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Bacterial Contamination of Mobile Phones of University Students in Eastern Nigeria: Hand-Phone Hygiene Practices Among Students and Antibiogram of Bacterial Contaminants

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Abstract

Background: Mobile phones could be reservoirs of a wide variety of bacterial species/infections. The Community-acquired infections caused by bacteria have increased and thus there are public health concerns of mobile phone usage. The study was aimed at determining the hand-phone hygiene practices among Pharmacy students, incidence and antibiogram of bacterial contaminants of their mobile phones of Pharmacy students .

Method: A pretested, structured, self-administered questionnaire was used to collect data on the participant's demographics, knowledge, attitude and practice of hand-phone hygiene practices. The data collected were analyzed using Statistical Package for Social Sciences (SPSS-20) and presented as frequency and percentages response. Swabs of 240 students' mobile phones were taken; cultivated and bacterial isolates obtained were identified using standard microbiological methods. Antibiotic susceptibility studies were also done on the prevalent bacterial species using Kirby- Bauer disc method.

Result: There were 95 (39.6%) males and 145 (60.4%) females that participated in the study. Majority of the students 215 (89.6 %) use their phones when eating while few 25 (12.9 %) do not.. Most of the respondents 211 (87.91 %) knew that their mobile phones can serve as a means of infection transmission. However, only 50% of the respondents admitted cleaning their phones regularly. A total of 162 bacterial isolates were obtained from mobile phones sampled. Amongst the bacteria species were Staphylococcus aureus 25%, Klebsiella Pneumonia 20%, Escherichia coli 19%, Shigella spp 16%, Pseudomonas aeruginosa 16%, and Halo-tolerant Bacillius 6%.

Conclusion: Mobile phones harbor arrays of bacterial species and can serve as a means of community- acquired infection transfer. The most prevalent bacteria specie amongst the students was Staphylococcus aureus and the hand and phone hygiene practices among the students were poor.

Keywords: Mobile phones • Hand and phone hygiene • Antibiotic resistance • Bacteria species • Students

Introduction

Mobile phones have been established as the most widely used electronic device. Within 20 years, mobile phones have moved from being expensive and owned by the business elite to a low cost personnel and accessible item. The African market has the largest growth rate of cellular subscribers Infectious pathogens can be spread through mobile phones by constant handling of the phones and majority of the available phones are handheld [1].

Ibrahim et al, has shown that mobile phones are good breeding grounds for microorganisms. Microbes especially bacteria require warmth conditions for its proliferation and frequent use of mobile phones generates heat, making the phones warm and thus a conducive ground for the growth of microbes. Majority of bacteria species found on mobile phone surfaces are those of the normal flora

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of the skin and body, due to the constant contact with the hand and ear lobes. Normal skin flora mostly reported is Staphylococcus aureus. In addition, intestinal flora such as Escherichia coli has also been reported in some studies while oral pathogens like actinobacteria, proteobacteria have also been reported and can spread through aerosols and droplets released while breathing or talking into the phone mouthpiece. Many species are resistant to desiccant and can persist on phone surfaces for weeks with Gram negative bacteria usually persisting longer than their Gram positives [2].

Increasing incidence of community acquired infections is a public health threat. Thus there is need to screen for possible sources of contamination of the pathogens in the community. The study was conducted to determine the hand-phone hygiene practices among Pharmacy students, incidence and antibiogram of bacterial contaminants of their mobile phones [3].

Materials and methods

Study location, design and participants

This was a cross-sectional descriptive study, designed to assess the knowledge, attitude and practice of hand-Phone hygiene practices among Pharmacy students in Nnamdi Azikiwe University, Awka. A total of 240 students of the Faculty of Pharmaceutical Sciences, Nnamdi Azikiwe University, Agulu Campus were enrolled for the study. The sample size was obtained using the formula reported by Yamanu, The ethical approval was obtained from Anambra state ministry of Health (Ref.2019/05/B6) [4].

Data collection/Questionnaire study

Data collection was done using a pretested, structured, self-administered questionnaires which were given to the respondents in the classes and were collected thereafter. The questionnaire was used to collect data on the participant's demographics (age, gender, marital status), in addition to questions regarding their knowledge, attitude and practice to hand-phone hygiene practices. The key components of the questionnaire include: Assessments of the students' mobile phone usage, Knowledge on the transmission of germs through the mobile phones, the Hand-phone cleaning routinely practiced by the participants [5].

Sampling techniques: Collection and preparation of samples

Phone smear samples were collected from each participating student, using sterile swab sticks soaked in normal saline.

Isolation, purification and identification of test organisms

Samples collected were aseptically inoculated into a sterile media and incubated for 18-24 hours at 37°C. Using the Agar streaking method, the organisms were isolated using the followingmedia: Mannitol salt Agar for Staphylococcus and Bacillus species, Salmonella-Shigella Agar for Salmonella, Proteus and Shigella species, MacConkey agar for Escherichia coli and Klesbsiella spps. while Cetrimide agar was used to isolate Pseudomonas aeruginosa.

Distinct colonies from previously incubated plates were subcultured using a nutrient agar and pure cultures obtained. The isolates were identified by cultural, Gram staining and biochemical analysis as reported by Chessbrough .Organism successfully identified was cultivated using the agar slant and stored in the refrigerator maintained at 2°C - 8°C.

Antibiotic susceptibility studies

Antibiogram analysis was done using the Kirby Bauer disc diffusion method as described by Ugwu et al., Broth culture of each isolate was brought to 0.5McFarland standard and swabbed onto the surface of a Mueller Hinton agar. Antibiotic discs for the analysis were aseptically placed on the agar plate, allowed to infuse for an hour and then incubated at 37°C for 24 hours. The zone of inhibition diameter for each antibiotic was measured and interpreted as susceptible, resistance or intermediate according to the Clinical and Laboratory Standard Institute. Antibiotics used were Ceftazidine (CAZ), Cefixime (CXM), Augmentin (AUG), Cefuroxime (CRX), Ofloxacin (OFL), Gentamicin (GEN), Ceftriaxone (CTR), Erythromycin (ERY), Nitrofurantoin (NIT), Ciprofloxacin (CPR), Cloxacillin (COX).

Data analysis

The data collected were presented as frequency and percentagesresponse. Levelof statistical significance was set at 5%($p \leq 0.05$). Data were analyzedusing Statistical Package for Social Sciences (SPSS-20).

Results

Demographic proportions of the study Participants

For the study, undergraduate Pharmacy students of Nnamdi Azikiwe University, Awka were selected randomly from the different levels at Agulu Campus. There were 95 (39.6%) males and 145 (60.4%) females that participated in the study. Majority (99.6%) of the respondents were between 18-25 years (Table 1).

Questionnaire analysis: Assessment of student mobile phone usage

Variable indicators such as students degree of hand washing after visiting the rest room, use of mobile phones in rest rooms and while eating, cleaning / disinfection of mobile phones were assessed using a 4-point-Likert scale of 1. "Always", 2."Sometimes", 3."Rarelyor 4. "Never"). In addition, the students' mobile phone use, implementation of hand-phone hygiene practices and their awareness that mobile phones are potential sources of infection were also assessed.

	Proportion of respondents, n (%)			
Demographic variables	**200 L**	**300L**	**400L**	**500L**
Gender	40 (16.67 %)	43 (17.92 %)	32 (13.33 %)	26 (10.83 %)
Female	17 (7.08 %)	17 (7.08 %)	28 (11.67 %)	33 (13.75 %)
Male				
Age (years)	47 (19.58 %)	54 (22.50 %)	48 (20.00 %)	44 (18.33 %)

18-25	14 (5.83 %)	6 (2.50 %)	9 (3.75 %)	15 (6.25 %)
26-34	0	0	3 (1.25 %)	0
35 and above				
Marital status	58 (24.17 %)	57 (23.75 %)	56 (23.33 %)	54 (22.50 %)
Single	3 (1.25 %)	3 (1.25 %)	4 (1.67 %)	5 (2.08 %)
Married				
Religion	61(25.42 %)	60 (25.00 %)	60 (25.00 %)	58 (24.17 %)
Christianity	0	0	0	0
Muslim	0	0	0	1 (0.42 %)
Others				

Table1: Socio-demographic data.

Location of mobile phone use	**Home**	**Public/ private transport**	**School**	**Others**	**All of the above**
	13	4	20	0	206
Frequency of mobile phone use	Always	Often	Occasionally	Rarely	Never
	129	105	6	0	0
Washing of hands after phone use	Always	Often	Occasionally	Rarely	Never
	5	5	86	76	78
Use of mobile phones while eating	Always	Often	Occasionally	Rarely	Never
	44	71	63	62	0
Frequency of mobile phone use in restroom	Always	Often	Occasionally	Rarely	Never
	154	77	13	4	0

Table2: Assessment of students mobile phone usage and disinfection.

The frequency of respondents, n (%)		
Variable	YES	NO
Do you use your phone when eating?	215 (89.6 %)	25 (12.9 %)
Do you know your mobile phone can serve as a means of infection?	211 (87.91 %)	29 (12.1 %)
Do you use your mobile phone in the toilet?	190 (79.4 %)	50 (20.8 %)
Do you wash your hands after using the toilet?	239 (99.6 %)	1 (0.4 %)
Do you know mobile phones should be cleaned on a regular basis?	120 (50 %)	120 (50 %)
Do you think it is necessary to disinfect your mobile phones?	190 (78.8 %)	50 (20.67%)
Do you use hand sanitizers?	110 (45.8 %)	130 (54.2 %)
Do you think it is important for mobile phone users to own and use hand sanitizers regularly?	183 (76.3 %)	57 (23.8 %)

Table 3: Knowledge of mobile phone as a source of contamination and infection spread.

On the cleaning / disinfection of mobile phones, 25 respondents said they disinfect their phones while 215 do not. Of the 25 that disinfect their mobile phones occasionally, 56%, and 36% use methylated spirit and alcohol swabs respectively to clean their phone surfaces.

Knowledge of mobile phone as a source of microbial contamination

Two hundred and eleven respondents (87.91%)) respondents are well aware that mobile phones are potential sources of microbial contamination. In addition, 50% indicated that there is need to regularly clean or disinfect mobile phones. One hundred and eighty three (76.3%) respondents were of the view that every mobile phone user should own a hand sanitizer for regular disinfection of hands in order to minimize the risk of infection.

Microbial analysis of mobile phones of respondents

A total of 162 bacterial isolates were obtained from the mobile phones sampled. Amongst the bacteria species isolated were Staphylococcus aureus (S. aureus) 25%, Klebsiella pneumonia (K. pneumonia) 20%, Escherichia coli (E. coli) 19%, Shigella 16%, Pseudomonas aeruginosa (P. aeruginosa) 14%, and Halo-tolerant Bacillius 6%.

S. aureus had the highest prevalent rate of 17%, showing that at least one in every six mobile phones tested harbored the organism. Followed closely is K. pneumonia with 13.8% prevalence rate.

The two organisms with the highest prevalence (S. aureus and K. pneumonia) were subjected to antimicrobial susceptibiltiy testing. S.aureus showed susceptibiltiy up to 40% for three antibiotics, GEN (53%), OFL (47%), AUG (53%) with resistance to CTR (85%), ERY (67%), CRX (63%) and COX (60%). K. pneumonia isolates were resistant toCAZ (70%), CRX (70%), CXM (73%), AUG (63%) while up to 40% of the isolates were resistant to GEN, OFL and CPR at 42%, 51%, and 42% respectively.

The bacteria isolates with Mutli-Drug Resistant (MDR) traits were determined by their resistance to at least two antibiotics of different classes. From the result, 33 (55.5%) K. pneumonia and 8 (19.5%), of S. aureus were MDR species.

Discussion

Mobile phones are the most frequently owned and used electronic device by students. They are breeding grounds for infectious microorganisms in communities and hospitals. The frequent handling and the heat generated by the phones create a prolific breeding ground for all sorts of microorganisms.Studies on the extent of bacterial colonization of mobile phones will ensure adoption of preventive measures such as disinfection procedures and proper hand-phone hygiene practices.

This study revealed that 62% of the mobile phones of students as at the time of sampling were contaminated with bacteria. The finding is in line with Other reports from. All showed a higher rate of bacterial contamination except for Balapriya et al, that reported 24% in India.

S. aureus (25%), K. pneumonia (20%) and E. coli (19%) were the predominant isolates, followed closely by Shigella (16%) and P. aeruginosa (16%) in our study. Other studies in Nigeria such as that by Amala and Ejikema, and outside Nigeria reported similar bacterial isolates. Some other studies have reported organisms such as Acinetobacter spp and Micrococci spp.Although S. aureus is a commensal bacterium found on the skin and in nares ,pathogenic strains of S.aureus can cause a wide range of infections especially skin infections that can manifest in different forms In addition, S. aureus has been reported as an important agent of food poisoning.

E.coli isolates from mobile phones, showed a poor hand and mobile phone hygienic practices as well as poor toilet hygiene, as the organism is one of the intestinal flora and suggests faecal contamination of these phones .This can also be related to the responses collected from the students, which showed that greater number of the respondents (79.4 %) use their mobile phones in the restroom.

The presence of these microbial contaminants on the Mobile phone is a concern as its usage touches parts of the body (hands, face, ears, nose and lips) that are mostly common gateways for infection. The transferred contaminants can readily cause infections especially in people with immune-compromised status.

Ilusanya et al., reported that the important factors of contamination are the personal hygiene levels, location, possible number of users, frequency and duration of usage of the phone . Soto et al. had earlier reported that contamination of mobile phones is mostly through the hands, bags, cases, pockets, but can alsobe caused by the environment and food residues. Higher temperature and humidity generated by mobile phone makes it a perfect habitat and thus support bacterial growth and biofilm formation on the surface of the device. However, the pathogens in the biofilm may persist in infectious state for several weeks depending on the environmental conditions.

Isolation of Bacillius which are saprophytic and feed on dead organic matter, is in line with the finding that majority of respondents use their mobile phones (always or occasionally/ sometimes)while eating .Previously Bacillius spp were seen as an environmental contaminants rarely being associated with disease when recovered Currently Bacillus is termed an opportunistic pathogen that is gaining increasingly public health attention as a cause of severe infections in immune-compromised subjects.

There is an increasing prevalence of MDR bacteria globally and this is of public health concern. From the study, S. aureus and K. pneumonia isolates that were subjected to antimicrobial evaluation showed resistance to most of the antibiotics used for the study. MDR S. aureus and K. pneumonia were isolated from mobile phones tested this goes to show that mobile phones could increase the burden of bacterial infections except measures are taken to improve good mobile phone hygiene practices..It is our hope that cleaning the phones with disinfection wipes that contains active antimicrobial agents like chlorhexidine digluconate , triclosan etc and good hand hygiene practices will reduce the level of contamination of the mobile phones.

Conclusion

Mobile phones are potential sources of microbial contamination. Majority of the isolates subjected to antimicrobial susceptibility were resistant to cephalosporins (Cefuroxime, Ceftazidime and Cefixime) as well as Amoxicillin -clavulanic. Lack of hygiene such as occasional cleaning and disinfection of hands and mobile phones, use of mobile phones while eating or in the restroom were significantly associated with increased bacterial contamination of the mobile phones used in the current study.

Thus there is need to educate the populace on the need to maintain good personal hygiene as well as develop mobile phone guideline as these will help in curbing the spread of infectious pathogens.

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