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Microbial Contamination of Mobile Phones Amongst Pharmacy Students in Gombe State University

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ABSTRACT

Mobile phones are becoming a necessary component of everyday life and are frequently taken into various places where they may harbor harmful bacteria. Studies have indicated that cell phones act as harbors for a variety of microbes. This investigation examined the bacterial contamination on phones of GSU's Faculty of Pharmaceutical Sciences in Nigeria 200level pharmacy students. A random sample of one hundred (100) student mobile phones were utilized to collect demographic data and other pertinent data using a semi-structured questionnaire. The data indicates that 80% of students share their phones, 81% do not clean them every day, 73% use microfiber cloths, 13% wash their hands before using them, 11% use hand sanitizers before using them, and 24% use their phones while using the restroom. Standard microbiological techniques were used to analyze the samples, and isolates were obtained by swabbing them on differential agar surfaces. We isolated three different types of microorganisms: 63% gram-negative bacteria strains, 39% *Staphylococcus aureus*, and 1% *Aspergillus niger*. Antibiotics susceptibility testing conducted on the isolates obtained shows that majority of them are resistant to antibiotics. The findings also indicate that male students' mobile phones have a higher level of contamination than those of female students.

Keywords: Mobile phones, Contamination, Microorganisms, Microbial Culture media.

INTRODUCTION

1982 saw the development of the global framework for mobile phones and telecommunication in Europe in an effort to create an efficient channel of communication. Asia has the fastest-rising mobile phone subscriber population in the world today. Based on RFE/RL's (2012) report, over 75% of adult individuals worldwide possess a cell phone. According to the most recent report, 90.7% of Nigerians use mobile phones for Internet access and communication, which has a significant impact on how people communicate, obtain information, and live their lives in general (Data Reportal, 2024).

According to predictions, there will be 7.1 billion mobile users worldwide in 2021, and by 2025, there will likely be 7.49 billion people worldwide. 86–94% of people of both genders under 65 who use a cell phone are projected to be teens in Europe and Asia, accounting for 90% of the total. Mobile phones are becoming an essential part of our social and professional lives, and the number of students using them has been steadily rising. In the classroom, mobile phones facilitate more communication and information sharing, which speeds up and improves the effectiveness of the learning process. Mobile phones are typically handled frequently and held close to the face. They are also typically kept in bags or pockets.

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Surface of commonly used mobile phones could be contaminated by microbes, Factors contributing to the transmission of contagious microbes, are survival time of the microorganisms on non-living surfaces and objects, poor disinfection habit of commonly used devices and/or poor hand hygiene among individuals has played a significant role in the transmission (Reynolds *et al*., 2019). The persistence of microorganisms is known to be associated with the environmental conditions such as temperature, humidity, presence of organic substances, and the ability to produce biofilms (Schulze *et al.,* 2021).

Additional assistance is provided by mobile phones and other devices for a number of tasks, such as information sending and receiving, internet access, and sharing of hard copy and soft copy files, audio files, photos, and so forth. These products are used in a variety of settings where people engage in social and non-social activities, such as workplaces, restrooms, kitchens, event spaces, hospitals, and marketplaces. These settings are all rife with pathogenic microbes that can injure or sicken people (El-Manama *et al*., 2015). Additionally, research have revealed that isolated bacteria from mobile phones are multi drug resistance species (Kaiki *et al*., 2020). In Ethiopia research has been carried out and it was found out that 69.9% bacterial isolates are multi drug resistant (Bodena *et al*., 2019). Hence, contaminated mobile phones, being one of the most highly touched surfaces serve as a reservoir for organisms and may play a significant role in the spread of microbes in the community (Ulger *et al*., 2015).

In contrast to other immobile items (fomites), mobile phones provide a greater threat since they are very hard to clean of viruses and other pathogenic microorganisms and easily allow the spread of these infections from person to person, object to person, and facility to person (Ulger et al., 2015). According to Al-Ghamdi *et al*. (2011), a significant portion of mobile phone users are unaware of the microbial load present on their device as well as on many commonplace items in their homes and workplaces.

Mobile phone is one of the most widely used gadget amongst students in tertiary institutions in Nigeria (Ozdalga *et al*., 2012) and this therefore increases the chances for cross contamination amongst the students and individual within the school setting (Ulger *et al*.,2015). Mobile phones have contributed massively in our day to day activities and are majorly used where there is a large number of microbial load. Therefore, serious measures must be taken in our day to day activities like proper washing of hands and cleaning of phones with disinfectant against microbial contamination (Arora *et al.,* 2009).

With our unaided eyes, we can plainly see the dust that frequently settles on cell phones, but we cannot see the microorganisms that could live there. The amount of germs on food vendors' and marketers' phones was found to be highly contaminated in a 2009 study by Akinyemi and colleagues.

Microbiologist have ascertained that the frequent usage of mobile phones and the heat generated by these phones creates a flourishing breeding ground for all sorts of microorganisms that are normally found on our skin surface (Brady *et al*., 2006). Numerous studies have revealed that because people frequently touch mobile phones, they are among the most prevalent devices that are home to a large number of germs (Rogo and Kawo, 2005). More microbial contamination of mobile phones results from carrying phones in bags or pockets as well as near the mouth, ear, eye, and nose, areas where microbial colonization is thought to be significant. Research has indicated that a variety of surfaces, including human skin or hands,

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phone pouches, bags, pockets, the environment, and food particles, can contaminate mobile phones. These are pathways that microorganisms can use to invade the phone and cause illnesses ranging from mild to severe. Despite originating from normal flora, the bacteria that have been isolated thus far by various health researchers have the ability to induce opportunistic infections (Soto *et al*., 2006).

MATERIALS AND METHODS

Collection and Enumeration of Microorganisms

A total of 100 samples were collected from both the male and female students using a sterile swab stick. Data were collected using a self-administered questionnaire to assess the students' awareness on microbial contamination of mobile phones. The sterile swab sticks were dipped in sterile normal saline and rotated firmly over the whole surfaces of the mobile phones. (Sadiq *et al*., 2021). The swab stick was then transfer into a bottle containing buffered peptone water where it was left for 24 hours at 37 °C and observed for turbidity. Using a sterilized wire loop, a portion was taken from the bottle and inoculated on to different agars (MAC, MSA, and PDA) immediately and incubated at 37°C for 24 to 48 hours for bacterial culture and every day for seven days at 25 °C to check for growth on PDA for fungal growth. The isolated organisms were identified by conventional microbiological methods by growth of colony, colony characteristics, hemolysis formation and pigment production.

Culture Media Preparation

Buffered Peptone Water (BPW) Preparation

BPW was prepared by dissolving 20 grams dehydrated medium in 1000 ml of distilled water, resulting in concentrations of 0.1% and 1% peptone water, following the manufacturer's instructions. After thorough mixing in a conical flask, sealed with cotton wool covered in aluminum foil, the mixture was heated for complete dissolution and then autoclaved at 121°C for 15 minutes. This is a non-selective broth medium used as a primary enrichment growth.

MacConkey Agar (MAC) Preparation

Using a weighing balance, 49.53g of dehydrated MAC was weighed, followed by thorough mixing with 1000ml of distilled water in a conical flask. This mixture was then wrapped in aluminum foil and surrounded by cotton wool. The blend underwent heating in a water bath until the powder completely dissolved, achieving homogeneity. Following autoclaving for 15 minutes at 121°C, the medium cooled before aseptically pouring it into sterile Petri dishes and allowing it to solidify. For selective isolation of Gram-negative and enteric bacteria and differentiate them based on lactose fermentation.

Mannitol Bile Salt Agar (MSA) Preparation

The manufacturer's instructions to prepare the medium. It's recommended to use a readily available dehydrated powder from most culture media suppliers. Mix 11.1 grams of the powder with 100 ml of distilled water, sterilize by autoclaving at 121°C for 15 minutes, and let it cool. Ensure thorough mixing before placing it in a sterile petri dish and labeling it. Store it in a plastic bag at 2 to 8 degrees Celsius to prevent moisture loss; it remains usable for a few weeks if it looks normal. Avoid using it if any abnormalities appear, as they may indicate contamination or deterioration. The medium has a pH between 7.3 and 7.7 at room temperature. MSA is a selective medium used for isolating pathogenic staphylococci from samples

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Potato Dextrose Agar (PDA) Preparation

Suspend 39 grams in 1000 ml distilled water. Heat to boiling to dissolve the medium completely. Sterilize by autoclaving at 121°C for 15 minutes. Mix well before pouring. It is a versatile growing medium for fungi (yeast and molds).

Mueller Hinton Agar (MHA) Preparation

Suspend 38g of your Mueller Hinton agar powder in 1000ml of distilled water. Mix and dissolve them completely. Sterilize by autoclaving at 121°C for 15 minutes. Pour the liquid into the petri dish and wait for the medium to solidify. MHA is used to culture bacterial isolates and test of their susceptibility to antibiotics.

Eosin Methylene Blue (EMB) Agar Preparation

Suspend 36 grams in 1000 ml distilled water. Mix until the suspension is uniform. Heat to boiling to dissolve the medium completely. Sterilize by autoclaving at 121°C for 15 minutes. This is selective for gram-negative against gram- positive.

Salmonella Shigella Agar Preparation

Suspend 60 grams in 1000 ml distilled water. Heat to boiling to dissolve the medium completely. Do not autoclave. Mix well and pour into sterile Petri plates. A selective and differential medium for isolation of pathogenic enteric bacilli, particularly Salmonell, Shigella and Yersinia from samples.

RESULTS

Demographic Characteristics of Participating Students

A total of 100 students were recruited from 200level faculty of Pharmaceutical Sciences Gombe State University, Gombe. Figure 1 shows that there were more female than males. And Figure 2 shows the Demographic Characteristics of the students that participated in the research, i.e. how the students handled and maintained their mobile phones. 80% of the students shares their phones with others, 81% do not border to clean their phones, washing hand before using phone (13%), use hand sanitizer before using phone (11%), using of mobile phone in the rest room is 24% and hand washing after using toilet (91%).

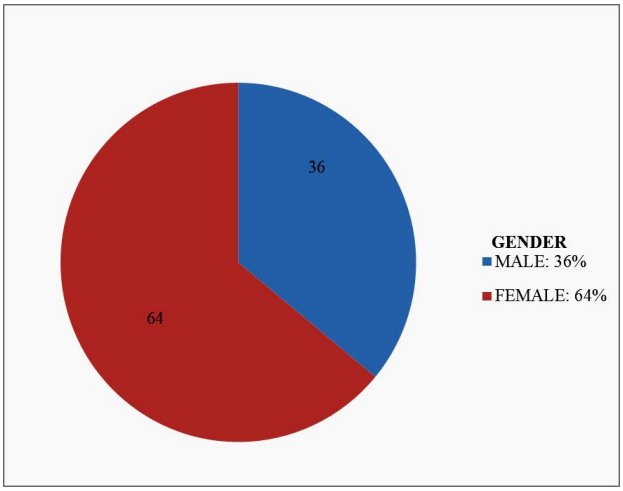

Figure 1: Distribution of Gender

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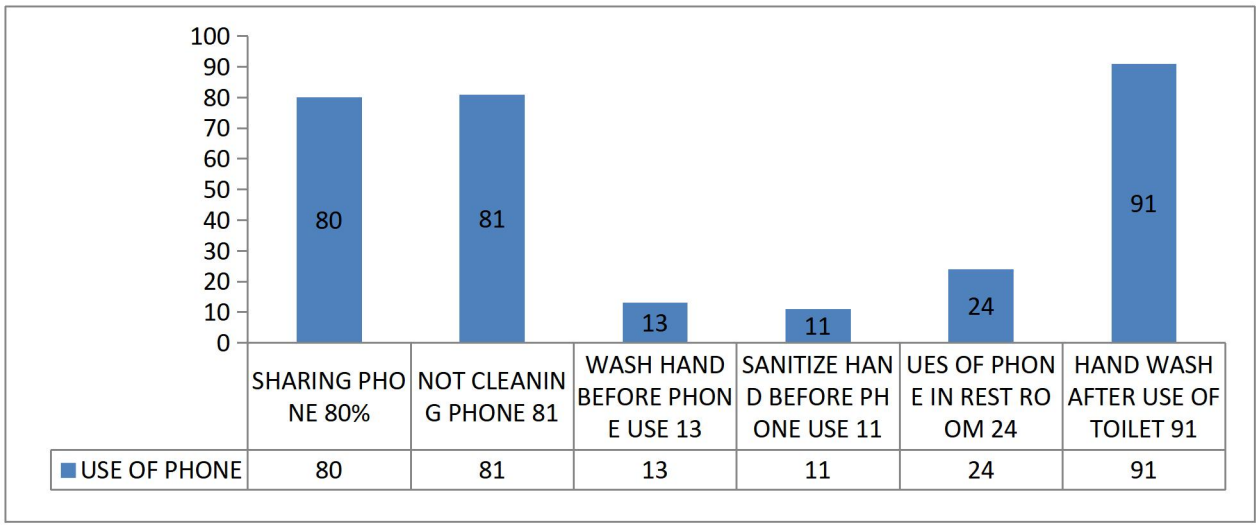

Figure 2: Summary of how students maintain their mobile phones

Colony Counts

Three (3) morphologically different microorganisms were isolated from the mobile phones of students in the faculty of Pharmaceutical Sciences.

The morphological characteristics of the isolates including shape and color was also observed. The color seen on the various plates include yellowish on Mannitol Salt agar which indicates *Staphylococcus aureus*, black on Potato Dextrose Agar which indicated *Aspergillus niger* and pink color on MacConkey agar indicate lactose fermenting species indicates gram-negative and enteric (normally found in the intestinal tract) bacteria based on lactose fermentation, examples of such organism are *Escherichia coli*, Enterobacter species and Klebsiella species.

Table 1 to 4 shows the results obtained upon swabbing the 100 mobile phones on the different microbial Medias. Out of which 63 plates showed growth on MacConkey agar, 39 on Mannitol Salt agar and only 1 growth was observed on the Potato Dextrose Agar.

Table 1: Results from MacConkey agar

Macconkey Agar	Total	Male	Female	Percentage (%)
Positive growth	63	34	29	63
Negative growth	37	07	30	37
Total	100			

Streaking of the positive results from the MacConkey agar on Eosin Methylene Blue (EMB) agar and Salmonella Shigella (SSA) agar, no growth was observed in any of the plates.

Table 2: Results from Mannitol Salt Agar

Mannitol Salt Agar	Total	Male	Female	Percentage (%)
Positive growth	39	20	19	39
Negative growth	61	23	38	61
Total	100			

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Table 3: Results from Potato Dextrose Agar

Potato Dextrose Agar	Total	Male	Female	Percentage (%)
Positive growth	01	01	00	01
Negative growth	99	99	00	99
Total	100			

Antibiotic Susceptibility Test of the Isolate

Antibiotic susceptibility testing was performed on some of the isolates. Some were found to be susceptible, others intermediate while others resistant to the antibiotics tested. This is shown in table 5 below.

Table 4: Antibiotics susceptibility test on some selected samples

Organism	AUG mm	CRO mm	C mm	TS mm	CIP mm	GM mm
Staphylococcus aureus	0 R	8 R	0 R	0 R	0 R	16 S
Staphylococcus aureus	0 R	17 R	8 R	0 R	22 I	18 S
Staphylococcus aureus	0 R	11 R	11 R	0 R	21 R	19 S
Staphylococcus aureus	0 R	0 R	6 R	0 R	0 R	15 S
Staphylococcus aureus	0 R	15 R	0 R	0 R	24 I	7 R
Staphylococcus aureus	0 R	17 R	0 R	0 R	0 R	16 S

Keys; S = susceptible, I = Intermediate and R = Resistant by the side of the number.
AUG = Augmentin, CRO = Ceftriaxone, C = Chloramphenicol, TS = Sulfamethoxazole and trimethoprim (Septrin), CIP = Ciprofloxacin, GM = Gentamicin

DISCUSSION

A total of 100 phone samples was collected from the participants of this exercise, from which microorganisms including strains of gram-negative bacteria, *Staphylococcus areus, Aspergillus niger* were able to be isolated. This is mainly because of the environment in which these thrive for example, nose, human skin, respiratory tract, damp building, soil, decaying vegetation, water, etc. More so, another reason could be as a result of poor personal hygiene habits that exposes humans to these organisms, and the use of this device poses danger to the user.

Some of these organisms demonstrates adaptability to different environmental conditions and can survive on surfaces for extended periods, increasing the chances of infection. Others demonstrates various forms of motility, including swimming, swarming, and twitching, which aid in colonization of diverse environments and host tissues and also exhibits high adaptability to stress conditions, such as low oxygen levels and exposure to antimicrobial agents, allowing them to survive and thrive in difficult condition.

Because people use their mobile phones constantly and take them everywhere, it's logical to assume that the phones could harbor the microbiota of their users as well as microorganisms from the surroundings. Additionally, worries have grown because mobile phones can serve as a breeding ground for pathogens and can spread both harmful and harmless microorganisms due to insufficient awareness and inadequate hand hygiene practices (Debnath *et al*., 2018; Chitlange, 2019).

Undergraduates frequently utilize their mobile devices for academic, leisure, and communication purposes, often in various settings. Our research revealed that health sciences students utilize their phones in microbiology labs. This usage in such location

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may transform phones into reservoirs and sources of both pathogenic and non-pathogenic microorganisms, potentially facilitating cross-contamination (Ulger *et al*., 2009).

The likelihood of cell phones transmitting microorganisms can be minimized by employing proper cleaning and disinfection methods (Jeske *et al*., 2007).

The male students tend to have a higher positive rate of contamination (70%) on their mobile phones and laptops compared to female students (30%) due to factors such as increased exposure to bacteria from activities like playing football and improper disinfection habit. A study conducted at Islamic University Gaza found a higher contamination rate on males' mobile phones (79%) compared to females (52%), with males also having a higher count range of bacteria. These findings align with research from Iraq, where males' personal mobile phones showed an 85% contamination rate compared to 80% for females (Auhim, 2013). This also corresponds to the findings obtained here upon the completion of this work.

Further study reveals that most of these organisms isolated from the mobile object are resistant to the antibiotics tested, hence the need to be cautious and protect to the barest minimum possible phone contamination and ensure safety to human lives.

CONCLUSION

In Conclusion, Mobile phones have become indispensable items for individuals and students alike, accompanying them wherever they go. Given their frequent use, the surfaces of mobile phones can harbor pathogens, potentially leading to the spread of infections, through hand contact they can become vectors for the transmission of different pathogen (e.g., *Staphylococcus and* Enterobacter species) causing urinary tract infections (UTIs). Fungi, and gram-negative and enteric (normally found in the intestinal tract) bacteria e.g. *Escherichia coli*, can enter the body and result in severe health issues like severe stomach cramps, bloody diarrhea and vomiting. While Klebsiella species can cause pneumonia, bloodstream infections, meningitis, and UTI. Hence, ensuring regular disinfection of phone surfaces and promoting awareness of proper hand hygiene are crucial steps in preventing the transmission of infections among the population.

From this study, it is recommended that microscopic examination based on gram staining and basic biochemical tests such as catalase, coagulase, and oxidase tests be carried out for each different colony for further identification. And the microbes isolated characterized and identified.

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