

Original Research Article

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Mobile Phones of Healthcare Workers: A Potential Threat to Nosocomial Infections?

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ABSTRACT

Mobile phones of healthcare workers carry various micro-organisms. If pathogenic bacteria and resistant strains are isolated from mobile phones, they can be a potential threat in the spread of nosocomial infections. To study the microbial flora isolated from mobile phones of doctors and nurses and to isolate possible pathogens and detect resistant strains among them. 90 swabs were collected from mobile phones of healthcare workers (30 physicians, 30 surgeons and 30 nurses) and plated onto sheep blood agar and MacConkey agar. Bacterial isolates were identified by suitable biochemical reactions. Resistance patterns among pathogens were recorded. Out of 90 swabs, 72 (Physicians-30, Surgeons-24, Nurses-18) showed growth. Commonly isolated organisms were Micrococci (59%), Diphtheroids (23%), *Staphylococcus aureus* (7%), Coagulase negative *Staphylococcus* (5%), *Enterococcus* species (3%) and *Klebsiella pneumoniae* (3%). Out of 6 *Staphylococcus aureus*, 4 were Methicillin resistant, all of which were isolated from physicians. Mobile phones of nurses showed significantly lesser growth, as most of them do not use their mobile phones during work hours. Overall, most organisms isolated were normal flora and common contaminants, the incidence of pathogens being significantly low. So, the process of regular hand sanitization itself can control the spread of infection from mobile phones.

Keywords

Mobile phone, Mobile, nosocomial infection, hospital acquired infection, fomites

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Introduction

Mobile phones have almost become like another hand amongst society in the last decade. Most healthcare workers like doctors, dentists, nursing staff and physician assistants carry a mobile phone to work and it is also

used time and again in the presence of patients to show them their laboratory and imaging reports, or references from the internet during consultation and even for official calls. Whether this unscrupulous usage occurs with or without gloves and before or after washing hands is often a question mark.¹

Researchers have shown that mobile phones harbour more organisms than the sole of a shoe or door handles with a huge count of more than ten thousand microbes in one square inch. Since the mobile phones also produce a lot of heat, that can serve as an incubator for the microbes to multiply exponentially, making the mobile phones a perfect source of cross infections.²

Since mobile phones have become absolutely essential and are being used in areas which are highly contaminated, it becomes an absolute necessity to maintain personal hygiene measures like washing of hands before and after consumption of meals or before and after examining each and every patient. Unfortunately, no such standard practices are available for cleaning or disinfecting a mobile phone. The dust that is sedimented on top of the mobile phone can be wiped down with a clean cloth. But as a device that harbours multiple micro organisms, mere surface cleaning of the mobile phone is not sufficient to prove it to be safe.³

Awareness of availability of mobile disinfectant solutions is not very common and the efficacy of those solutions have not been proven or demonstrated with much scientific studies either. The moisture present in the atmosphere and even the warmth of the hands or palms or pockets can lead to exponential growth of microbes on the mobile phones. Numerous studies have identified and isolated *Staphylococcus aureus* from different mobile phones, which happens to be a causative agent of different nosocomial infections.⁴ The present study was done to evaluate the bacterial flora of the mobile phones of health care workers, to identify the pathogenic bacteria among the ones isolated, to study the resistant strains among the isolated pathogens and to study the awareness amongst the healthcare individuals to clean their mobile phones on a regular basis.

Materials and Methods

Questionnaire

After obtaining the approval of the Institutional Ethics Committee to conduct the study, 90 health care workers, 30 physicians, 30 surgeons and 30 staff nurses working in Dhanalakshmi Srinivasan Medical College, Perambalur, Tamil Nadu were chosen by random sampling method. After obtaining informed consent, a brief questionnaire was given to them and details like the participants age, designation, kind of phone (Touch or analog), extent of phone usage during duty hours were collected.

Sample Collection

Samples were collected from the mouthpiece side and the backside of all their mobile phones were collected using disposable sterile swabs. The collected samples were plated onto Blood agar (for isolation of fastidious organisms) and MacConkey agar (to differentiate between lactose fermenting and non lactose fermenting bacteria and were incubated at 37°C for 24 hours.

Processing

The plates were examined for growth after 24 hours, where the colony morphology was studied on the culture plates. Smears were made from the colony and Gram staining was done and the morphology was recorded. Spore bearing Gram positive bacilli were not processed. Gram positive cocci and Gram negative bacilli were processed separately.

Gram Positive Cocci

For Gram positive cocci, a slide catalase test was done. Catalase positive gram positive cocci were subjected to tube coagulase test and antibiotic sensitivity testing was done on

Mueller Hinton agar after 2 hour incubation in peptone water. AST was performed by disc diffusion method after streaking the growth on peptone water using a sterile swab. For Catalase negative Gram positive cocci, Bile esculin test was done and Antibiotic Sensitivity testing was done by disc diffusion method on Blood Agar after direct streaking.

Gram negative Bacilli

Colonies belonging to Gram negative bacilli were inoculated in peptone water and incubated for 2 hours, following which motility was performed by hanging drop method and the results were recorded. Catalase test was done for all gram negative bacilli and oxidase test using dry filter paper method was done for Non lactose fermenting colonies alone. The broth culture was then inoculated in biochemical reactions like Indole, Citrate, Urease, Mannitol Motility testing and Triple sugar iron agar. Antimicrobial sensitivity testing was done by disc diffusion method on Mueller Hinton agar by streaking the growth on peptone water using a sterile swab.

Identification and Antibiotic Sensitivity testing

The results of the biochemical reactions were recorded and identification of the organism was done. Antibiotic sensitivity was estimated and drug resistant organisms were noted down the next day and the answers of the questionnaire were compiled and recorded. Prevalence of bacteria on the surface of the mobile phones of health care workers was calculated using simple percentage calculation.

Results and Discussion

Out of the 90 samples collected, 30 samples were from physicians, 30 were from surgeons

and 30 were from staff nurses. All of the physicians from whom the sample was collected are males and belong to an age group less than 40. The surgeons from whom the sample was collected are all males and belong to age groups ranging from 28 to 60. The staff nurses from whom the sample was collected are all females and they belong to the age group ranging from 23 to 40 (Fig.1).

The designations of the physicians vary between Post graduates, assistant professor and associate professor. Their designations of the surgeons vary between Post graduates, assistant professor and associate professor and professor. The designations of the staff nurses vary between junior staff nurse, senior staff nurse and head nurse.

All 30 physicians use a touch screen mobile. Among the 30 surgeons, 28 use a touch screen mobile phone and 2 use an analogue mobile phone. Among the 30 staff nurses, 20 of them used an analogue mobile and 10 of them were using a touch screen mobile phone (Fig.2).

Among physicians, mobile phone usage during working hours ranges between half an hour to four hours. For surgeons it ranges between half an hour to three hours and the mobile usage during working hours for staff nurses ranges between half an hour to one hour.

Amongst the 90 samples collected, 72 samples showed growth on the culture plate. Among the 72 plates that showed growth, 30 belonged samples collected from physicians, 24 belonged to surgeons and 18 belonged to staff nurses. 30 out of 30 samples (100%) from physicians were positive, 24 out of 30 samples (80%) from surgeons were positive and 18 out of 30 (60%) samples from staff nurses were positive. 18 samples were sterile, among which 6 were samples collected from surgeons and 12 samples were collected from staff

nurses (Fig 3). Out of the 72 positive samples, 70 belonged to people belonging to age less than 40 and two belonged to age between 40-60. Growth was seen more in mobile phones of postgraduates (20), assistant professors (25) and junior nurses (18) while samples from professors (2) and head nurse (0) showed little or no growth. Among the 72 positive samples, 64 were collected from touch screen mobile and 8 were from analogue mobile phones.

Out of the 72 samples which showed growth, 62 samples had a single type of bacterial growth and 10 samples had more than 1 type of bacterial growth. Among the 10 samples that showed two types of colonies, 6 came from samples collected from physicians, 2 from samples collected from surgeons and one from samples collected from a staff nurse.

Out of the 82 organisms grown, 48 (59%) were *Micrococcus* spp, 20 (23%) were Diphtheroids, 6 (7%) were *Staphylococcus aureus*, 4 (5%) were Coagulase negative *Staphylococcus* 2(3%) were *Enterococcus* spp and 2 (3%) were *Klebsiella pneumoniae* (Fig 4).

Among the 6 *Staphylococcus aureus* strains isolated, 4 were Methicillin resistant and all 4 MRSA strains were isolated from mobile phones belonging to physicians. Among the 2 isolates of Enterococci isolated, none of them were resistant to Vancomycin. Among the 2 isolates of *Klebsiella pneumoniae*, none of them were ESBL or MBL producers. The distribution of the various kinds of organisms that were isolated across the different healthcare workers are elaborated in Table 1.

Only 10 out of the 90 healthcare workers from whom the samples were collected had the habit of cleaning their mobile phones regularly. Among the 10, 8 were surgeons and 2 were physicians. Out of the ten mobiles

which were regularly cleaned, 6 showed no growth, 4 from surgeons and 2 from physicians.

The duration of mobile phone usage during duty hours is high with physicians because they use their mobiles to check and convey the reports of X-rays or other imaging techniques and laboratory test reports to patients in the outpatient area and in the wards during everyday rounds.⁵

The growth is considerably lesser with surgeons since they spend a considerable amount of time in the operating room and procedure room, performing sterile procedures, thus making them stay away from their mobile phones in working hours.⁶ The staff nurses are prohibited to carry or use their mobile phones during their duty hours which is constantly monitored by the supervisors and chief nurses, which could be a reason behind lesser mobile usage during working hours. The same reason could be used to justify the reason why samples from mobile phones of physicians showed higher growth compared to surgeons and even lesser growth among samples collected from staff nurses.⁷

64 of the positive samples came from touch screen mobiles while only 12 positives came from analogue mobile phones. This could be because of the presence of the internet and a cast number of applications present on a touch screen mobile compared to an analogue mobile phone. Subjects who own an analogue mobile phone in this study stated that they use their mobile only to attend important calls and for no other purposes. Touch screen mobile users on the other hand said that they use their mobiles for various purposes like watching movies, listening to songs, alarm clock, reminders in calendar, drug dosage calculation etc.⁸

Table.1

Organism	Overall Prevalence (%)	Distribution in Physicians	Distribution in Surgeons	Distribution in Staff Nurses
<i>Micrococcus</i> sp	48 (59%)	20	20	8
Diphtheroids	20 (23%)	4	6	10
<i>Staphylococcus aureus</i>	6 (7%)	4	2	-
Coagulase negative Staphylococcus	4 (5%)	3	1	-
<i>Enterococci</i> species	2 (3%)	2	1	1
<i>Klebsiella pneumoniae</i>	2 (3%)	1	1	-

Fig.1

Figure 1: Age Group:

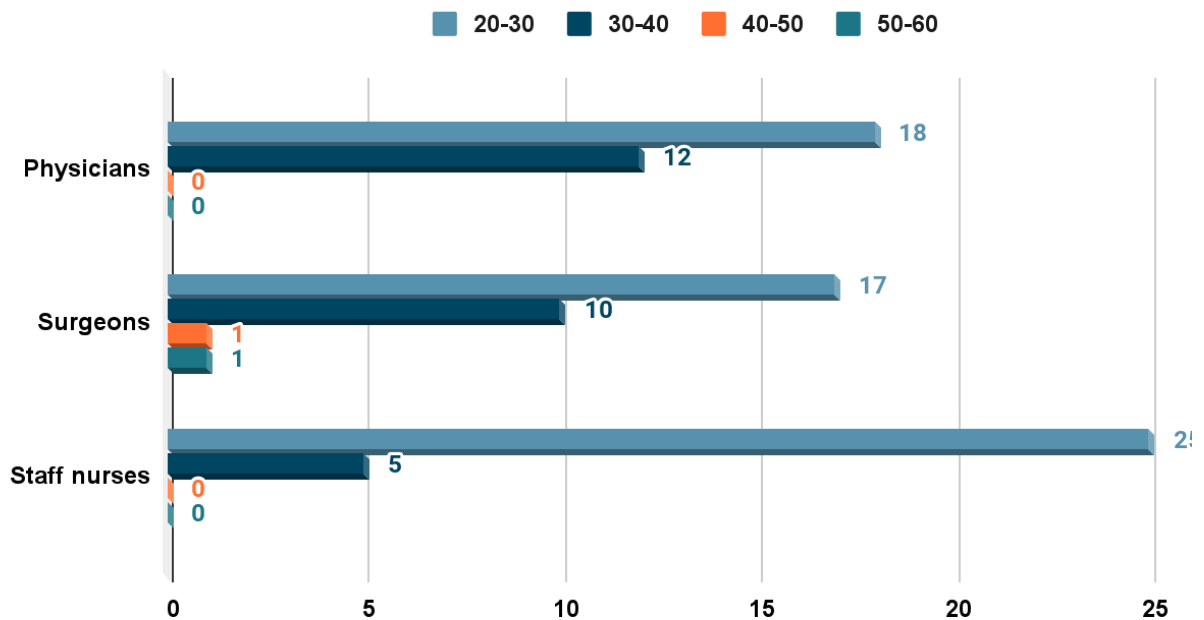


Fig.2

Figure2: Type of mobile phone

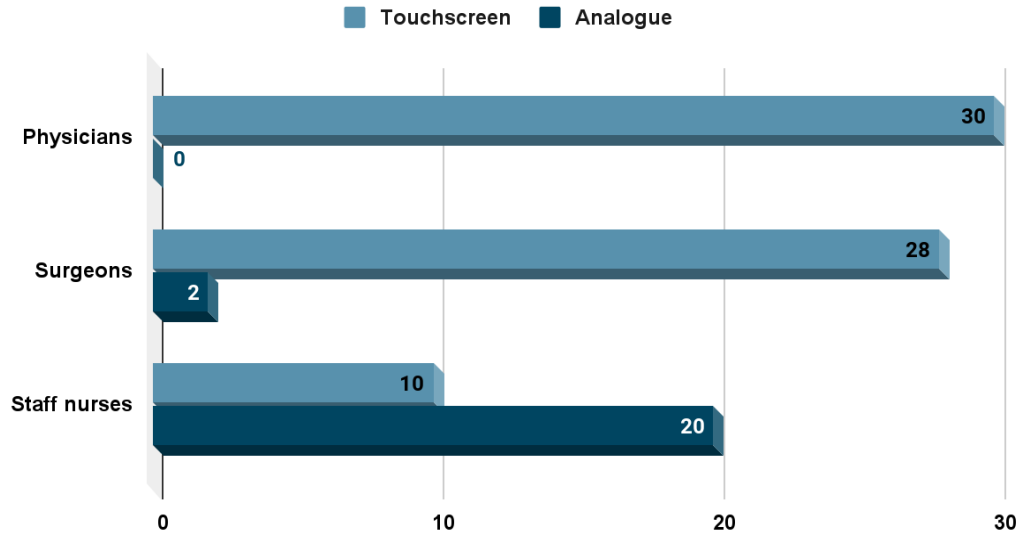


Fig.3

Figure 3: No. of Samples with growth

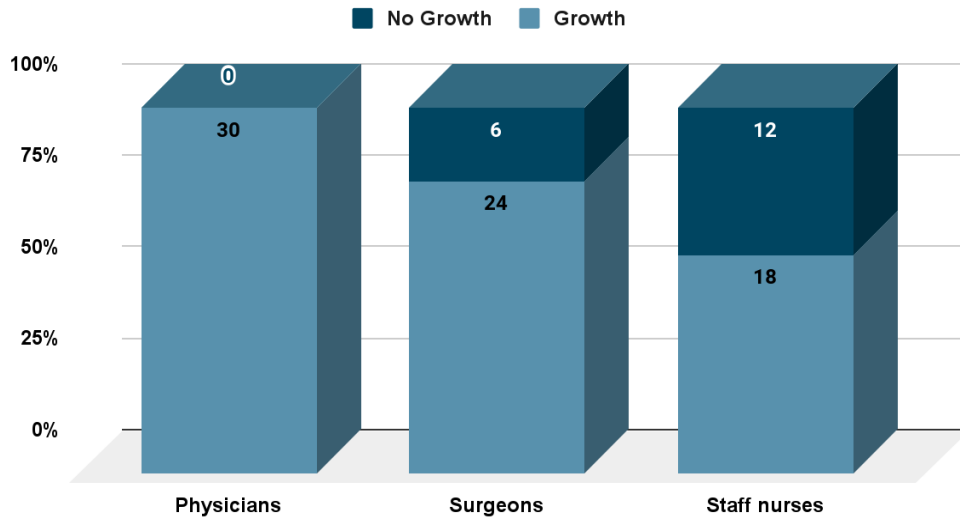
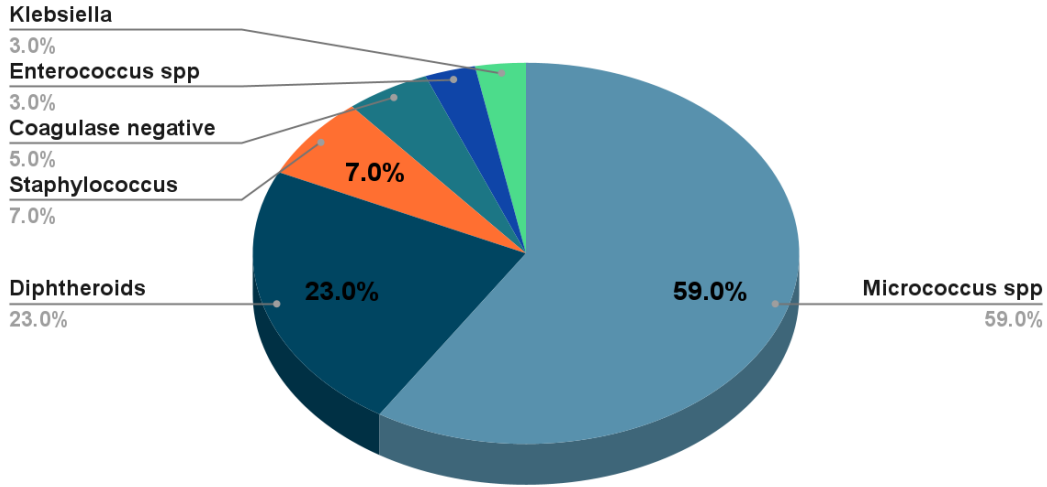


Fig.4

Figure 4: Bacterial growth pattern



Out of the 72 positive samples, 70 were isolated from age groups below 40 and only 2 people were above 50. The reason could be due to fear of technology or sticking to ethical practices and avoiding mobile phones during duty hours in the elderly age group.⁹

The overall prevalence of microorganisms isolated from the samples was 80%, which is in concordance with Mohanram K *et al.*,¹⁰ and Sharma *et al.*,¹¹ which show 70-75% of growth. While studies like Bodena *et al.*,¹², Kakade *et al.*,¹³ and Gumanju *et al.*,¹⁴ show prevalence percentages as high as 99%, there are also studies like Mohammad *et al.*,¹⁵ and Gulnar *et al.*,¹⁵ which have a prevalence that is less than 50%.

Micrococcus species was the commonly isolated organism(59%), which is in concordance with. Mohanram K *et al.*,¹⁰ which has also recorded Micrococci as the most commonly isolated organism from the mobile phones of healthcare workers. Sharma

et al.,¹¹ showed only a prevalence of 16% and Kakade *et al.*,¹³ a prevalence of 11%.This could be due to the geographical similarities in topography, temperature and other climatic factors between the regions where Micrococci was commonly isolated as skin commensal.

The next common organism that was isolated was Diphtheroids (23%), in accordance with Gumanju *et al.*,¹⁴(20%) and Mohammad *et al.*,¹⁵(21%) and in discordance with studies like Sharma *et al.*,¹¹(0%) and Mohanram K *et al.*,¹³(8%) which could be because it is an ubiquitous organism and its spores are seen widespread in the environment and spreads through air.

Staphylococcus aureus was isolated from 6 samples(7%), out of which 4 were Methicillin resistant. This result is in discordance with various studies like Mohammad *et al.*,¹⁵(15%) and Sharma *et al.*,¹¹ (35%), Kakade *et al.*,¹³ (15%). This could be due to lack of screening of healthcare workers who are at the risk of

being carriers for MRSA because the area where it is isolated is usually from the palm region, which is what is mostly in contact with mobile phones.

4(5%) Coagulase negative Staphylococcus and 2(3%) Enterococcus species were isolated which again are normal residents of the skin flora which are in concordance with the results of the studies conducted by Mohanram K *et al.*,¹³ Sharma *et al.*,¹¹ and Mohammad *et al.*,¹⁵

In a study conducted by Bodena *et al.*,¹² the prevalence of *Klebsiella pneumoniae* isolated from mobile phones was 4%, which is in concordance with the study(3%). There is also the study conducted by Mohammad *et al.*,¹⁵(19%) which is against the result of the current study. Nevertheless, presence of a pathogenic organism like *Klebsiella pneumoniae* is alarming, since it could act as a potential vector for the spread of nosocomial infections and the probable source could have been from the wards or intensive care units.

Organisms like *Escherichia coli*, *Pseudomonas aeruginosa* and *Acinetobacter baumannii* have been isolated in various researches by Gumanju *et al.*,¹⁴ Mohanram K *et al.*,¹³ Mohammad *et al.*,¹⁵ and Sharma *et al.*,¹¹

Among the 10 mobile phones which were being cleaned on a regular basis with sterile alcohol wipes, 6 showed no growth. The 4 samples which showed growth only contained commensal flora and not pathogens. This is probably because periodic cleaning prevents deposition and multiplication of pathogens on the surface of the mobile phones. A study conducted by Mohanram K *et al.*,¹³ also shows a considerable decrease in the growth of microorganisms if the mobile phones are cleaned with isopropyl alcohol on a regular basis. The prevalence of pathogenic organisms were considerably lower and most organisms

that were isolated were only commensals, there could be a chance that mobile phones can act as fomites or vectors and play a minor role in transmission of hospital acquired infections.

Isolating Drug resistant bacteria from mobile phones is something to be alarmed about and using mobile unscrupulously in hospitals should be brought under control. Unless absolutely necessary, usage of mobile phones in contaminated areas should be avoided as much as possible,

Since it is evident that regular cleaning of mobile phones is effective, it could also be included in the hospital infection control policy to promote cleaning of mobile phones and create awareness regarding the same amongst general public.

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