Magna Scientia Advanced Biology and Pharmacy

eISSN: 2582-8363

Cross Ref DOI: 10.30574/msabp

Journal homepage: https://magnascientiapub.com/journals/msabp/

(RESEARCH ARTICLE)

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# Prevalence of bacterial isolates from cell phone surfaces in Madonna University Elele Campus

Martin O. Anagboso [1, *], Judith O. Osuala [1] and Edet E. Akpanenang [2]

[1] *Department of Microbiology, Madonna University Nigeria, Elele Campus, Rivers State Nigeria.*
[1] *Department of Pharmaceutical Microbiology and Biotechnology, Madonna University Nigeria, Elele Campus, Rivers State Nigeria.*
[2] *Department of Pharmaceutical Microbiology and Biotechnology, University of Uyo, Uyo. Akwa Ibom State, Nigeria.*

Magna Scientia Advanced Biology and Pharmacy, 2023, 09(02), 024–032

Publication history: Received on 14 June 2023; revised on 23 July 2023; accepted on 26 July 2023

Article DOI: https://doi.org/10.30574/msabp.2023.9.2.0049

## Abstract

Cell phones is a major revolution in the communication industry. In recent times, cell phone is carried by almost everybody, however, in some areas where not everyone has a cell phone, people patronize paid phone booths to communicate with loved ones. Madonna University, Elele Campus, is in Rivers State Nigeria and accommodates the University where all the students and staff are living on campus, The Madonna University Teaching Hospital, the pilgrimage center where pilgrims from all over the world visit regularly. There are phone booths at strategic locations where individuals pay and use their phone. Since different people use the same phone with their hands and mouth to make calls, this research was aimed at accessing the prevalence of bacteria isolates from cell phone surfaces in Madonna University, Elele campus, and the susceptibility of these organisms to commonly used antibiotics. Fifty swab samples were collected from the surface of cell phones at various locations in Madonna University, Elele Campus, and were microbiologically analyzed for the aerobic bacteria count and susceptibility to different antibiotics using the pour-plate method. Madonna University Teaching Hospital phone booth recorded the highest total aerobic bacterial count and number of bacteria isolates compared to other centers. *Staphylococcus* species was significantly ($p<0.05$) the most prevalent bacteria species isolated on the cell phones, and the percentage occurrence of various isolates were: *Staphylococcus* species (59.5%), *Salmonella* species (19.1%), *Streptococcus* specie (9.5%) *Psuedomonas* species (3.1%) and *Escherichia coli* (2.1%). Among the gram-negative bacteria, *Escherichia coli* had 100% susceptibility against all the antibiotics, *Salmonella* species recorded 100% susceptibility against ciprofloxacin, nalidixic acid, gentamycin, chloramphenicol and ampicillin while Proteus species had 100% against streptomycin and chloramphenicol. For the gram-positive, *Streptococcus* species and *Staphylococcus* species recorded a significant percentage of susceptibility ranging from 62.5% to 100% against some of the antibiotics used. This study conclude that cell phone surfaces could be a reservoir for different disease causing micro-organism and users should take precaution against bacterial infection while using cell phone.

**Keywords:** Prevalence; Bacterial-Isolates; Cell Phone Surfaces; Madonna University

## 1. Introduction

The first actual cell phone was made in 1973 by Martin Cooper of Motorola and other assisting inventors who used the idea of the car phone and applied the technology necessary to make a portable cell phone possible. Cell phones were first made available to the public in 1984; they were very large and expensive instruments [1, 2]. Today it is found everywhere, and carried by all people. By its nature and name "hand set", the cell phone is carried in the hand which is used in greeting, touching, cleaning all parts of the body, touching and wiping surfaces etc. The phone is in contact with

* Corresponding author: Martin O. Anagboso

the hands, the ear, the skin and every other part of the body as such, they are more contaminated with bacteria than any other object. The level of contamination is high partly because during use, the temperature of the device increases and when it return to its normal temperature moisture condense which encourage the growth of microorganism in the device [3, 4]. Activities that promote the production of air borne respiratory droplet include coughing, sneezing, spitting and talking with a cell phone. During these activities, droplets which contains pathogen can be inhaled by the next person that will handle the phone to make a call [4]. This is mostly common in business centers (phone booth). The case for cellular phone is made of leather or vinyl so that any external contamination by the carrier is directly transferred to the cellular phone. Since no special function to treat contamination of any source on the cellular phone is provided, users pick up the pathogen with their hand and transfer same to other part of the body when they touch or use the hands to eat [5, 6, 7].

Since human hands usually harbor microorganism both as part of the person's normal microbial flora as well as transient microbes acquired from the environment [6, 8] , the chances that another person will acquire these organisms is somewhat dependent on how long the bacteria can survive in that environment. Numerous studies have examined the survival of bacteria on the surface of stainless steel subsequent to contamination [9, 10, 11].

Madonna University, is located in Elelle, Rivers State, Nigeria and accommodates the University where all the students are living on campus, there is also Catholic Pilgrimage Center (CPMC) where pilgrims from all over the world visit regularly. The University has a hospital, Madonna University Teaching Hospital (MUTH). There is also the Benefactor Shopping Complex (BSC) which is open to staff of the University, students and pilgrims. The London hostel (LH) is occupied by the male, while the Chicago hostel (CH) is for the female. Each of these places has a phone booth where inhabitants or visitors go in to use their cell phones.

This research is aimed at identifying and carrying out antibiotics susceptibility pattern on the bacterial found on cell phone in the five different crowded areas in Madonna University; the church, hospital, shopping center and the two student hostels.

## 2. Material and methods

### 2.1. Chemicals

All chemicals used in this study were of analytical grade. They were purchased from Sigma Aldrich-Germany or BDH Chemical- Poole England through their Nigeria representative. All other materials including autoclave, microscope glass wares and others were standard equipment used in microbiology laboratory.

### 2.2. Antibiotic reagents

All the antibacterial reagents were obtained from registered Pharmacy in Port Harcourt, and were from reputable manufacturers and all had a shelf life not less than eighteen months from the expiry date of manufactures. They include; Ciprofloxacin, Norfloxacin, Gentamycin, Lincomycin, streptomycin, Rifampicin, Erythromycin, Chloramphenicol, Ampiclox, Floxapen, Ofloxacin, Pefloxacin, Amoxicillin and Clauvonic acid combination, Cephorexime, Nalidixiic acid, Cotrimoxazole and Ampicilin.

### 2.3. Sample collection and transportation

A total fifty (50) swab samples were collected using a properly labeled swab stick dipped into a peptone water suspension and seabed on the surface of the cell phone from each cell phone center [12, 13, 14]. The following selected phone call centers were used; Catholic Prayer Ministry (CPM), Madonna University Teaching Hospital (MUTH), Benefactor shopping complex (BSC), London hostel (LH) and Chicago hostel (CH).

### 2.4. Sample processing

#### *2.4.1. Enumeration of the isolates*

Six test tubes were arranged in a rack and labeled $10^{-1}$ to $10^{-6}$ for each sample. With a sterile pipette, 9mL of the distilled water was dispensed into all the test tubes. The test tubes were corked and autoclaved at 121$^{o}$C for 15 minutes to ensure complete sterility of the distilled water.

After allowing the water to cool, a sterile pipette was used to dispense 1.0mL of the sample into first test tube labeled $10^{-1}$. The test tube was shaken for complete homogeneity and then 1.0mL aliquot was aspirated from it and dispensed

into the second test tube labeled $10^{-2}$. The same procedure was carried out on all the other test tubes, until the test tube labeled $10^{-6}$. From the prepared dilutions, 1.0mL was taken from the test in the mid dilution and dispensed into sterile petri dishes labeled according to each test tube.

About 18 to 20mL of already sterilized nutrient agar was poured into the dishes and mixed evenly for the suspension to spread. The plates were allowed to solidify and then incubated at 37°C for 24.0hrs [13, 14, 15].

*2.4.2. Isolation of pure culture*

With a sterile standard wire loop, an aliquot of each isolate was sub-dried on sterile nutrient agar plate and incubated at 37°C cultured on an incubator for 24hrs. After this, a single colony of each strain was sub-cultured on a sterile nutrient agar slants and incubated at 37°C for 24hrs. The slants were then stored in the refrigerator at 4°C

*2.4.3. Identification of isolates*

The isolates were indentified based on their morphology, gram stain reaction and biochemical reactions [16, 17].

*2.4.4. Colonial morphology*

The bacteria lisolate were classified morphologically based on their shape, size, margin, surface, colour, opacity and elevation [13, 16, 17].

*2.4.5. Smear Preparation*

A drop of sterile tap water was added on a grease free glass slide. Aliquot of the isolate was emulsified with the water to give a uniform smear. Water was allowed to air dry and fixed by passing it three times over a Bunsen flame to make it ready for staining [6].

### 2.5. Gram staining

All of the slides to be stained were arranged vertically in a slanted position on a staining rack. The slide was flooded with crystal violet for 30 to 60 seconds and rinsed off with sterile distilled water. Lugol's iodine was applied on the slides and allowed to stand for 30 to 60 seconds, and decolorized rapidly with acetone and rinsed off the sterile distilled water to avoid complete decolorization of the primary dye. The slides were then counter stained with Safranin for 2 minutes and then rinsed off with sterile distilled water. The stained slides were allowed to air dry and observed by using an oil immersion object in a microscope with (X100) magnification [17, 18].

## 3. Results

### 3.1. Aerobic bacteria plate counts from cell phone in different locations

During this survey, a total of 50 swab samples were collected from each center and bacteriological analysis was carried out for aerobic bacteria count using the pour plate method. As shown in Fig. 1 MUTH phone centre record the highest mean of 200 x $10^3$ cfu/mL while CH record the lowest with 80 x $10^3$ cfu/mL.

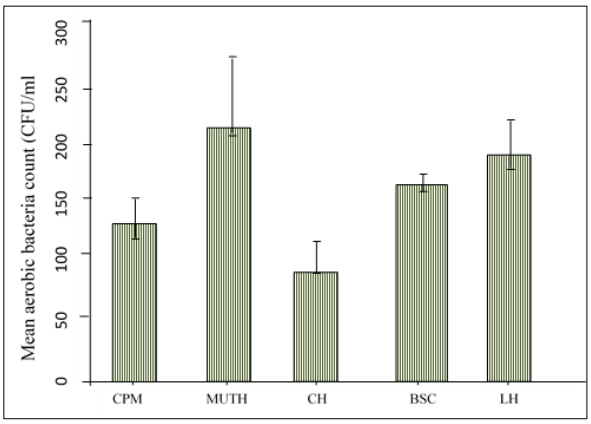


**Figure 1** Mean aerobic bacteria count at different locations

### 3.2. Frequency of different bacteria isolates on cell phone surface

In this study the frequency of occurrence of bacteria isolates from cell phone surface in various sites of collection was investigated. *Staphylococcus* species recorded a significantly higher number of overall isolates with a percentage of (59.5%), compared to other bacteria species ($p<0.05$). This was followed by *Streptococci* species (22.9%), *Salmonella* species (19.1%), *Proteus* species (6.3%), *Pseudomonas* species (3.1%) and *Escherichia coli* (2.1%) (Fig.2). MUTH had the highest number of isolates 26(27.9%) with *Staphylococcus* spp being half of total isolates 13(50%) and *Salmonella* spp being the least with 7(26.90%). CMP and BSC had the same numbers of isolates 21(22.9%) each with *Staphylococcus* spp being the highest and *Salmonella* spp being the least. LH recorded total of 15(16.1) isolates with *Staphylococcus* species having 10(66.6%), *Streptococcus* species with 3(20%) and *Salmonella* species with 2(13.3%). CH had the least number of 10(10.7%) isolates where the *Staphylococcus* species got 7(70%). *Salmonella* species 2(20%) and *Streptococcus* species with 1(7%) (Table 1).

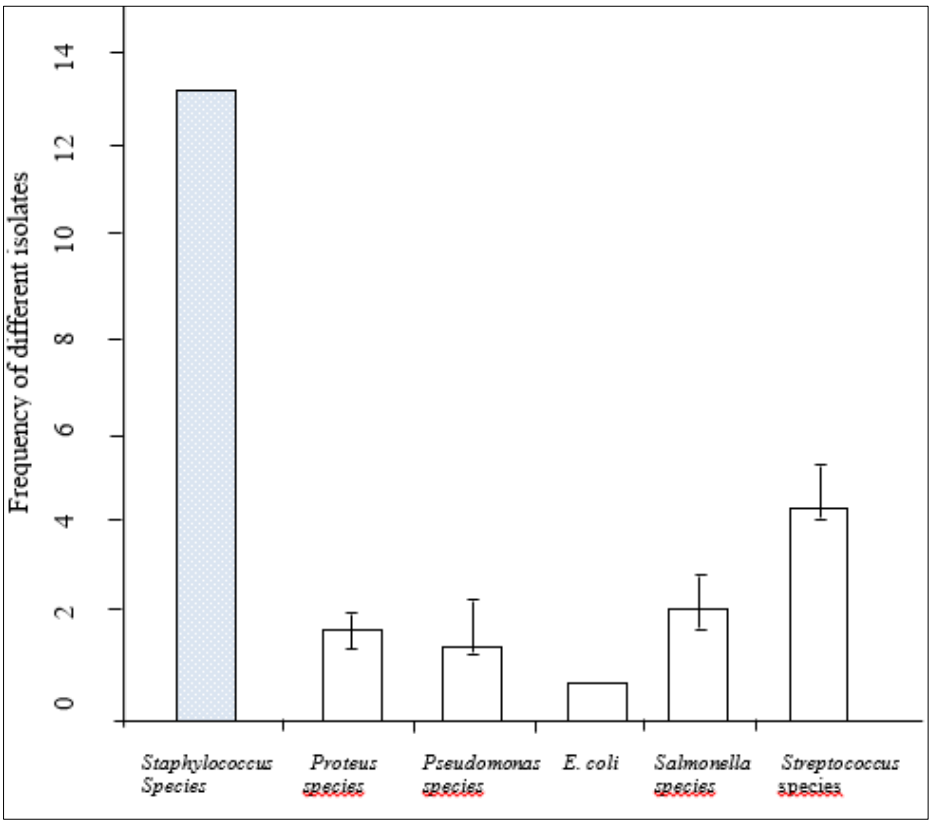


**Figure 2** Frequency of different types of bacteria isolates in all locations

**Table 1** Frequency of occurrence of bacteria isolates from cell phone surface in the various sites of collection

| Location | Total No. of Isolates | No of strains | Isolates | No. of each Isolates | % Occurrence of Isolates |
|---|---|---|---|---|---|
| CPM | 21(22.5%) | 6 | *Staphylococcus* spp | 13 | 61% |
| | | | *Streptococcus* spp | 1 | 4.7% |
| | | | *Pseudomonas* spp | 2 | 9.5% |
| | | | *E. coli* | 1 | 4.7% |
| | | | *Proteus* spp | 2 | 9.5% |
| | | | *Salmonella* spp | 2 | |
| MUTH | 26(27.9%) | 4 | *Staphylococcus* spp | 13 | 50% |
| | | | *Streptococcus* spp | 3 | 11.5% |

| | | | | | |
|---|---|---|---|---|---|
| | | | *Proteus* spp | 3 | 11.5% |
| | | | *Salmonella* spp | 7 | 26.9% |
| BSC | 21 (22.5%) | 5 | *Staphylococcus* spp | 13 | 61% |
| | | | *Streptococcus* spp | 1 | 4.7% |
| | | | *Pseudomonas* spp | 1 | 4.7% |
| | | | *Proteus* spp | 1 | 4.7% |
| | | | *Salmonella* spp | 5 | 23.8% |
| LH | 15(16.1%) | 4 | *Staphylococcus* spp | 10 | 66% |
| | | | *Streptococcus* spp | 3 | 20% |
| | | | *E. coli* | 1 | 4.7% |
| | | | *Salmonella* spp | 2 | 13.3% |
| CH | 10(10.7%) | 3 | *Staphylococcus* spp | 7 | 70% |
| | | | *Streptococcus* spp | 1 | 7% |
| | | | *Salmonella* spp | 2 | 20% |

### 3.3. Percentage susceptibility of Gram negative bacteria isolates from cell phone to common antibiotics

Out of the 56 *Staphylococcus* species only 3 isolates were coagulase positive while the rest were coagulase negative. The organisms were subjected to some antibiotics for their susceptibility pattern as shown in table 2. *Salmonella* species showed the highest percentage (100%) susceptibility against ciprofloxacin, nalidixic acid, gentamycin, chlorophenicol and ampicilin, while ceporex, cotrimoxazole (septrin) and ofloxacin (tarivid) had the least percentage (50%) each. *Pseudomonas* species recorded the highest percentage (100%) susceptibility against gentamycin, streptomycin and chlorophenicol while ceporex had the least percentage (25%). *Escherichia coli* recorded (100%) susceptibility to all the antibiotics used. There was however no significant difference (>0.05) in the mean susceptibility (Fig. 3).

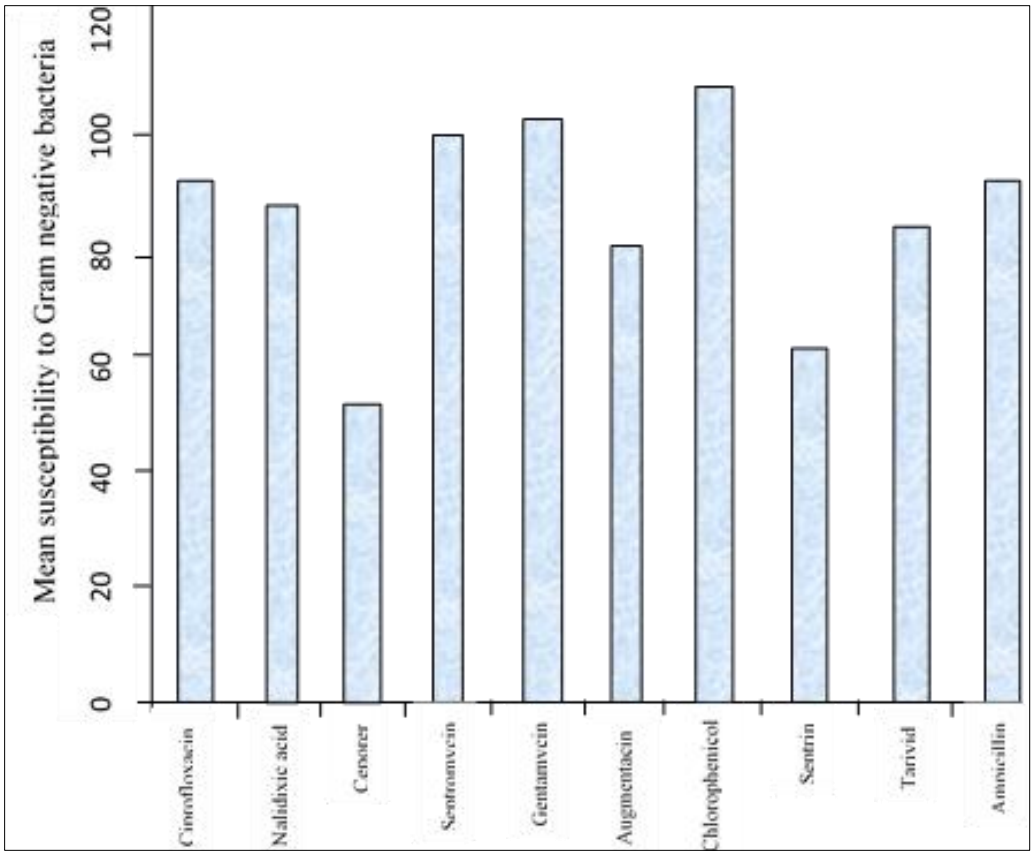


**Figure 3** Mean percentage susceptibility of Gram negative bacteria to different antibiotics

**Table 2** Percentage susceptibility of Gram negative bacteria isolated from cell phone to some common antibiotics

| | **No. of Isolates** | **Ciprofloxacin** | **Nalidixic acid** | **Ceporex** | **Streptromycin** | **Gentamycin** | **Augmentacin** | **Chlorophenicol** | **Septrin** | **Tarivid** | **Ampicillin** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Salmonella spp | 18 | 18(100) | 18(50) | 9(50) | 15(83.3) | 18(100) | 10(55.5) | 18(100) | 9(50) | 9(50) | 18(100) |
| Proteus spp | 6 | 4(66.6) | 3(50) | 2(33.3) | 6(100) | 6(100) | 3(50) | 6(100) | 5(83.3) | 5(83.3) | 5(83.3) |
| Pseudomonas spp | 4 | 4(100) | 4(100) | 1(25) | 4(100) | 4(100) | 3(75) | 4(100) | 2(50) | 3(75) | 3(75) |
| E. coli | 1 | 1(100) | 1(100) | 18(100) | 1(100) | 1(100) | 1(100) | 1(100) | 18(100) | 1(100) | 1(100) |

**Table 3** Percentage susceptibility of Gram positive bacteria isolated from cell phone to some common antibiotics

| | **No. of Isolates** | **Riframpicin** | **Floxapen** | **Norfloxacin** | **Ciprofloxacin** | **Erythromycin** | **Chloramphenicol** | **Streptomycin** | **Gentamycin** | **Lincocin** | **ampiclox** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Staphylococcus spp | 56 | 56(100) | 34(60.7) | 50(89.2) | 22(39.2) | 50(89.2) | 56(100) | 56(100) | 50(89.2) | 40(71.4) | 45(80.3) |
| Streptococcus spp | 8 | 5(62.5) | 5(62.5) | 8(100) | 5(62.5) | 8(100) | 8(100) | 8(100) | 8(100) | 8(100) | 8(100) |

### 3.4. Percentage susceptibility of Gram Positive bacteria isolated from cell phone to common antibiotics

From table 3, *Staphylococcus* species recorded the highest percentage (100%) susceptibility against Refampicin, Streptomycin, and Gentamycin while ciprofloxacin had the least percentage (39.2%). The case was different in *Streptococcus* species recording the highest percentage (100%) against Norfloxacin, Erythromycin, Streptomycin, Gentamycin, Chloramphenicol, Lincocin and Ampiclox while Refampicin, Floxapen and Ciprofoxacin had the least percentage (62.5%). In all, there was no significant difference ($p>0.05$) in the mean susceptibility of Gram positive to different antibiotics (Fig 4).

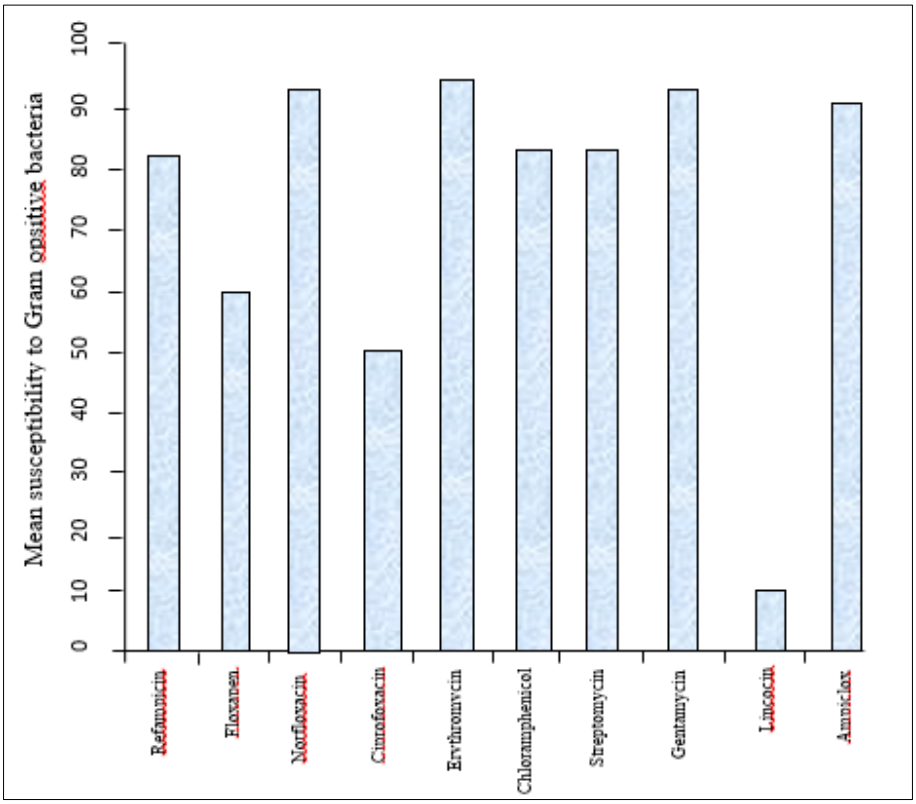


**Figure 4** Mean Percentage susceptibility of Gram Positive bacteria to different antibiotics

## 4. Discussion

Cell phone may be new devices, but they originate in the 1920's. The first actual cell phone was made in 1973 by Martin Cooper of Motorola and other assisting inventors who used the idea of the car phone and applied the technology necessary to make a portable cell phone possible. Thanks to them, for today, cell phone have become daily companions to most people in developed and developing nations.

In Madonna University community, handling of cell phones in different phone booths with unclean hands and other environmental factors such as dust, contaminate the cell phones. This research therefore, sort to find out the prevalence of bacteria associated with surface contamination of cell phone. As shown in Fig. 1, Madonna University Teaching Hospital (MUTH) had the significantly higher ($p<0.05$) mean bacteria count and mean number of bacteria isolates compared to (CH). However the difference was not statistically significant ($p>0.05$) compared to other locations. From this finding it is obvious that phone users in MUTH environs should be cautious of possible infections. Infections that could possibly be associated with the contamination of cell phone surface include; typhoid fever, nosocomial infection, respiratory tract infection, gastrointestinal tract infection and Tuberculosis which are caused by the organisms isolated from the phone surfaces [19]. In this study comparing the mean counts for different bacteria species, *Staphylococcus* species was significantly the most common bacteria isolate identified ($p<0.05$). This therefore implies that cell phone users in Madonna University and any other public environment should watch out for bacterial infections caused by *Staphylococcus* species. Overall there was no significant difference ($p>0.05$) in the mean percentage susceptibility of the different bacteria to the various antibiotics investigated. However as shown in Fig. 3 and Table 2, Gentamycin and Chloramphenicol recorded the highest mean percentage susceptibility compared to other antibiotics against Gram-

negative bacteria. On the other hand, Norfloxacin, Erythromycin, Gentamycin and Ampiclox had higher mean percentage susceptibility compared to other antibiotics against Gram-positive bacteria, though the difference still was not statistically significant ($p>0.05$) (Fig. 4 and Table 2). Comparing this research with that of (Corus *et al.,* 2001, in Angelo State University's campus where they conducted a study investigating the metal push of 46 public rest rooms throughout Angelo State University campus for the presence of the bacteria species *Staphylococcus aureus*[16]. Their result yielded evidence that the metal was a reservoir for microbes, though the push plates might be exerting a fairly rapid level of auto-disinfection this is because when metal and plastic surface were intentionally contaminated, it was difficult to re-isolate from the metal surface as compared to the plastic surface [17], confirming that the plastic surface are a real reservoir for bacteria [17, 18, 20].

## 5. Conclusion

Based on this study and reviewed literature, cell phone is very vital in our daily lives. However, phone could be potential reservoir for different disease causing microbes. Therefore, users should be careful in handling food after making use of their cell phone to avoid contamination especially phones used in commercial phone centers and hospital and laboratory environments.

### *Recommendation*

The following measures should be adopted in maters associated with the handling of cell phone:

- Pay phone patronizers and phone users generally should constantly wash their hands after handling phones and also wash their hands before eating.
- The use of alcohol based hand sanitizer is highly recommended after using public phones.
- Shouting while making calls should be minimized to avoid droplet nuclei on the surface of the phone.
- The use of handkerchief in cleaning the surface of the cell phone should be avoided as this may bring about bacterial infections and transfer.
- Dropping of cell phone on the bed of a sick patient should be guarded against to avoid nosocomial infection.

## Compliance with ethical standards

### *Acknowledgments*

The authors wish to express their appreciation to staff of the various phone booths for their cooperation in allowing the researchers to obtain samples. We are also grateful to staff of medical microbiology laboratory that helped in microbiological analysis.

### *Disclosure of conflict of interest*

The authors have declared that no competing interest exist in this study.

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