



## STUDY ON MICROBIAL LOAD OF SMARTPHONES USED BY ALLIED HEALTH SCIENCE STUDENTS AND STAFF

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### ABSTRACT

Cell phones have become one of the essential devices used for communication in daily life, and they are commonly used almost everywhere. This study has done to enumerate the microbial load of smart phones used by allied health care students and staff. Mobile swabs from students and staff was collected and inoculated with different types of bacterial and fungal media. In this study, bacteria such as *Pseudomonas aeruginosa*, *Coagulase – negative Staphylococcus*, *Staphylococcus aureus*, *Moraxella catarrhalis*, *Enterococcus*, *Klebsiella sp* and aerobic spore forming bacilli were found. Fungisuch as *Aspergillusniger*, *Candida albicans* and *A. flavus* were found. It is necessary to create awareness among health care students and staff and also to restrict the usage of mobile phones in sterile areas and laboratories. Advisable to use the nanotechnology that has the anti- bacterial coat for mobile phones.

**Key Words:** Allied health care, *Pseudomonas aeruginosa*, *Coagulase – negative Staphylococcus*, *Staphylococcus aureus*, *Moraxella catarrhalis*, *Enterococcus*, *Klebsiella sp*, *Proteus sp*, *Aspergillusniger*, *Candida albicans*

### INTRODUCTION

Medical students and healthcare workers use smart phones for rapid communication within hospital settings (Ramesh *et al.*, 2008). However, one of the most common concerns regarding heavy use of mobile devices is that they can act as a vehicle for transmitting pathogenic bacteria and other microorganisms (Brady *et al.*, 2007). Contamination can spread from out-side surfaces to > 80% of exposed hands. Moreover, a previous study reported that > 90% of cell phones of health-care workers were contaminated with microorganisms and > 14% of them carried pathogenic bacteria that commonly cause nosocomial infections (Brady, *et al.*, 2006).

Several investigations in hospitals have demonstrated the presence of *Staphylococcus aureus*, *Bacillus spp.*, *Enterococcus spp.*, *Streptococcus spp.*, *Escherichia coli*, *Proteus spp.*, *Klebsiella spp.*, *Pseudomonas aeruginosa*, *Acinetobacter* and coliforms on mobile phones used by medical staff (Ramesh *et al.*, 2008) students (Nwankwo *et al.*, 2014) and patients (Tekerekoglu M.S., 2011).

In medical laboratories, mobile phones are often touched during activities related to sample collection, sample processing, culturing of microorganisms, etc. Therefore, mobile phones are

likely to get contaminated by various micro-organisms, some of which could be pathogenic in nature and multiple drug-resistant at times (Jaya Madhuri *et al.*, 2015). Keeping the mobile phones in the pockets, handbags and snug pouches increases the possibility of bacterial proliferation. Warmth, ideal temperature conditions and heat generated by mobile phones contribute to harboring bacterial populations on such devices at alarming rates (Jaya Madhuri *et al.*, 2015).

Moreover, physicians and paramedical staff, while attending patients, sometimes hold mobile phones close to their face, which facilitates the transmission of bacteria from mobile surfaces to hands, thus leading to the nosocomial spread of the bacteria (Elkholy and Ewees, 2010). Unlike fixed phones, mobile phones serve as a perfect habitat for the microbes to breed providing higher temperature and humid conditions (Srikanth *et al.*, 2009).

Mobile phones are often touched during activities related to health care like-examining the patients, providing nursing care, processing the samples, etc. Hence mobile phones are likely to get contaminated by various micro-organisms, some of which could very well be pathogenic in nature. Despite being used on a continuous basis, these mobile phones are seldom cleaned. They can also act as fomites for transmission of pathogenic organisms like *Staphylococcus aureus*, *Escherichia coli*, *Pseudomonas*, *Acinetobacter*, *Candida*, etc. Screening of mobile phones have been carried out in several studies (Usha *et al.*, 2007). By using this study, the microbial load of Smart phones used by MMM College of Health Science Students and Staff was evaluated.

## **METHODOLOGY**

The prospective study was performed from 1<sup>st</sup> April 2019 to 30<sup>th</sup> April 2019, A total of 100 samples were collected from the mobile phones of 87 volunteers of MMM students going to clinical, posted in different departments (3rd-year and Internship). 13 samples from teaching staff from MMM college of health sciences, Chennai. The following questions were asked to the students, If they use mobile phones at work and If they use mobile phone after proper hand wash while finishing their clinical/ duty time.

### **Specimen Collection**

Sampling was done using sterile cotton swab sticks. The swab sticks were dipped in sterile 0.9% normal saline rubbed all over the surface of mobile phones (Kiran Chawla, *et al.*, 2009)

### **Preparation of media and reagents**

All the media and reagents used in this study were prepared according to the revised written procedure of Manufacture Company and manual supplied by manufacturing company.

### **Himedia**

The readily available media such as Blood agar, Chocolate agar, MacConkey agar and Sabouraud dextrose agar were used for the isolation of the bacteria.

### **Specimen processing**

The samples (swabs) were immediately brought within half an hour of specimen collection to microbiology lab of MMM College of Health Sciences. The mobile swabs were inoculated in 5ml peptone water and incubated at 37°C for 2 hours. After incubation 0.1ml of sample was pipetted and dropped in four plates of Blood agar, Chocolate agar, MacConkey agar and

Sabouraud Dextrose agar. Using L-rod the sample was spreaded all over the plate. The Blood agar, Chocolate agar, MacConkey agar plates were incubated aerobically at 37°C for 24 hours for the isolation of bacteria. Sabouraud dextrose agar plates were incubated for 48 hours at 37°C for Yeast and also incubated for 10 days at room temperature for molds. Microbes were observed for growth. Colonies were counted and enumerated using colony counter.

**Identification of bacteria** (Aneja KR., 2003).

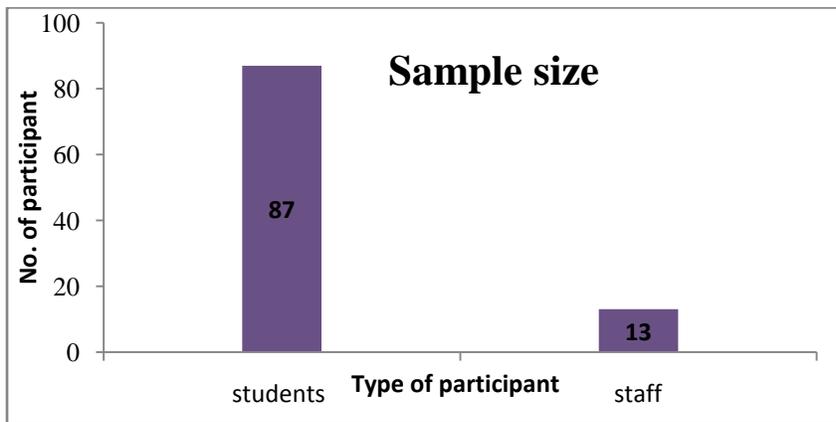
The bacterial colony characteristics in culture plates were identified by using Gram staining and microscopical observation and Biochemical tests

**Identification of fungus**

Identification of fungi by their cultural characteristics, lactophenol cotton blue stain and by Germ tube test for *Candida albicans*

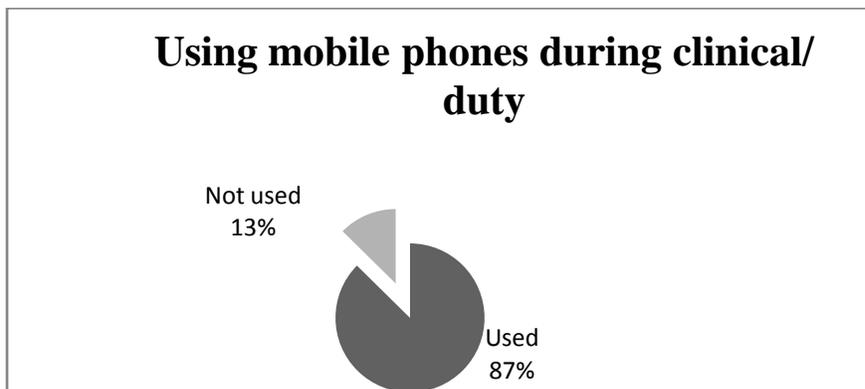
**RESULTS**

Out of 100 participants, 87 were students (Internship, 3<sup>rd</sup> year and 2<sup>nd</sup> year). 13 were staff of College of Health Sciences (fig 1.1).



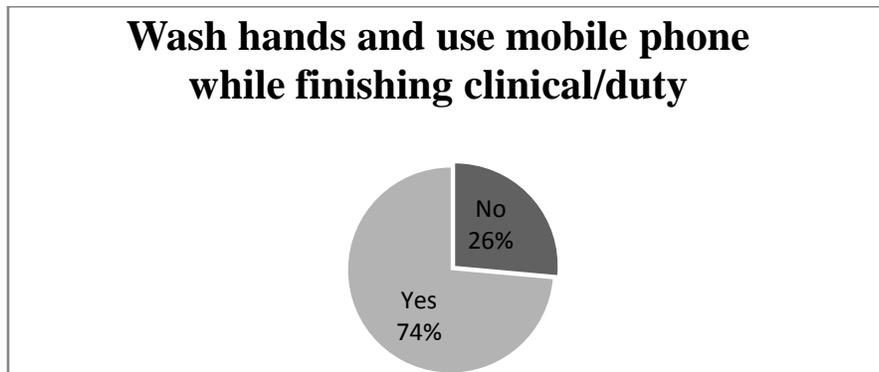
**Figure 1.1**

Around 92% of mobile phone swabs showed at least one type of bacterial growth. Out of 87 students, 76 (87.3%) use their mobile phone during clinical / duty hours. Remaining 11 (12.6%) do not use during clinical / duty hours (fig 1.2).



**Figure 1.2**

Also, out of 87 Students, 23(26.4%) revealed that after clinical training they use their mobile phones without handwashing. Remaining 64(73.5%) use their mobile phones after washing their hands( fig 1.3).

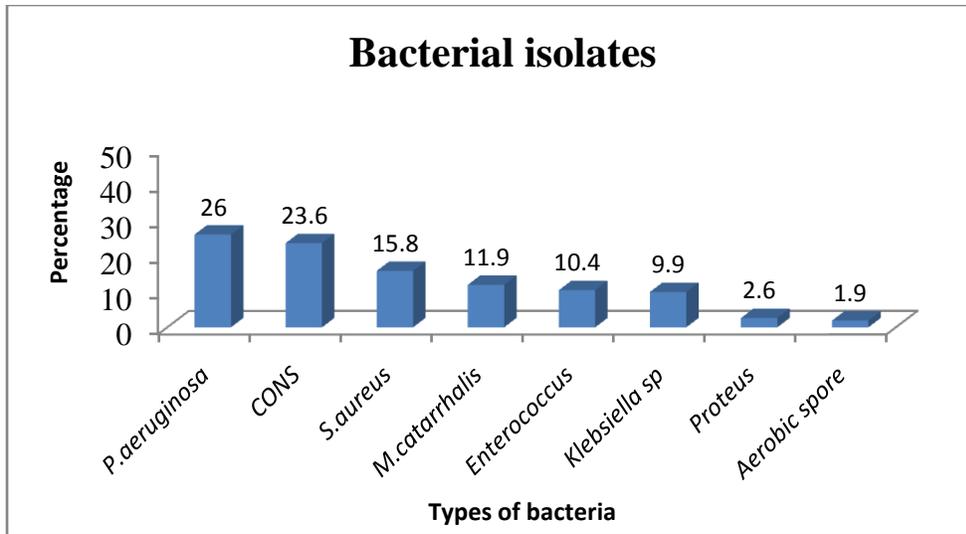


**Figure 1.1**

Out of 100 samples, *Staphylococcus aureus*, *Coagulase - negative Staphylococcus species(CONS)* and *Pseudomonas aeruginosa* were accounted >60% of the samples. Some mobile phones are contaminated by two or three microbial species (Tab 1.1 ) (fig 2.1.1). *Pseudomonas aeruginosa* (26%), *CONS* (23.4%), *Staphylococcus aureus* (15.8%), *Moraxella catarrhalis*( 11.9%), *Enterococcus* (10.4%), *Klebsiellasp* (9.9%), *Proteussp* (2.6%), *Aerobic spore forming bacilli* (1.9%)

Bacterial isolates	Sample	Colonies	Percentage%
<i>Pseudomonas aeruginosa</i>	44	107	26.0
<i>Coagulase- negative Staphylococcus sp</i>	32	97	23.6
<i>Staphylococcus aureus</i>	31	65	15.8
<i>Moraxella catarrhalis</i>	19	49	11.9
<i>Enterococcus</i>	12	43	10.4
<i>Klebsiellasp</i>	8	41	9.9
<i>Proteus sp</i>	2	11	2.6
Aerobic spore forming bacilli	4	8	1.9

**Table 1.1**

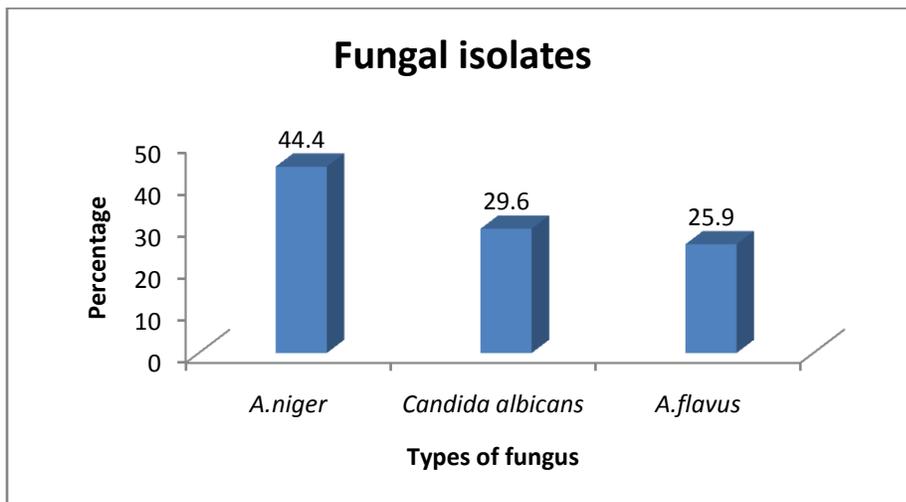


**Figure 2.1 1**

Out of 100 samples, 27 samples were found to have fungal contamination 12 (44.4%) *Aspergillus niger*, 8 (29.6%) *Candida albicans* and 7 (25.9%) *Aspergillus flavus*. (tab 1.2) (fig 2.1.1) Remaining 73 samples are not showing any growth of fungus.

Fungal isolates	Sample	Percentage%
<i>Aspergillus niger</i>	12	44.4
<i>Candida albicans</i>	8	29.6
<i>Aspergillus flavus</i>	7	25.9

**Table 1.2**



**Figure 2.1 2**

**DISCUSSION**

Although most cell phones tested were contaminated with one or more microorganisms, contamination with *S. aureus* was found in 17 cell phones. This represents a high percentage of contamination with this pathogenic organism that is commonly found in toilets (Ajayi AE., 2014). Given that medical students are present in health-care settings, mobile devices belonging

to this group may act as vehicles for transmission of infection to patients if these devices are not used cautiously. The concern about cell phone contamination in medical settings is increased due to the possibility of cross-contamination of these devices that act as an environmental reservoir and source of bacterial cross-contamination, particularly in the most sensitive clinical areas such as operating theaters, intensive care units and burn units ( Brady RR *et al.*,2007).

The presence of the gram-negative rod, *Enterobacter aerogenes*, a member of the coliforms, indicates the possibility of the presence of faecal contamination on the mobile phone. Gram-negative sepsis is most commonly caused by *E coli*, *Klebsiella* spp, *Enterobacter spp* and *Pseudomonas aeruginosa* (Amira H.A., Al Abdalall 2010). The potential of cell phones to transfer microorganisms can be reduced through the use of cleaning and disinfecting practices (Jeske *et al.*,2007). The need to clean mobile phones is well known and agents such as ethanol and isopropanol have been investigated for this purpose (Harrison P., 2014). Recommendations in the literature include the use of nanotechnology, antibacterial coatings/covers, or silver metal to reduce the contamination rate of mobile phones.(Karabay *et al.*,2007).

In this study, bacteria such as *Pseudomonas aeruginosa*, *Coagulase – negative Staphylococcus species*, *Staphylococcus aureus*, *Moraxella catarrhalis*, *Enterococcus*, *Klebsiella* sp, *Proteus sp*, *Aerobic spore forming bacilli* were isolated.

## CONCLUSION

Mobile phones has become necessary tool that is used everywhere. Pathogenic microbes are harboured from outside and inside to the sterile areas of the hospital. The mobile phones of health care students act as a transmissible vehicle for the microbes. These bacterial isolates are an opportunistic, nosocomial pathogen that may cause skin and soft tissue infection, respiratory tract infection and gastrointestinal tract infection. Although they are usually a commensal of the human, it can also become an opportunistic pathogen that may cause skin infections including abscesses, respiratory infection, pneumonia, septicemia, meningitis, diarrhea. Fungal isolates such as *A. niger*, *candida albicans* and *A. flavus* are pathogenic that may bring infection ranging from superficial to systemic infection

## RECOMMENDATIONS

- It is necessary to create awareness among health care students and as well as hospital staff about the microbial load of smartphones.
- Should restrict the usage of smartphones in hospital area such as laboratory, ICU, NICU, operation theatre , other sterile areas and during aseptic procedures.
- It is also important to educate the staff and students about the hand hygiene practice during clinical / duty time. . Microbial load of smartphones can also be minimized by using hand rubs often.
- It is also recommended to use the anti- bacterial liquid gadget sanitizer on mobile phones that are commercially available.

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