

Original Article

Bacterial 'Cell' Phones: Do cell phones carry potential pathogens?

Authors

Kiran Chawla, Chiranjay Mukhopadhyay, Bimala Gurung, Priya Bhate, Indira Bairy,

Department of Microbiology, Kasturba Medical College, Manipal, Karnataka, India

Address For Correspondence

Kiran Chawla,

Department of Microbiology,
Kasturba Medical College,
Manipal, Karnataka,
India.

E-mail: arunkiranchawla@yahoo.com

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Abstract:

Cell phones are important companions for professionals especially health care workers (HCWs) for better communication in hospital. The present study compared the nature of the growth of potentially pathogenic bacterial flora on cell phones in hospital and community. 75% cell phones from both the categories grew at least one potentially pathogenic organism. Cell phones from HCWs grew significantly more potential pathogens like MRSA (20%), *Acinetobacter* species (5%), *Pseudomonas* species (2.5%) as compared to the non HCWs. 97.5% HCWs use their cell phone in the hospital, 57.5% never cleaned their cell phone and 20% admitted that they did not wash their hands before or after attending patients, although majority (77.5%) knows that cell phones can have harmful colonization and act as vector for nosocomial infections. It is recommended, therefore, that cell phones in the hospital should be regularly decontaminated. Moreover, utmost emphasis needs to be paid to hand washing practices among HCWs.

Key Words: Cell phones, Health care workers, Pathogen carriers

Introduction:

Cell phones are increasingly becoming an important means of communication in India. Being expensive and conveniently small in size, they are used by doctors and other health care workers (HCWs) in a hospital for immediate communication during emergencies, in rounds, and even in operation theatres and intensive care units.^{1,2} They may serve as mobile reservoirs of infection allowing the transportation of the contaminating bacteria to many different clinical environments.³ Further, sharing of cell phones between HCWs and non HCWs may directly facilitate the spread of potentially pathogenic bacteria to the community.

Various objects like stethoscopes, patient's file, bronchoscopes and ballpoint pens have already been reported as vectors for potentially pathogenic microorganisms from HCWs to patients.⁴⁻⁷ The potential of cell phones as vectors to nosocomial infection has been studied before.¹⁻³ These studies reported that the most commonly found bacterial isolate was *Coagulase Negative Staphylococcus* (CONS) as a part of normal skin flora. Potentially pathogenic bacteria found were methicillin sensitive *Staphylococcus aureus* (MSSA), coliforms, methicillin resistant *Staphylococcus aureus* (MRSA), *Corynebacterium* spp., *Enterococcus faecalis*, *Clostridium perfringens*, *Klebsiella* spp., *Enterobacter* spp., *Pseudomonas* spp., *Aeromonas* spp., *Acinetobacter* and *Stenotrophomonas maltophilia*.

Although the contamination of cell phones of HCWs has been studied, little information regarding the contamination of personal cell phones of people in the community exists. Bacterial flora on cell phones of HCWs may vary in composition, number and antibiotic sensitivity, to that found on cell phones of non-HCWs. This is probably the first study in India that attempts to study the bacterial flora present on the cell phones of HCWs and to compare it with that found on cell phones of non HCWs in terms of composition, number and antibiotic sensitivity.

Methods:

The prospective study was conducted for three months from July, 2008 to September, 2008 in a teaching institution. Samples from the mobile phones of all participants from the hospital and the community who volunteered and verbally consented were collected without prior intimation and each was asked to fill up questionnaire regarding patterns of usage, hygiene practices and awareness.

Sample Collection: A sterile cotton swab moistened with sterile normal saline was rolled over all exposed outer surfaces of the cell phones which were used for at least 1 month. Care was taken to make sure that the keypad and all buttons were swabbed since these areas are most frequently in contact with the tips of fingers.

Samples were collected from 2 populations

1. **HCWs (40):** A total of 40 HCWs including doctors (n=30) and nurses (n=10) from different departments like medicine, surgery, urology, orthopedics, skin and STDs, pediatrics, and obstetrics and gynecology were included.
2. **Non - HCWs: (40)** A total of 40 people who do not work in any health care set up like rickshaw drivers (n=5), people working in the food court (n=10), staff of the central library (n=7), staff of the institutional administrative office (n=8) and 1st yr medical students (n=10) were included.

The samples, transported within 30 min, were streaked onto sheep blood agar (SBA) for semiquantitation by dilution streaking into 4 quadrants and incubated overnight at 37°C.

Quantification of growth: The visible growth from each plate was categorized into no growth, scanty, moderate or heavy growth based on the following criteria:

- **No growth:** No colonies in any of the 4 quadrants of the plate
- **1 + or scanty growth:** Growth in quadrant 1 only
- **2 + or Light growth:** Growth in quadrant 1 and 2 only
- **3 + or moderate growth:** Growth in quadrant 1, 2 and 3
- **4 + or heavy growth:** Growth in quadrant 1, 2, 3 and 4

Identification of growth: Based on Gram-stain and appropriate biochemical tests, isolates were identified. Fungi were stained with lactophenol cotton blue and were cultured on Sabouraud's dextrose agar.

Antibiotic sensitivity test: Antibiotic sensitivity was done using Kirby-Bauer disc diffusion method on Mueller-Hinton agar according to Clinical Laboratory Standards Institute antibiotic disc susceptibility testing guidelines.⁸ MRSA was confirmed by testing with an oxacillin (1 µg) disc on Mueller Hinton agar with 4% NaCl and incubated at 35°C for 24 hours.

Analysis of results: The data was analysed using SPSS 11.5. Tests of significance were done using Chi square test and Fischer's exact test.

Results:

Of the 80 subjects, 37 (92.5%) HCWs and 37 (92.5%) non HCWs showed positive growth. The bacterial growth, the type and number of organisms found on the cell phones have been summarized in Table I, II and III. The most common organisms found on cell phones of HCWs were *diphtheroids* & aerobic spore bearing bacilli (25, 62.5%), followed by MSSA (22, 55%). The most common organisms found on cell phones of non HCWs were MSSA (29, 72.5%) followed by *diphtheroids* & aerobic spore bearing bacilli (18, 45%).

Table I: Quantification of bacterial growth found on the cell phones of HCWs and non HCWs.

| Quantification of growth | HCWs (n=40) | | Non HCWs (n=40) | | p-value |
|--------------------------|-------------|-------|-----------------|-------|---------|
| | n | f (%) | n | f (%) | |
| No growth | 3 | 7.5 | 3 | 7.5 | 0.445 |
| Scanty | 23 | 57.5 | 21 | 52.5 | |
| Moderate | 10 | 25 | 15 | 37.5 | |
| Heavy | 4 | 10 | 1 | 2.5 | |

Table II: Comparison of microbial growth on cell phones of HCWs and non HCWs

| Type of organism | HCW (n=40) | | Non HCW (n=40) | | p-value |
|---|------------|-------|----------------|-------|---------|
| | n | f (%) | n | f (%) | |
| <i>Diphtheroids</i> & aerobic spore bearing bacilli | 25 | 62.5 | 18 | 45 | 0.12 |
| MSCONS | 16 | 40 | 13 | 32.5 | 0.49 |
| MSSA | 22 | 55 | 29 | 72.5 | 0.10 |
| MRSA | 8 | 20 | 0 | 0 | 0.005 |
| <i>Acinetobacter</i> species | 2 | 5 | 1 | 2.5 | |
| <i>Pseudomonas</i> species | 1 | 2.5 | 0 | 0 | |
| <i>Neisseria</i> species | 1 | 2.5 | 0 | 0 | |
| <i>Candida</i> species | 1 | 2.5 | 0 | 0 | |
| <i>Aspergillus</i> species | 1 | 2.5 | 0 | 0 | |

Table III: Number of cell phones that showed multiple organisms

| Number of different organisms isolated | HCWs (n=40) | | Non HCWs (n=40) | | p-value |
|--|-------------|-------|-----------------|-------|---------|
| | n | f (%) | n | f (%) | |
| None (no growth) | 3 | 7.5 | 3 | 7.5 | 0.163 |
| 1 type | 10 | 25 | 17 | 42.5 | |
| 2 types | 16 | 40 | 16 | 40 | |
| 3 or more types | 11 | 27.5 | 4 | 10 | |

In case of HCWs, 30 (75%) showed growth of at least one potentially pathogenic organism, like 22 (55%) grew MSSA, 8 (20%) grew MRSA, 3 grew Gram negative bacilli (GNB) including 2 (5%) *Acinetobacter* species and 1 (2.5%) *Pseudomonas* species and 2 (5%) grew fungi including *Aspergillus* species (1, 2.5%) and *Candida* species (1, 2.5%) Totally, there were 9 different potentially pathogenic organisms found on cell phones of HCWs. Assessment of antibiotic sensitivity revealed that all the isolates of *Acinetobacter* species and *Pseudomonas* species were sensitive to antibiotics.

In non HCWs, 30 (75%) showed growth of at least 1 potentially pathogenic organism. 29 (72.5%) grew MSSA and 1 (2.5%) grew *Acinetobacter* species. Totally, there were 2 different potentially pathogenic organisms found. However, no drug resistant organisms were found on cell phones of non HCWs.

In case of cell phones of HCWs majority (27.5%) showed the presence of 3 or more types of organisms whereas only one type of organisms were grown in majority of cases (42.5%) of non HCWs. Eight (26.67%) out of 30

S.aureus isolates from the cell phones of HCWs were MRSA; in contrast, none of the 29 *S. aureus* isolates from non HCWs' cell phone were MRSA.

Table IV and Table V show the response to questions asked from HCWs and non-HCWs. Most of the HCWs use cell phones in hospitals (97.5%) and 47.5% use it while attending patients. A majority of the HCWs (65%) uses cell phones when involved with invasive procedures. Majority neither clean their cell phones regularly (82.5%) nor wash hands after using cell phones (87.5%). Many of them (32.5%) do not believe that cell phones can act as vector for spread of nosocomial infections from one patient to another and it can have harmful colonization. Most of them share cell phones with colleagues (70%) and at home (95%).

Community awareness is much better regarding colonization and infection. While 45% believe that microbes can cause disease and can be present on the skin (55%) as well as on non-living things (57.5%), sharing of cell phones was noticed in 60% of non HCWs.

Table IV summarizes the response to the questions asked to the HCWs (n=40)

| Questions | Yes | | No | |
|--|-----|------|----|------|
| | f | % | f | % |
| Do you use a cell phone in the hospital? | 39 | 97.5 | 1 | 2.5 |
| Do you answer phone calls while attending to patients? | 19 | 47.5 | 21 | 52.5 |
| Have you ever cleaned your cell phone in the past? | 17 | 42.5 | 23 | 57.5 |
| Do you clean your cell phone regularly? | 7 | 17.5 | 33 | 82.5 |
| Do you wash your hands after using your cell phone? | 5 | 12.5 | 35 | 87.5 |
| Do you wash your hands before attending to your patient? | 32 | 80 | 8 | 20 |
| Do you think your cell phone can carry bacteria? | 37 | 92.5 | 3 | 7.5 |
| Do you think your cell phone can transfer bacteria from one patient to another? | 27 | 67.5 | 13 | 32.5 |
| Do you think you could have harmful colonization from using cell phones in the hospital? | 27 | 67.5 | 13 | 32.5 |
| Do your colleagues use your cell phone? | 28 | 70 | 12 | 30 |
| Do you use the same cell phone at home? | 38 | 95 | 2 | 5 |
| Do you carry out any invasive procedures? | 26 | 65 | 14 | 35 |
| Do you carry your stethoscope, hammer etc in the same place with the cell phone? | 10 | 25 | 30 | 75 |
| Do you want to know the growth from your cell phone? | 38 | 95 | 2 | 5 |

Table V summarizes the response to the questions asked to the non HCWs (n=40)

| Questions | Yes | | No | |
|---|-----|------|----|------|
| | f | % | f | % |
| Have you visited a healthcare centre in the past 15 days? | 10 | 25 | 30 | 75 |
| Do you have any family members/ friends who are doctors/ nurses/who work in the hospital that use your phone? | 8 | 20 | 32 | 80 |
| Do your colleagues at your workplace use your cell phone? | 24 | 60 | 16 | 40 |
| Do you think all microorganisms cause disease? | 18 | 45 | 22 | 55 |
| Do you think microbes are present on your skin? | 22 | 55 | 18 | 45 |
| Can microbes be present on nonliving things? | 23 | 57.5 | 17 | 42.5 |
| Do you frequently get skin infections? | 8 | 20 | 32 | 80 |
| do you have a habit of scratching ears/ picking nose | 14 | 35 | 26 | 65 |
| have you ever cleaned your cell phone in the past | 13 | 32.5 | 27 | 67.5 |

Discussion

This is the first study from India where bacterial load and existence of potential pathogens on cell phones of HCWs and non-HCWs were compared. This study indicates that the carriage of MRSA on the cell phones of HCWs is significantly higher (p-value = 0.005) than that of non HCWs. The only other study from India that reported similar rates (25%) of contamination by MRSA of cell phones of HCWs, but it was not compared with the non-HCWs in the community level.⁹ The MRSA carriage status, however, is much higher than those reported from western countries which range from 0 to 1.9%.^{1-3,10} Comparatively poor hygiene and hand washing practices followed by HCWs in India might be the contributory factor. A study in north India suggested that the major reservoir of MRSA in hospitals are colonized/infected inpatients and colonized hospital workers.¹¹ It might as well be concluded from our study that contaminated cell phones has a role as a reservoir of MRSA.

Studies from UK and USA found MCONS as the most common organism on cell phones of HCWs,^{1,3,10} whereas we have isolated MSSA more commonly as compared to MCONS on cell phones of both HCWs (55% MSSA, 40%

MCONS) and non HCWs (72.5% MSSA, 32.5% MCONS). It might be due to higher skin colonization of MSSA in this region. In previous studies the isolation of MSSA from cell phones was considered significant since it is a potential pathogen.^{9,10,12} However, our isolation of MSSA (72.5%) from cell phones of HCWs is not significantly higher (p = 0.10) than that of non HCWs (55%). This MSSA may represent a part of skin flora that has been transferred to cell phones after repeated contact with hands of users.

In other studies bacterial flora on cell phones showed lower rates of contamination, ranging from 7 – 14.3%, which included MSSA, MRSA, coliforms, *Enterococcus faecalis*, *Clostridium perfringens*, *Acinetobacter* spp., *Stenotrophomonas maltophilia*, *Pseudomonas* spp. and *Aeromonas* spp.^{1,2,3} No MRSA or vancomycin resistant *Enterococcus* (VRE) were detected, but 6% grew MSSA in one of the studies.¹⁰ The higher rates of contamination of cell phones in HCWs in this study might be due to the influence of various factors like general hygiene and hand washing practices of the HCWs, disinfection practices followed in the hospital, frequency of use and cleaning of cell phones etc. The kind of bacterial flora



grown depend on the conditions under which the plates are incubated. Here, the plates were incubated only under aerobic conditions.

Two types of GNB (*Acinetobacter species* and *Pseudomonas species*) on HCWs' cell phones and one type (*Acinetobacter species*) on non HCWs' cell phones were observed which were sensitive to all antibiotics. Regular surveillance studies of water in hospital campus commonly report the presence of these drug sensitive strains which shows that water might be the probable source.

The findings are alarming from the responses to questionnaire, which shows that HCWs are really lacking the awareness of the safety measures when a significant number of them neither clean their hands before and after seeing a patient nor clean the cell phone after using in the hospital set up. However, 92.5% of HCWs acknowledged that microbes could be present on their cell phones. In contrast, the awareness at the community level with rickshaw drivers, food handlers, clerical staff and medical students is much better where majority of non HCWs (57.5%) have the idea that microbes can colonize their cell phones and 32.5% of them clean their cell phones regularly. So there is an urgent need to stress the awareness in the HCWs about cell phone as carrier for potential pathogens and regular cleaning of cell phones. The cell phones should be restricted for use in the hospital set up and for emergency calls only. The strict maintenance of the practice will prevent the transfer of potentially pathogenic organisms not only in community but to close relatives at home as well.

Hand washing is the simplest and most economical measure that can prevent transfer of harmful pathogens. Microorganisms on the skin are generally divided into two categories. Resident flora are microbes that normally colonize or live on the skin of most individuals; they generally do not cause infections unless they are introduced into normally sterile body sites and/or unless the host is immunocompromised. In contrast, transient flora are microbes that are present on the skin for only a short time; they tend to be more pathogenic than the resident flora and are responsible for most nosocomial acquired infections.¹³ These transient or contaminant flora may be picked up by the hands of a health care worker; for example, when they touch a patient or any contaminated object, such as cell phones. Handwashing is a process which removes soil and transient microorganisms from the hands. Hence the simple process of handwashing has long been a mainstay of any control measure for reducing nosocomial infections.

In the present study efficacy of various chemical disinfectants was not checked for cleaning of cell phones. These types of studies should be done in future that can help to reduce the transmission of pathogens from cell phones to their users.

To conclude, cell phones can act as vehicles for transfer of potential pathogens associated with nosocomial infections. Regular hand washing prior to examination of patients or decontamination of cell phones with alcohol disinfectant wipes should be done to prevent nosocomial infections.

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