Mobile Phones of Health Professions Students are reservoir of methicillin resistant *Staphylococcus aureus*

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Abstract
The contamination of mobile phones with antibiotic resistant bacteria is well documented. However, there is limited data on the rate of methicillin resistant *Staphylococcus aureus* (MRSA) contamination of mobile phones in Sokoto, Nigeria. The aim of this study was to determine the rate of contamination of mobile phones of health profession students of Usmanu Danfodiyo University with MRSA. A questionnaire was administered to collect demographic data and the health history of the recruited participants. Sterile swabs pre-moistened with sterile physiological saline were used to swab the surface of mobile phones of the participants. The collected samples were processed using standard microbiological techniques. The detection of MRSA was done using the oxacillin resistance screening agar base test (ORSAB). The susceptibility of the MRSA isolates to commonly prescribed antibiotics was carried out using the disc diffusion method. A total of 200 participants were recruited from medical and allied faculties. The participants comprise 142 clinical students and 58 pre-clinical students. The majority of the participants were males 121 (60.5 %). The mobile phones of 85 (42.5 %) of the study participant were contaminated with MRSA. The carrier rate was higher among the male (64.7%) and participants aged between 20-24 years (82.4%). The contamination was predominant among the clinical students (71.8%%). The isolates were resistant to most commonly used antibiotics. There is a high level of contamination of mobile phones of medical students of Usmanu Danfodiyo University Sokoto with MRSA. The finding of this study underscores the importance of hygiene practices in cell phone usage.

Keywords: MRSA, mobile phones, *Staphylococcus aureus*, medical student.

Introduction:
Mobile devices have become an indispensable part of human lives. It has emerged as a necessity for communication, entertainment, and educational purpose (Olu-taiwo *et al*., 2021). The applications of mobile devices are numerous but among the medical students, it is mostly used as a means of communication and a handy source of educational information (Mohan *et al*., 2021; Asongu and Nwachukwu, 2016).

As at July, 2021, 5.27 billion unique individuals use mobile phone for various purposes around the world (Digital Around The World, 2021; GSMA Intelligence, 2021). According to the Nigeria Communication Commission, around 192 million people currently has an active mobile phone in Nigeria (Nigerian Communication Commission, 2021).

On average, an individual touches their mobile phone more than 200 times a day. Several factors including the heat generated by the phones, readily available source of essential amino-acids and nutrients from shed skin, makes the surface of mobile phones an ideal environment for bacterial growth (Simmonds *et al*., 2019). The contamination of mobile phones with antibiotic resistant bacteria is well documented. For instance, the mobile phones of healthcare workers have been demonstrated to be contaminated with methicillin resistant *Staphylococcus aureus*, vancomycin resistant *Enterococci* and multidrug resistant Gram-negative bacteria (Simmonds *et al*., 2019; Spelman *et al*., 2018). The exposure of medical students to hospital environment during clinical

postings predisposes them to colonization and infections by antibiotic resistant bacteria including MRSA. This may further be disseminated to their non-medical colleagues sharing facilities with them in the university community and eventually into the larger society. Thus, underscoring the importance of proper infection control. While few studies have documented the contamination of mobile phones of medical students in Nigeria with MRSA, reliable data is generally lacking on this in Sokoto, Nigeria. In this short communication, we aimed to determine the rate of contamination of mobile phones of health profession students of Usmanu Danfodiyo University with methicillin resistance *Staphylococcus aureus*.

Materials and Methods:
Settings and study centre
This study was conducted among undergraduate students of medical and allied faculties (Pharmacy, Nursing, Medical Laboratory Science and Radiography) in Usmanu Danfodiyo University Sokoto (UDUS), Nigeria. Students of the faculties shared hostel facilities within the Usman Danfodiyo University Teaching Hospital (UDUTH) complex. The students are routinely posted on clinical posting from the third year of their study to observe and learn basic clinical skills within the teaching hospital. Ethical approval was obtained from the Sokoto State Ministry of Health.

Study design and participant recruitment
Participants were contacted for enrolment during the official working hour within the faculties, hostels and also by posting of flyers on social media platform (student WhatsApp group). The participants were adequately briefed on the objectives of the study and assured that the procedure for sample collection does not pose any hazard to their health. Those who consented willingly to participate in the study was included while those that declined consent were excluded from the study.

Data collection
A questionnaire was administered to collect demographic data and habitual character of the participants. Data collected include age, year of study, gender, hospitalization in the last three months, use of mobile phone in toilet, cleaning of mobile phone with any antiseptic solutions, hospital visitation history.

Sampling and sample collection
Convenient sampling technique was employed. Sterile swab moistened with sterile physiological saline was used to collect samples from the frequently touch surfaces of mobile phones of the participants. The collected samples were taken immediately to the Microbiology Laboratory of the Faculty of Pharmaceutical Sciences for culturing and further analysis.

Culturing, Isolation and identification
Each swab collected was inoculated into petri-dishes containing mannitol salt agar (Oxoid Limited, UK) and incubated at 37°C for 24 hours. Bacterial isolates that grew on the mannitol salt agar were subjected to Gram staining, catalase and coagulase tests as described (Cowan *et al*.,1993). The identity of the isolates was confirmed by Microgen™ Staph-ID System kit (Microgen, Surrey, UK). The *S. aureus* isolates were inoculated unto Oxacillin resistant screening agar (ORSAB) plate (Oxoid, UK) and the resultant isolates after overnight culture were regarded as MRSA as previously described (Correia *et al*., 2019).

Antibiotic susceptibility test
The isolates were subjected to antibiotic susceptibility using the disc diffusion method according to the Clinical and Laboratory Standards Institute (CLSI) guidelines (CLSI, 2019). The disc of antibiotics used includes those recommended by the CLSI and/or those most commonly used locally for empirical treatment of *S. aureus* infections. This includes amoxicillin-clavulanate (30µg), ciprofloxacin (5µg), gentamycin (30µg), chloramphenicol (30µg), azithromycin (15µg), trimethoprim/ sulphamethoxazole (25µg). Interpretation of results as susceptible, intermediate or resistant was carried out according to the criteria recommended by the CLSI guideline.

Statistical analyses
Statistical analysis was performed using SPSS v20 (IBM Corporation). Pearson's χ^2 test or Fisher's exact test was used for data comparison. At 95% confidence interval, $p<0.05$ was considered as statistically significant.

Result and Discussion
A total of 200 participants were recruited from medical and allied faculties. The participants were mainly male (60.5). The participants

comprised of 142 clinical students and 58 pre-clinical students. Overall, the mobile phones of 85 (42.5 %) of the study participant were contaminated with MRSA. The carrier rate was higher among the male (64.7 %). The contamination was predominant among the clinical students (71.8%%). Among the investigated risk factors, only the use of mobile phones in the toilet significantly correlated with the MRSA mobile phone contamination rate (Table 1). The isolates were highly resistant to the tested antibiotics. Resistance of all the isolates against the tested commonly prescribed antibiotics exceeded 90 % (Figure 1).

Table 1: Distribution of MRSA isolates based on the demographic and clinical characteristics of participants

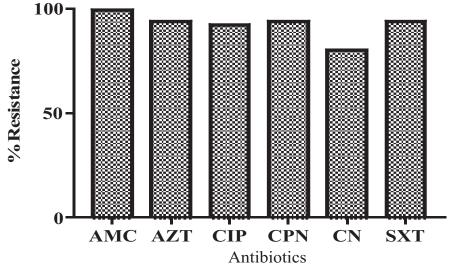| Variable	Total Number of Participants	Number of MRSA	Percentage
Overall prevalence	200	85	42.50
Gender			
Male	121	55	45.45
Female	79	30	37.97
Faculties			
Pharmacy	40	11	27.50
Medicine	40	25	62.50
Nursing	40	17	42.50
Radiology	40	15	37.50
Medical Laboratory Sciences	40	17	42.50
Level of study			
Clinical	142	61	42.96
Pre-clinical	58	24	41.38
More than four visits to hospital a month			
Yes	85	33	38.82
No	115	52	45.22
Antibiotic use in the past four weeks			
Yes	52	29	55.77
No	148	56	37.84
Hospitalization in the last three months			
Yes	6	3	50.00
No	194	82	42.27
Use of mobile phone in the toilet			
Yes	118	61	51.69
No	82	24	29.27
Cleaning of pho ne with antiseptic solutions			
Yes	39	18	46.15
No	161	67	41.61

Figure 1: Resistance profile of the isolates to commonly prescribed antibiotics

Key: AMC - amoxicillin-clavulanate; AZT - Azithromycin; CPN - chloramphenicol; CIP - ciprofloxacin; CN -Gentamicin; SXT-trimethoprim/sulfamethoxazole.

Discussion

Contamination of the mobile phones of medical students by microorganisms has been a source of great concern. In health care settings, these contaminated mobile phones can serve as a reservoir for the transmission of microbial infection. The high MRSA contamination rate (42.5 %) observed in this study correlates with result of several other studies in different regions of Nigeria (Nwankwo *et al*., 2014; Akinyemi *et al*., 2009). In Northeast Nigeria for example, a 45.46% contamination rate of mobile devise with MRSA has been reported (Chimbekujwo *et al.,* 2020).

In this study, we demonstrated that the mobile phones of students of faculties of Medicine and Nursing were more colonised by MRSA than the students of faculties of Pharmaceutical Sciences and Radiology. This is in line with result of a similar study conducted in Kogi state, Nigeria where an equalled higher contamination rate of mobile phones of nursing and medical staff has been reported (Nwankwo *et al*., 2014). Similarly, the mobile devices of clinical students were more contaminated with MRSA compared to the pre-clinical students. We opined that this may be due to longer exposure of medical and nursing students to hospital environment than their counterparts in other medical related faculties. This has serious implication on public health, as the MRSA contaminated mobile phones of these students can subsequently act as reservoirs and vector for the spread to MRSA naive populations within the community (Olsen *et al*., 2020). These students

should be taken into consideration when formulating and implementing hospital infection control policies. In addition, safe handling of mobile phones within and outside the hospital environment should be greatly encouraged, as most of the participants admitted to use of their mobile phones in restrooms and also not using antiseptic solution regularly for phone disinfection. Continuous visual reminders such as leaflets and posters about cell phone restrictions and hand hygiene can help reduce the rate of contamination. Personal hygiene should be strongly encouraged among the students, and the use of phones in toilets should be strongly discouraged. The hand should be washed properly before starting a meal and also after using the toilet.

The high resistance of the MRSA isolates (90 %) in this study is not surprising because MRSA isolates are known to be highly resistant to other antimicrobials. A 2018 systematic review on the susceptibility of MRSA isolates to commonly prescribed antibiotics revealed that the isolates were highly resistant to most orally available antibiotics (Abubakar and Sulaiman, 2018).

This study is limited mainly by the phenotypic nature of the tests. Molecular techniques such as polymerase chain reaction should be considered in future studies for confirmation of identity of the isolates and also for detection of antibiotic resistant determinants in the isolates. However, we succeeded in establishing a baseline data on the MRSA colonisation of mobile

devices of health profession students of the University. The high level of colonisation of the mobile devices underscores the importance of hygiene practices in cell phone usage.

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