Original research article

A study to assess the prevalence of pathogens on mobile phones on healthcare workers at Malla Reddy Hospital, Suraram, quthbullapur, Hyderabad

[1]Beulah Philips Kothapally, [2]Dr. Lakshmi Bhaskar, [3]Dr. G. Sravanthi

[1]Principal, Mallareddy Nursing College, Hyderabad, Telangana, India
[2]Associate Professor, Department of Hospital Administration, Nizam's Institute of Medical Sciences, Panjagutta, Hyderabad, Telangana, India
[3]Masters in Hospital Management, Nizam's Institute of Medical Sciences, Panjagutta, Hyderabad, Telangana, India

Corresponding Author:
Dr. Lakshmi Bhaskar

Abstract
Background: Mobile phones have started as a small portable radio telephone for the usage of calling but with the growing technology smartphones have bought the whole world into our hands and hence they have become important part of our lives and with these varied uses the smartphones have turned to be a major part of healthcare and healthcare workers lives.
Methods: These smart phones are like a double-sided sword, with the immense advantages also comes even more disadvantages and this study cares to focuses on prevalence of pathogens on mobile phones of 157 HCWs. And the samples were streaked on blood agar and McConkey agar plates and Mannitol plates.
Results: Results show that various pathogens as coagulase negative staphylococcus, pseudomonas, *Acinetobacteria* spp., *Acinetobacter baumannii*. Not only just with the prevalence of pathogens an analytical study was carried out explanation on awareness of the HCWs regarding how the mobile phones they use may act as one of the cause to nosocomial infections by sharing the questionnaire among the same 157 HCWs. And with p-value being considered 5.3 the null hypothesis stands still.
Keywords: Mobile phones, healthcare workers, *Acinetobacteria* spp., *Acinetobacter baumannii*

1. Introduction
Mobile phones have become part of health professional's equipment and are used extensively for communication in a clinical setting however they are seldom are cleaned and are often touched during or after examination of patients and even specimens are handled without proper hand washing. These cell phones can harbour enormous pathogens and become exogenous source of infection for the patients and are also potential health hazard for self and family members. Different studies in different parts of the world indicated that medical equipment and mobile phones of healthcare workers are potential sources of nosocomial infections. So, this study focuses on determining the presence and type of bacteria that contaminate mobile student and their antibiotic susceptibility.
Thus, in this we investigated bacterial contamination of the mobile phones of the health care workers employed on Mallareddy hospital.
Mobile phones are also increasingly becoming an important means of communication among doctors and other health care workers (HCWS) in hospitals where hospital-associated infections (HAI) are prevalent. It has been estimated that one third of all nosocomial infections may be preventable and are frequently caused by organisms acquired within the hospital environment. Hands of HCWS play an important role in transmission of HAI and mobile phones which are seldom cleaned and often touched during or after the examination of patients without hand washing can act as a reservoir as well as vehicle for transmission of nosocomial infections. Moreover, sharing of mobile phones between HCWs and non-HCWS directly facilitates the spread of potentially pathogenic bacteria to the community. Different studies in different parts of the world indicated that medical equipment and mobile phones of healthcare workers are potential sources of nosocomial infections.

1.1 Aim & Objectives
1.   To determine whether mobile phones act as a vehicle of transmission for nosocomial infections.
2.   To determine awareness of mobile pathogens among healthcare workers.
3.   To isolate the pathogens found on the surface of mobile phones.

1.2 Materials & Methods

A total of 157 mobile phones of health care workers from Mallareddy hospital from all the departments. The samples were collected aseptically using swabs moistened with sterile saline. Samples were collected by rotating the swabs over the mouthpieces, earpieces, keypad and external cover of the mobile phones. And where streaked on blood agar and MacConkey agar plates, and were incubated at 37" C for 24 hours. Plates were observed for growth isolates were identified by colony, morphology. gram staining and standard biochemical reaction Gram positive cocci were tested for Mannitol utilisation and for production of coagulase enzyme. Gram positive cocci were identified by bile Esculin agar, oxidase and other gram-negative bacilli were identified by biochemical tests including production of indole, utilization of citrate production of enzyme urease and triple sugar ion agar &mannitol motility. The isolates were further subjected to antibiotic sensitivity testing by Kirby-Bauer disc diffusion method on Muller-Hinton agar according to clinical laboratory standards institute antibiotic disc susceptibility testing guidelines.

1.3 Study design, sample & setting

The cross-sectional study was carried out during a period of 3 months beginning from September 2021 to November 2021.

1.3.1 Study population

In this study, Doctors, Nurses and class 4 workers were taken into consideration and majorly the surgical departments were the main criteria i.e. SICU, MICU, ICU, CRITICAL CARE UNITS, RADIOLOGY DEPARTMENTS and from other wards. Consenting participants were asked to enroll their phones.

1.3.2 Sample size

ROSOFT sample calculator was used to decide the sample size with 95% confidence level, 5% error margin. The hospital consists of about 1500 HCWs. And with the formula about 1000 samples were considered.

1.3.3 Questionnaire

Consent participants were asked to complete a questionnaire before taking a swab sample from their MPs. The questionnaire addressed participants' usage habits by several domains: their daily use and a special section asking about using their MPs in hospital and medical practice. Only the HCW has filled this particular section. The questionnaire was written in Two languages, English and Telugu. It included questions about gender, age, and average time spent daily on MPs. Other questions assessed the frequency of handwashing per day, frequency of MP cleaning per month, last time of MP cleaning, and MP cleaning method. Besides, questions set smoking status, using MP in the bathroom, and broken quality of the screen or the screen protector.

A special section asked HCWs about their position at the hospital, availability of antiseptic solutions in the wards, using mobile on the entrance to operating rooms, using the MPs in the operating theatre, and using MPs next to the patient.

The Likert's rating scale was used for making the questionnaire with 0 being totally unaware to 5 being totally aware.

1.3.4 Statistical tool & hypothesis

A student t-test was performed to understand if there is any statistical mean differences in the views of the healthcare workers during the isolate pathogens and their mobile phones being the potential carriers of the nosocomial infections.

H0: HCWs are unaware about the fact that the MPs can be potential cause for nosocomial infections.

1.3.5 Samples collection and processing

Samples from mobile phones were collected using sterile cotton swabs. Each swab was first moistened with sterile saline water and was rotated over the mouth piece, ear piece, key pad, and external cover of the mobile phones. All the swabs were immediately streaked over the surface of blood agar and MacConkey's agar plates. The cotton ends of these swabs were cut off and soaked in 10 ml peptone water. All inoculated blood and MacConkey's agar plates together with the inoculated peptone water tubes were transferred rapidly to the microbiology laboratory at Nizams Institute of Medical Sciences (NIMS).

As the laboratory, blood and MacConkey's agar plates were incubated at 3700 for 24 hours. The plates were observed for growth. Isolates were identified by colony morphology.

Gram staining and standard biochemical reaction, Gram positive cocci were tested for mannitol utilisation and for production of coagulase enzyme. Gram positive cocci were identified by bile esculine agar only for entero bacilli. Pseudomonas were identified by oxidase enzyme. Other gram-negative bacilli [biochemical tests] were identified including production of indole, utilization of citrate production

of enzyme urease and triple sugar ion agar. The isolates were further subjected to antibiotic sensitivity tests by Kirby-Bauer disc diffusion method on Mueller Hinton agar according to clinical laboratory standards institute antibiotic disc susceptibility testing guidelines.

1.4 Results

1.4.1 Prevalence of the bacteria

Out of 157 phones screened in this study,12 showed bacterial growth and 147 showed no bacterial growth coagulase staphylococcus negative growth was detected in swabs of 1 doctor (4%) from department of general surgery and 5 staff nurse (4%) from ICU, post op medical ward, male surgical department, and 4th class employees (50 %) methicillin resistance coagulase staphylococcus negative was the most prominent bacterial growth in this study.

Pseudomonas growth was detected from swabs of 1 doctor (3%) from paediatric ward and from 1 staff nurse (0.7%) from surgical intensive care unit.

Acinetobacter spp. growth was detected from the swabs collected from 1 staff nurse (0.7%) from medical intensive care unit.

Table 1: Shows the demarcation of the organisms isolated on different mobile phones collected from various staff members

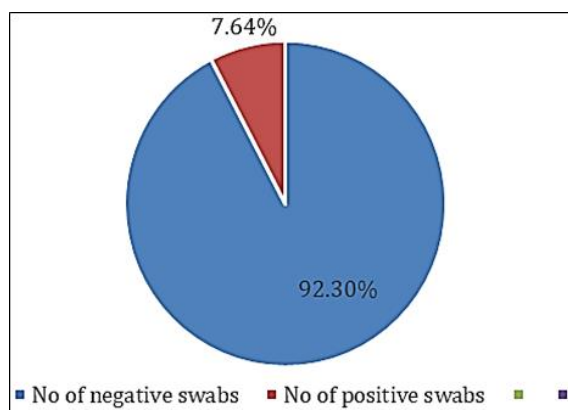| Organism Isolate	Doctors	%	Staff Nurse	%	4th class employees	%
Coagulase negative staphylococcus	1	4	5	4%	1	50%
Pseudomonas	1	3	1	0.7%	-	-
Acinetobacteria spp.	-	-	1	0.7%	-	-
Acinetobacter baumannii	-	-	2	1.5%	-	-

Fig 1: Percentage of bacterial contamination of mobile phones of healthcare workers

Fig. 1 shows among the 157 consented participants MPs sample 145 swabs has demonstrated negative swabs but even 12 swabs have showed positive swabs which constitutes up to 7.64%.
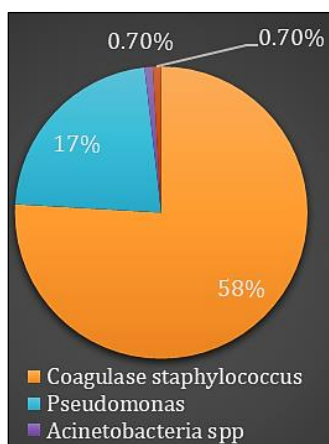

Fig 2: Total distribution of positive swabs

Fig. 2: Shows that with the majority Coagulase staphylococcus is been distributed constituting to 58% and pseudomonas with 17% followed by *Acinetobacter baumannii* and finally with 0.7% both *Acinetobacteria* spp. and *Acinetobacter baumannii* are distributed.

Modified High Speed 32-bit Vedic Multiplier Design and Implementation

1.4.2 Health care workers awareness regarding the MPs potential spread

Understanding the HCWs awareness regarding the Pathogens present on their phones and their spread to patients was considered to vital part of this study. It was hypothesised that "HCWs are unaware about the fact that the MPs can be potential cause for nosocomial infections". Further mean scores and standard deviation were computed for the variables as MPs sanitization, usage and spread of pathogens. In order to known the significance of the differences in their mean scores on all the study variables, independent student t-test was computed. Results in this regard are presented in the following table.

Table 2: Awareness of healthcare workers regarding the pathogens spread through mobile phones

	N	Mean	SD	Mean Difference	t	df	P
Awareness on pathogens	157	9.30	3.12	9.30	-3.322	70	0.534
Awareness on MPs acting as nosocomial infections	157	13.28	4.79	1.211	-4.322	70	0.322
Sanitization process of MPs	157	1.15	0.464	1.155	-2.322	70	0.455
Usage of phones in workplace	157	1.15	0.364	1.533	-5.322	70	0.355

From the table we understand that the maximum significant t-value is -5.322 and since all the mean values suggest that means difference is statistically significant. This means that awareness among the health care workers is not very significant and awareness needs to be increased. And hence, with the p-value being 0.533 the null hypothesis stands still and accepted, which means that Mps can act as cause for nosocomial infections and healthcare workers are unaware regarding it.

1.5 Discussion

Mobile phones today are used extensively in every facet of life is therefore imperative that they are carries of infection, in many cases especially those that are used by the health care workers since, they are in constant contact with the patient. In the present study out of 157 phones screened 12 showed bacterial growth (7.64%) and 147 showed bacterial growth. Our results were similar to a study conducted by Jimma university south west ethiopia were it was found that the bacterial contamination is 71.20%.

The rate of contamination of mobile phones was reported to be higher in other studies such as a study conducted by Algar *et al*. where it was reported that 95% of bacterial contamination was present. Famurewa reported 91% and Kerabay reported 83% comparable with the findings of the present study. In our study methicillin resistant coagulase negative staphylococcus was the most prominent bacterial growth. The second prominent isolate was pseudomonas third prominent was *Acinetobacteria* spp. and fourth prominent isolate was *Acinetobacter baumannii*.

This result was similar to the finding to other studies. Though gram positive bacteria are normal skin inhabitants, these organisms have the potential to harbour and transfer drug resistance gene among their genera or beyond. The issue may become more serious if Health care workers become a potential source for transfer of these organisms during invasive procedures. Coagulase negative staphylococcus are increasingly the causative agents of nosocomial infections.

1.6 Conclusion and Summary

In this study it was revealed that all study participants use their mobile phones both at home and in the work place, while 86.40% of them share their mobile phones at work. After touching the patients no proper hand washing protocol and sterilization technique are in place these conditions enhanced the cross of mobile phones and spread bacterial pathogens among users. It is sensible to increase the awareness about mobile phones disinfection rather than trying to forcefully ban using mobile phones in clinical settings and after touching the patients.

Health care workers should clean the hand with antiseptic solution there after they can use their mobile phones in clinical settings.

In conclusion, this study highlights the high rates of contamination of mobile phones used by Health care professional in a hospital setting. Mobile phones contamination with potential human pathogens was common in Health care professionals working at various areas of the hospital including sensitive areas like OTs and ICUS and also irrespective of professional cadre. Carriage rates of resistant organisms (MRSA) were low. These findings stress the need for awareness of mobile phones as fomites, need for strict monitoring of hand hygiene and guidelines for routine decontamination of mobile phones in hospital.

We conclude that 12% of mobile phones were contaminated. Which is not acceptable in health care environments? More resistant bacteria were isolated from Health care workers mobile phones than from non-Health care workers mobile phones.

References
1. Lapinsky SE, Easty AC. Electromagnetic interference in critical care. J Crit Care. 2006;21(3):267-70.
2. Goldblatt JG, Kriefi Klonsky T, Haller D, Milloul V, Sixsmith DM. SRUGO 1. and Potasman 1: Use of cellular telephones and transmission of pathogens by medical staff in New York and Israel. Infect Control Hospital Epidemiol. 2007;28(4):500-3.
3. Semmelweis IP. Die Aetilogie, der begriff und die Prophylaxis des Kind Bettliebers. Expedition, 1861.
4. Manning ML, Archibald LK, Bell LM, Baneriee SN, Jarvis WR. Serratia marcescens transmission in a pediatric intensive care unit: A multifactorial occurrence. Am. J Infect Control. 2001;29:115-119.
5. Wikler Matthew A. Performance Standards for antimicrobial Disk Susceptibility Tests; Approved Standards. A9. Ninth edition. Clinical and Laboratory Standard Institute (CLSI). 2006;2:52.
6. Isaacs D, Daley A, Calton D. Swabbing computers in search of nosocomial bacteria. Ped. Infect Dis J. 1998;17:533.
7. Bellamy K, Laban KL, Barreto KE, Btalbot DC. Detection of viruses and body fluids which may contains viruses in the domestic environment. Epidemiol. Infect, 1998, 673-680.
8. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4549928/
9. https://www.sciencedirect.com/science/article/abs/pii/S0195670119303913
10. https://tropmedhealth.biomedcentral.com/articles/10.1186/s41182-019-0144-y