Isolation and Susceptibility Profile of Bacteria isolated from Mobile Phones of Pharmacy Students of Ahmadu Bello University, Zaria, Nigeria

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Abstract: Today, mobile phone (MP) due to its great benefits has become an indispensable tool for people from all and sundry irrespective of profession, social status or location. However, MP can also serve as habitat for pathogenic bacteria. This study was aimed at isolating bacterial contaminants from mobile phones of some pharmacy students in Ahmadu Bello University, Zaria, Nigeria and to determine the antibiotics susceptibility pattern of such bacterial isolates. Twenty swabs were obtained from the MPs of 20 volunteered students, using standard biochemical methods of analysis, specific bacterial isolates were identified. Antibiotic susceptibility testing was carried out using Kirby Bauer disc agar diffusion method. The resistance pattern of the isolates was determined using descriptive statistical analysis. Multiple antibiotic resistance index (MARI) was also determined. A total of 35 bacterial isolates were gotten which were:*S. aureus* 19 (54.3%), *E. coli* 11 (31.4%), *Klebsiella pneumoniae* 3 (8.6), *Streptococcus* spp 2 (5.7%). The greatest activity was observed with the quinolones especially pefloxacin while the isolates were highly resistant to beta lactam antibiotics; 85.7% of the isolates had MARI greater than 0.2.All the MPs sampled were contaminated with pathogenic bacteria and showed high level of resistance to commonly prescribed antibiotics. This might be an indication that antibiotics are being misused or abused. As much as possible, exchange of MPs between individuals should be avoided to limit the level of transmission of bacterial contaminants through MPs.

Keywords: Antibiotics, Bacteria, Contaminants, and Mobile phones.

INTRODUCTION

Mobile phone has become an indispensable accessory in daily activities, this is because of its multitasking ability and ease of communication. Handset as it is popularly called, mobile phones are handy and most of the time held by the hand. There had been reports of transmission of bacterial infections through hand contacts (Obajuluwa *et al.,* 2020). There is therefore a high possibility of transmitting infection through the use of mobile phones which are always in contact with human and held closely to human face with hands. Since mobile phones are seldom cleaned they served as fomites for a variety of infections such as nosocomial infections (Yusha'u *et al*., 2010). It had been discovered that contaminated fomites play important role in the spread of bacterial infection (Kawo and Musa, 2013).

Normal human bacterial flora is considered to be non-pathogenic but in recent years they are being considered as opportunist pathogens. They can cause both community and hospital acquired infections either through direct and indirect contact (Arora *et al*., 2009, Elkholy and Ewees, 2010). Studies have shown that mobile phones can be contaminated with pathogenic bacteria and can also serve as a vehicle for their transmission (Oloduro *et al*., 2011, Tagoe *et al*., 2011, Mofolorunsho *et al*., 2013). Among the microorganisms which had been isolated from mobile phone surfaces are: *Staphylococcus aureus, Staphylococcus epidermidis* (which are normal human flora), *Klebsiella* spp, *E. coli* and *Pseudomonas aeruginosa* (Yayachandra *et al*., 2011).

Due to the enormous use and benefits derived from the use of mobile phones, people often disregard its potential hazard to health. People use mobile phones while eating or waiting for food at restaurants even after washing their hands. In the process, microorganisms are transferred from phone to hands. Mobile phone sharing also makes the spread of pathogenic organisms, nosocomial and opportunistic infections through it very possible (Soto *et al.,* 2006; Brady *et al*., 2007) between users.

Likewise, antibiotic resistant bacterial strains can be transmitted in the process.

The aim of this study was to isolate bacteria contaminants from some mobile phones of some pharmacy students in Ahmadu Bello University, Zaria and to determine the antibiotics susceptibility of the isolates. This will also assess indirectly the level of antibiotics abuse among the students.

MATERIALS AND METHODS

Area of study

The study was carried out using the mobile phones of few students of the Faculty of Pharmaceutical Sciences, Ahmadu Bello University, Samaru Campus, Zaria, Nigeria.

Sample collection

Twenty samples (20) were randomly collected from mobile phones of some pharmacy students from Ahmadu Bello University, Samaru Campus, Zaria, using swab sticks initially soaked with sterile normal saline. The swab sticks were then incubated overnight in sterile nutrient broth.

Microscopy and Biochemical tests for identification of isolates

Gram's staining technique was carried out according to the method described by Cheesbrough, (2002) to determine which of the isolates were Gram positive or Gram negative. The isolates were further cultured on selective media such as Mannitol salt agar, MacConkey agar, and *Salmonella-Shigella agar*. The following biochemical tests were carried out according to the methods described by Cheesbrough, (2002): catalase, methyl red, Voges proskauer, citrate, indole and coagulase tests.

Antibiotic susceptibility test

Antibiotic susceptibility of the isolates was determined using agar disc diffusion method (Cheesbrough, 2002). The isolates were standardized by making a turbid suspension of each in sterile normal saline, and was compared with 0.5 McFarland Standard. A sterile swab was dipped into the standardized suspension, pressed on the side of the bottles to allow excess drip-off, and then used to evenly streak the entire surface of the Mueller-Hinton agar(Oxoid, England) plate. Sterile forceps were then used to place the antibiotic discs in a circular pattern on the agar plate, the plate was allowed for 15 minutes and thereafter incubated at 37°C for 24 hours. This procedure was carried out for all the isolates. After incubation, the zone of inhibition in diameter for each antibiotic was measured and results interpreted using Clinical and Laboratory Standard Institute (CLSI, 2013) recommendations. The following antibiotic discs (Oxoid, England) were used: Ampicillin-cloxacillin (50µg), Gentamicin (10µg), tetracycline (25µg), ofloxacin (5µg), levofloxacin (5µg), Streptomycin (20µg), erythromycin(10µg), Ceftriaxone (30µg), Ciprofloxacin (10µg), pefloxacin (5µg).

Determination of multiple antibiotics resistance index (MARI) and multidrug resistance (MDR)

Isolates that were resistant to more than 3 classes of antibiotics and had MARI ≥ 0.3 were categorized as multidrug resistant. Pan drug-resistant isolates were those isolates with non-susceptibility to all the antibiotics used (Magiorakos, 2012). The MARI for each isolate was determined using the method described by Krumperman, (1983): number of antibiotics to which isolate is resistant divided by the total number of antibiotics tested.

RESULTS

Identification of isolates

A total number of 35 bacterial isolates were identified from the students' mobile phones, 60% were Gram positive while 40% were Gram negative isolates. *S. aureus* had the highest prevalence of 19(54.3%), followed by *E. coli* 11(31.5%), *Klebsiella pneumoniae* 3(8.6%) and *Streptococcus* spp 2(5.7%). (Figure 1).

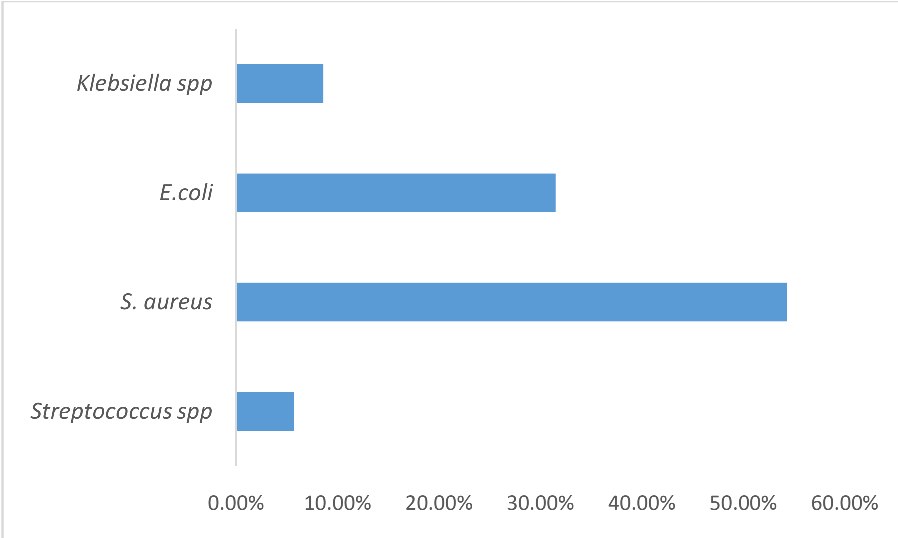

Figure 1: Prevalence of bacterial isolates from mobile phones of selected students in Ahmadu Bello University, Zaria (%)

Results of antibiotic susceptibility tests

The results of antibiotic susceptibility tests showed that the *S. aureus* isolated from the mobile phones were highly sensitive to quinolones. The highest sensitivity was observed with pefloxacin, (89.5%) followed by ciprofloxacin (84.2%), and ofloxacin(78.9%) (Table 1).

Table 1: Antibiotic susceptibility of Gram positive isolates from mobile phones in Ahmadu Bello University, Zaria (%)

	S. aureus		*Streptococcus spp*	
Antibiotics	Sensitive (%)	Resistant (%)	Sensitive (%)	Resistant (%)
Tetracycline 25 µg	15.8	84.2	0	100.0
Gentamicin 10 µg	31.6	68.4	0	100.0
Levofloxacin 5 µg	36.8	63.2	0	100.0
Ofloxacin 5 µg	78.9	21.1	0	100.0
Ciprofloxacin 5 µg	84.2	15.8	0	100.0
Erythromycin 10 µg	31.6	68.4	0	100.0
Ampiclox50 µg	10.5	89.5	50.0	50.0
Ceftriaxone 30 µg	26.3	73.7	0	100.0
Streptomycin 20 µg	47.4	52.6	50.0	50.0
Pefloxacin 5 µg	89.5	10.5	50.0	50.0

The Gram negative isolates were also very sensitive to quinolones compared with the other antibiotics used in this study. *E. coli* showed the highest sensitivity to pefloxacin, (81.8%). Ciprofloxacin and ofloxacin had the same level of activity (72.7%) against *E. coli* (Table 2).

Table 2: Antibiotic susceptibility of Gram negative isolates from mobile phones in Ahmadu Bello University, Zaria (%)

	E. coli		*Klebsiella pneumoniae*	
Antibiotics	Sensitive (%)	Resistant (%)	Sensitive (%)	Resistant (%)
Tetracycline 25 µg	36.4	63.6	33.3	66.7
Gentamicin 10 µg	27.3	72.7	66.7	33.3
Levofloxacin 5 µg	36.4	63.6	66.7	33.3
Ofloxacin 5 µg	72.7	27.3	66.7	33.3
Ciprofloxacin 5 µg	72.7	27.3	66.7	33.3
Erythromycin 10 µg	36.4	63.6	0	100.0
Ampiclox 50 µg	9.1	90.9	0	100.0
Ceftriaxone 30 µg	27.3	72.7	0	100.0
Streptomycin 20 µg	45.5	54.6	0	100.0
Pefloxacin 5 µg	81.8	18.2	66.7	33.3

Resistance profile of the bacterial isolates

Considering the resistance profile of all the isolates, it was observed that all the isolates were generally resistant to the beta lactam antibiotics used (Tables 1 and 2). They were also resistant to tetracycline, gentamicin and levofloxacin. Both the results of MARI and multidrug resistance determination showed that 30(85.7%) of mobile phones bacterial isolates had MARI greater than 0.2 (Table 3) and were resistant to three or more classes of antibiotics. Pandrug-resistance was observed in 3(8.6%) of the isolates; these isolates were non-susceptible to all the antibiotics used in this study.

Table 3: MARI of mobile phonesbacteria isolated from students of Ahmadu Bello University, Zaria

MARI	No of organisms	Percentage (%)
0.1	2	5.7
0.2	3	8.6
0.3	1	2.9
0.4	6	17.1
0.5	4	11.4
0.6	2	5.7
0.7	8	22.9
0.8	3	8.6
0.9	3	8.6
1.0	3	8.6
Total	35	100%

DISCUSSION

Mobile phones remain as one of the most highly and commonly used device in our communities today. The bacterial contaminants (which are considered pathogenic) isolated from the mobile phones considered in this study were *S. aureus, E. coli, Klebsiella* spp and *Streptococcus* spp. The high prevalence of *S. aureus* observed in this study might be due to the fact that *S. aureus* is a normal human skin flora. However, *S. aureus* is pathogenic and it is the causative agent of wide range of infectious diseases such as skin infections, bacteremia, endocarditis, pneumonia and food poisoning (Archer, 1998), the continuous presence of pathogenic *S.aureus* on mobile phone surface can be hazardous toboth the owner and any other user of the phone.

The findings of this study is similar to that of Famurewa (2009), Shahay *et al.*(2012), Abubakar *et al.* (2017), Razina *et al.* (2017), Vivekanandan *et al.* (2017) and Zakari*et al.* (2020) who isolated *S.aureus,E. coli and Klebsiella* spp from students' mobile phones.
Streptococcus spp was another Gram-positive pathogenic organism isolated from this study. Acute *Streptococcus pyogenes* infections may cause pharyngitis, scarlet fever (rash), impetigo, cellulitis, or erysipelas. Invasive infections can result in necrotizing fasciitis, myositis and streptococcal toxic shock syndrome (Patterson, 1996).The isolation of *E. coli* from the mobile phones was an indication of faecal contamination. Most *E. coli* are harmless; they are an important part of a healthy human intestinal tract. However, some *E. coli* are pathogenic, they can cause illness, either diarrhea or other common bacterial infections, including cholecystitis, bacteremia, cholangitis, urinary tract infection (UTI), and other clinical infections such as neonatal meningitis and pneumonia (Karen *et al.*, 2014; Odongo*et al.*, 2020). The types of *E. coli* that can cause diarrhea can be transmitted through contaminated water or food, or through contact with animals or persons. When such persons touch their mobile phones and subsequently use the same unwashed hands to touch their faces and mouths, *E. coli* can be transferred.
Klebsiella pneumonia, also isolated from the mobile phones sampled in this study had been reported by Navon-Venezia *et al*., (2017), to account for about one-third of all Gram-negative infections such as urinary tract infections, cystitis, pneumonia, surgical wound infections, endocarditis and septicemia. It also causes necrotizing pneumonia, pyogenic liver abscesses and endogenous endophthalmitis (Podschun and Ullmann, 1998). It had also been reported that high mortality rates, extended hospitalization, coupled with high cost are often associated with infections caused by this organism (Giske*et al.,* 2008).
Quinolones were the most active antibiotics observed in this study that is pefloxacin, ciprofloxacin and ofloxacin. They act by inhibiting DNA synthesis of the bacteria by binding to two enzymes DNA gyrase and topoisomerase IV (Hawkey, 2003). The isolates in this study demonstrated a high level of resistance to gentamicin, this was similar to the findings reported by Zakarie (2020). The reason for this resistance maybe that the source of the bacteria might have had previous exposure to gentamicin. The bacterial isolates were generally resistant to the beta lactam antibiotics used in this study, similar result was reported by Elmanama (2015); high level resistance to tetracycline was also observed.
Even though the previous exposure to antibiotics of the individuals involved in this study was not investigated in this study, the high level of multidrug resistance observed in this study was alarming. The multidrug resistance rate observed in this study was higher than that reported by Sujan*et al.* (2018) Comparing this with the result of the MARI it can be said that these bacterial isolates originated from an environment where antibiotics are being abused. The problem of misuse and abuse of antibiotics in our society is highly disturbing. This is the probable leading cause of multidrug resistance being observed. Since mobile phones can be exchanged from one person to another, there is therefore the possibility of mobile phones becoming both reservoir and vehicle for transfer of pathogenic and multidrug resistant bacteria strains.

CONCLUSION AND RECOMMENDATION

Bacterial contaminants isolated from the students' mobile phones sampled were *S. aureus, E. coli, Klebsiella pneumoniae* and *Streptococcus* spp. High percentage of these isolates were multidrug resistant. It is therefore recommended that the campaign against abuse and misuse of antibiotics and the implication of the abuse should be flagged in the university community especially among the pharmacy students. Likewise, routine cleaning and disinfection of mobile phones should be encouraged. This will prevent possible spread of pathogenic and multidrug resistant bacteria strains through phone hand contacts.

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