colony morphologies. *Journal of Biophotonics*, *12*(12), 1–12. https://doi.org/10.1002/jbio.201900149

Dubljanin, E., Crvenkov, T., Vujčić, I., Grujičić, S. Š., Dubljanin, J., & Džamić, A. (2022). Fungal contamination of medical students' mobile phones from the University of Belgrade, Serbia: a cross-sectional study. *Scientific Reports*, *12*(1), 1–9. https://doi.org/10.1038/s41598-022-21118-2

Kampf, G., Todt, D., Pfaender, S., & Steinmann, E. (2020). Persistence of coronaviruses on inanimate surfaces and their inactivation with biocidal agents. *Journal of Hospital Infection*, *104*, 246–251.

Kowalski, C. H., & Cramer, R. A. (2020). If looks could kill: Fungal macroscopic morphology and virulence. *PLoS Pathogens*, *16*(6), 1–8. https://doi.org/10.1371/journal.ppat.1008612

Martina, P. F., Martinez, M., Centeno, C. K., Von Specht, M., & Ferreras, J. (2019). Dangerous passengers: Multidrug-resistant bacteria on hands and mobile phones. *Journal of Preventive Medicine and Hygiene*, *60*(4), E293–E299. https://doi.org/10.15167/2421-4248/jpmh2019.60.4.1283

Olsen, M., Nassar, R., Senok, A., Albastaki, A., Leggett, J., Lohning, A., Campos, M., Jones, P., McKirdy, S., Tajouri, L., & Alghafri, R. (2021). A pilot metagenomic study reveals that community derived mobile phones are reservoirs of viable pathogenic microbes. *Scientific Reports*, *11*(1), 1–11. https://doi.org/10.1038/s41598-021-93622-w

Olsen, M., Nassar, R., Senok, A., Moloney, S., Lohning, A., Jones, P., Grant, G., Morgan, M., Palipana, D., McKirdy, S., Alghafri, R., & Tajouri, L. (2022). Mobile phones are hazardous microbial platforms warranting robust public health and biosecurity protocols. *Scientific Reports*, *12*(1), 1–15. https://doi.org/10.1038/s41598-022-14118-9

Ratthawongjirakul, P., & Thongkerd, V. (2016). Fresh garlic extract inhibits Staphylococcus aureus biofilm formation under chemopreventive and chemotherapeutic conditions. *Songklanakarin Journal of Science and Technology*, *38*(4), 381–389.

Sadiq, T., Arikan, A., Sanlidag, T., Guler, E., & Suer, K. (2021). Big concern for public health: Microbial contamination of mobile phones. *Journal of Infection in Developing Countries*, *15*(6), 798–804. https://doi.org/10.3855/jidc.13708

Sriprapun, M., Atthakorn, O., & Phuakwilai, A. (2022). The prevalence of bacterial contamination on mobile phones of pharmacy university students. *Pharmaceutical Sciences Asia*, *49*(4), 356–363. https://doi.org/10.29090/psa.2022.04.22.084