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Bacterial Load on Cellphones of Healthcare Givers and Patient Attendants in a Tertiary Care Hospital of Odisha- A Cross Sectional Study

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A B S T R A C T

This study aimed to examine the presence of bacterial contaminants on the surfaces of mobile phones that are used frequently by health care providers and patient attendants. A cross sectional study was carried out on 96 mobile phones used by doctors, nurses, laboratory technicians and patient attendants. Each participant's mobile phone was swabbed aseptically by rotating damp cotton swabs with sterile normal saline over the screen, sides, and back. Isolated microorganisms were identified using gram stain, colony morphology, catalase, coagulase reactions and appropriate biochemicals. Of the 96 mobile phones tested, 82 (85.4%) showed bacterial growth from which 163 organisms were isolated. Mixed infections were seen in 64 (66.7%) mobiles and pure growth were observed in 18(18.8%) mobiles. Coagulase-negative staphylococci (31.9%) was the predominant isolated followed by *Micrococcus* (20.8%) and *Staphylococcus aureus* (14.7%). Methicillin-resistant *Staphylococcus aureus* (MRSA) were isolated in 6.1% and the treating doctors had maximum burden(70%) of MRSA isolated. With the rampant use of mobile phones in healthcare settings their chances of being vehicle of transmitting pathogens especially the multidrug resistant ones has increased many fold. Isolation of MRSA and Gram-negative bacteria from mobile phones of clinicians treating patients is of a major concern, and calls for efforts to consider guidelines for mobile phone disinfection and its restricted use.

Introduction

Cellphones are widely used by the healthcare workers (HCWs) and non-HCWs equally in every location. With all the achievements and benefits of the mobile phone, it is easy to overlook the health hazard it might pose to its many users [1]. The constant handling of mobile phones by users in hospitals (by patients, visitors and HCWs, etc.) makes it an open breeding place for transmission of microorganisms, as well as health care-associated infections (HAIs). This is especially so with those associated with the skin due to the moisture and optimum temperature of human body especially our palms. Unlike our hands, which are easily disinfected using alcohol-based hand rubs (ABHRs) that are made available readily across all hospitals and medical facilities, our

mobile phones are cumbersome to clean. We even rarely make an effort to disinfect them. As a result, these devices have the potential for contamination with various bacterial agents[2].

Colonized micro-organisms on the devices of HCWs may be transmitted to patients even if patients do not have direct contact with mobile phones. These organisms if pathogenic can be detrimental to the health of the patients especially those in critical care units[3]. Doctors and healthcare staff working in critical areas as intensive care units (ICUs) and operating units are highly exposed to deadly micro-organisms.

These mobile phones used by HCWs often become carriers and may serve as vectors and spread microorganisms wherever they are taken along [4]. Colonized micro-organisms on the devices of HCWs may be transmitted to patients even if patients do not have direct contact with mobile phones[5]. These organisms if pathogenic can be detrimental to the health of the patients especially those in critical care units and if the organisms transferred happen to be drug-resistant; the situation becomes even more grave as it becomes difficult to treat because of the limited drug options available[6].

Healthcare-associated infections (HAIs) are a major challenge to the healthcare system and are associated with significant mortality, morbidity, and high economic burden. It is estimated that of every 100 hospitalized patients at any given time, seven in developed and ten in developing countries will acquire at least one HAI[7].Patients in intensive care units (ICUs) are particularly susceptible to HAIs because of their poor health status in addition to the use of invasive equipment like catheters and cannulae. Similarly, infants in neonatal care units (NCUs) have a higher risk of HAIs because of their immature immune systems, their skin does not provide a strong barrier against organisms in the environment and a large number of these infants are premature and often require invasive procedures to sustain their life such as mechanical ventilation and total parenteral nutrition[8]. Contaminated hands of healthcare providers play a major role in spreading infections in healthcare settings. Hand hygiene is one of the most important preventive interventions against the spread of infections in healthcare settings[9].

Materials and Methods

Study Design, Sample Size and Study Setting. A cross sectional study was carried out on 96 mobile phones used by doctors, nurses, laboratory personnel and patient attendants for a period of five months from May 2018 to September 2018.

Sample collection and processing

Samples from mobile phones were collected using sterile cotton swabs. Each swab was first moistened with sterile peptone water and was rotated over the surface of both sides of the tested mobile phone together with the keypad in non touchscreen phones. All swabs were immediately streaked (surface spread) over the surface of blood 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 the laboratory, blood and MacConkey's agar plates were incubated aerobically at 37°C for 24 hours. The inoculated peptone water tubes were vortexed and a one ml from each tube was placed in a sterile petridish, then 15 ml of melted plate count agar medium was poured over the sample portion. The agar was thoroughly mixed with the sample portion and

allowed to set and solidify. The plates were then inverted and incubated aerobically at 37°C for 24 hours.

Identification of organism

Isolated bacterial agents were identified according to the standard microbiological methods described by Forbes *et al.*, (2007)[10]. They were identified using Gram's staining, colony morphology and appropriate biochemical tests.

For identification of Gram-positive cocci (GPC); isolates that appeared as medium sized circular, white or golden yellow with smooth convex surface and entire edge and were β-hemolytic or non-hemolytic on blood agar plates and were positive for catalase, slide and tube coagulase and Voges Proskauer tests were considered as *Staphylococcus aureus* (*S. aureus*).

Non-haemolytic, catalase-positive, coagulase-negative, bacitracin-sensitive GPC were identified as *Micrococcus* spp., while catalase-positive, coagulase-negative and bacitracin-resistant GPC were considered as coagulase-negative staphylococci (CoNS).

Staphylococcus aureus and CoNS identified isolates were further checked for their susceptibility to methicillin using oxacillin (1 µg) and cefoxitin (30 µg) discs on Mueller Hinton agar plates supplemented by 4% NaCl by disk diffusion method described by Bauer and Kirby[11]. The inhibition zone diameters were measured and interpreted as recommended by the Clinical and Laboratory Standards Institute (CLSI)[12].

As regards Gram-negative bacilli (lactose and non-lactose fermenters), the oxidase, catalase, triple sugar iron agar (TSI), indole, methyl red, Voges Proskauer, citrate (IMViC) and urease tests were carried out for their identification.

Results and Discussion

The present study was conducted on 96 mobile phones randomly selected from patients, patient attendants and HCWs from our hospital.

This study enrolled the mobile phones of 28 doctors (29.17%), 21 patients (21.87%), 26 patient attendants (27.08%) and 21 laboratory personnels (21.87%) (Fig. 1).

Of the 96 mobile phones tested, 82 (85.4%) showed bacterial growth from which 163 organisms were isolated. Mixed infections were seen in 64 (66.7%) mobiles and pure growth was observed in 18(18.8%) mobiles.

Mixed growth was seen in 64 (78.04%) mobiles and pure growth was observed in 18(21.96%) mobiles (Fig. 2).

As regards the organisms isolated Coagulase negative staphylococcus were the most common isolates (31.9%) followed by *Micrococcus* (20.8%) and *Staphylococcus aureus* (14.7%). *Klebsiella* spp. (8%) and *Candida* spp. (6%) were the least common isolates. Methicillin resistant *Staphylococcus aureus* accounted for 6% of the total isolates.

Of the 82 cell phones with microbial contaminations, 24 doctors (29.26%), 17 patients (20.73%), 23 patient attendants (28.04%) and 18 laboratory personnels (21.95%) cell phones had microbial contamination in them (Fig. 3).

Hospital acquired infection caused by multidrug-resistant organisms is a growing problem in many health care institutions [13,14,15]. Hands, instruments, mobile phones or other inanimate hospital objects used by HCWs may serve as vectors for the nosocomial transmission of microorganisms[16,17,18]. Unlike fixed phones,

mobile phones are often used in these areas close to the patients and these patients are more vulnerable to hospital acquired infections[19,20].

In this study, 96 mobile phones from 4 different categories of hospital population viz., doctors, patients, patient attendants and lab personnels were screened for the presence of bacterial contamination. 82 (85.41%) cell phones had microbial contamination in them. Similar findings were found in a study conducted by Tambe and Pai (2012)[21] 83% of screened mobile phones of the HCWs showed bacterial or/and fungal contamination.

In a separate study, researchers found that 95% of phones were contaminated with some kind of bacteria, many of which were resistant to multiple antibiotics. By also testing the participants' hands, the researchers were able to show that a significant number of germs were transferred from their hands to their phones, and vice versa. In fact, about 30% of the bacteria on the phones ended up on the owner's hands[22].

CONS (31.9%), Micrococcus (20.8%), *Staphylococcus aureus* (14.7%), Diphtheroids (10.4%), Escherichia coli (8.4%), *Klebsiella* (8%), *Candida* spp. (6%) were the organisms isolated in the present study. MRSA accounted for 6%. In the study by Tagoe *et al.*, (2011)[1] the isolated bacteria included *Klebsiella pneumoniae* (10%), *Citrobacter* spp. (2%), *S. aureus* (4%), CoNS (15%), *Pseudomonas aeruginosa* (4%), *Salmonella* spp.(3%), *Shigella* spp. (2%), *Proteus mirabilis* (19%), *E. coli* (8%), *Bacillus cereus* (23%), *Streptococcus pneumoniae* (10%), *Salmonella* spp. (3%) and *Shigella* spp. (2%).

Tambe and Pai (2012)[21] reported that the isolation of *S. aureus* was maximum in all the categories of HCWs (54%), followed by *Micrococci* (21%), diphtheroids (8%), *Enterococci* (4%), *Pseudomonas*, *Citrobacter* and *Bacillus* spp. (3% each), Acinetobacter, Enterobacter and *Streptococcus viridans* (2% each).

In a study by Bhoonderowa *et al.*, (2014)[23]CoNS was the most prevalent (69 %) bacteria from mobile phones of volunteers in the community. In 2014, a study carried out by Raghavendra *et al.*,[24] revealed that 52% of the examined mobile phones of HCWs were contaminated by *S. aureus*. In this work, it has been noted that staphylococci were the most frequently encountered isolates. This pathogen is of greater concern because of its virulence, its ability to cause a diverse array of life threatening infections, and its capacity to adapt to different environmental conditions[25]. It is also a well-known fact that organisms like *S. aureus* and CoNS resist dryness and thus can survive and multiply rapidly in warm environments like cell phones[26].

Of the 82 cell phones with microbial contaminations, 24 doctors (29.26%), 17 patients (20.73%), 23 patient attendants (28.04%) and 18 laboratory personnels (21.95%) cell phones had microbial contamination in them.

A practice guideline was issued by the community and Hospital Infection Control Association (CHICA, Canada) to address the issues of electronic devices in health care settings. Some of their recommendations include that hand hygiene should be performed between patient contact and before and after accessing a device, manufacturer's guidelines for use, cleaning/disinfection and maintenance should be reviewed to ensure that these guidelines meet the standards for cleaning and low-level disinfection that are necessary for exposure to multidrug-resistant organisms[27] (Table 1 and 2).

Table.1 Number of cell phone showing growth of microorganisms

	Number of Cell Phones	Percentage (%)
GROWTH	82	85.4
NO GROWTH	14	14.6

Table.2 Organisms isolated

Organism	Number of Isolates	Percentage (%)
CONS	52	31.9
Micrococcus	34	20.8
Staphylococcus aureus	24	14.7
Diphtheroids	17	10.4
Candida spp.	10	6.2
Escherichia coli	14	8.4
Klebsiella spp.	12	8.0

Fig.1 Distribution of study population

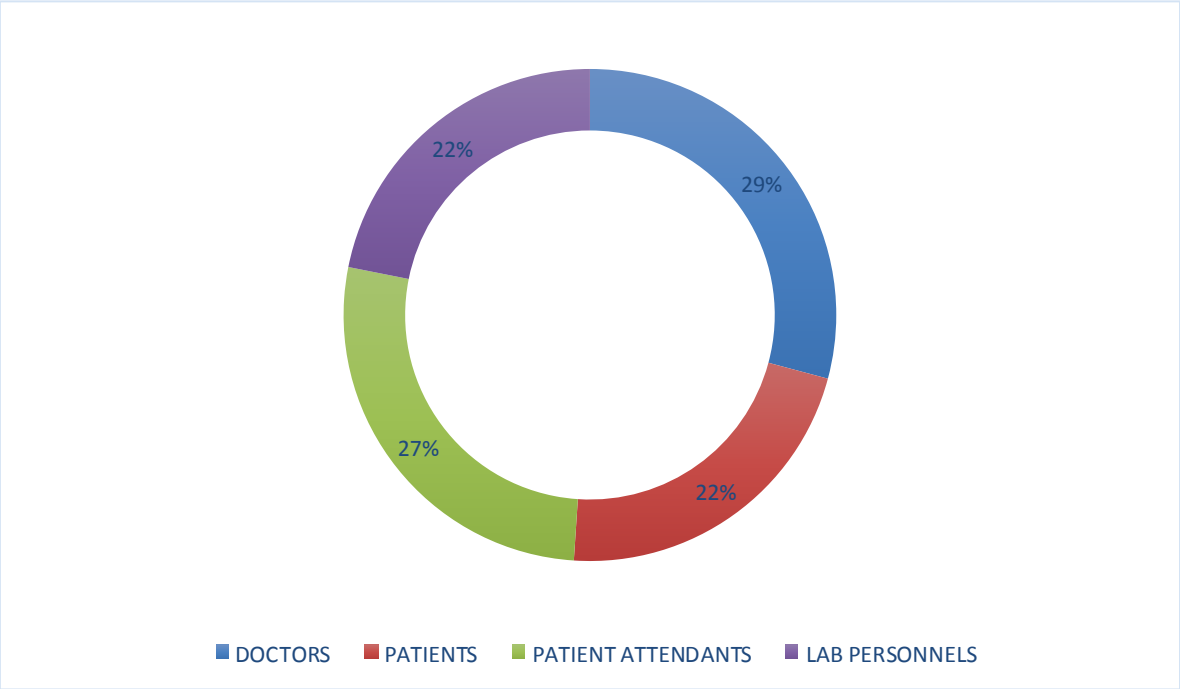


Fig.2 Mobiles with mixed growth and pure growth

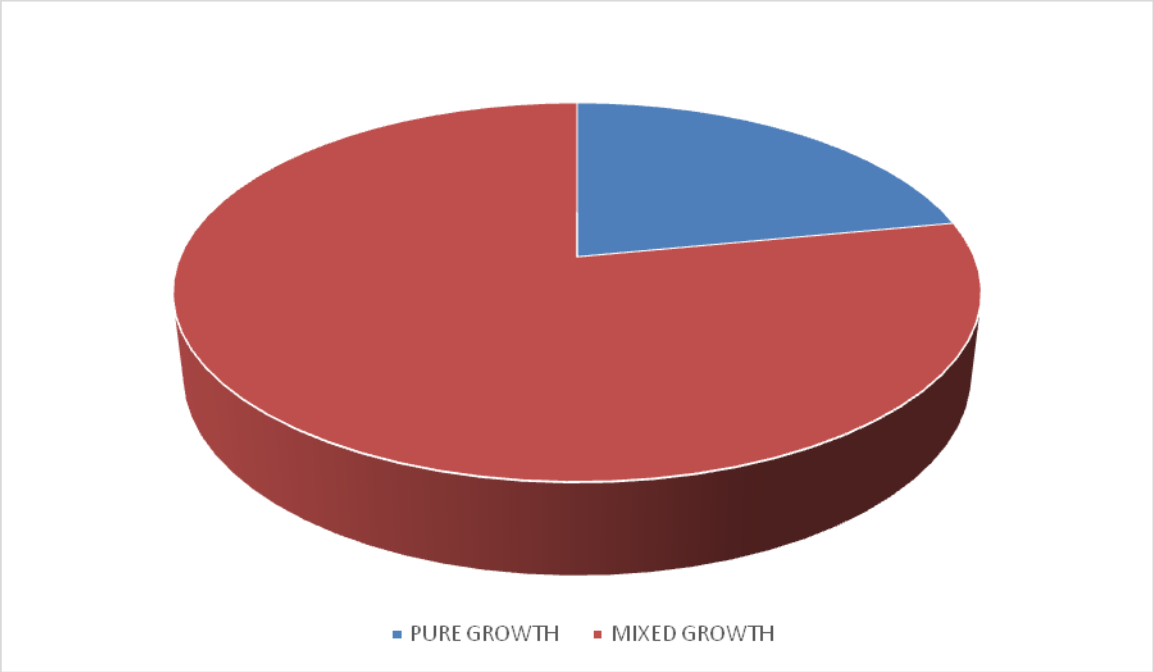
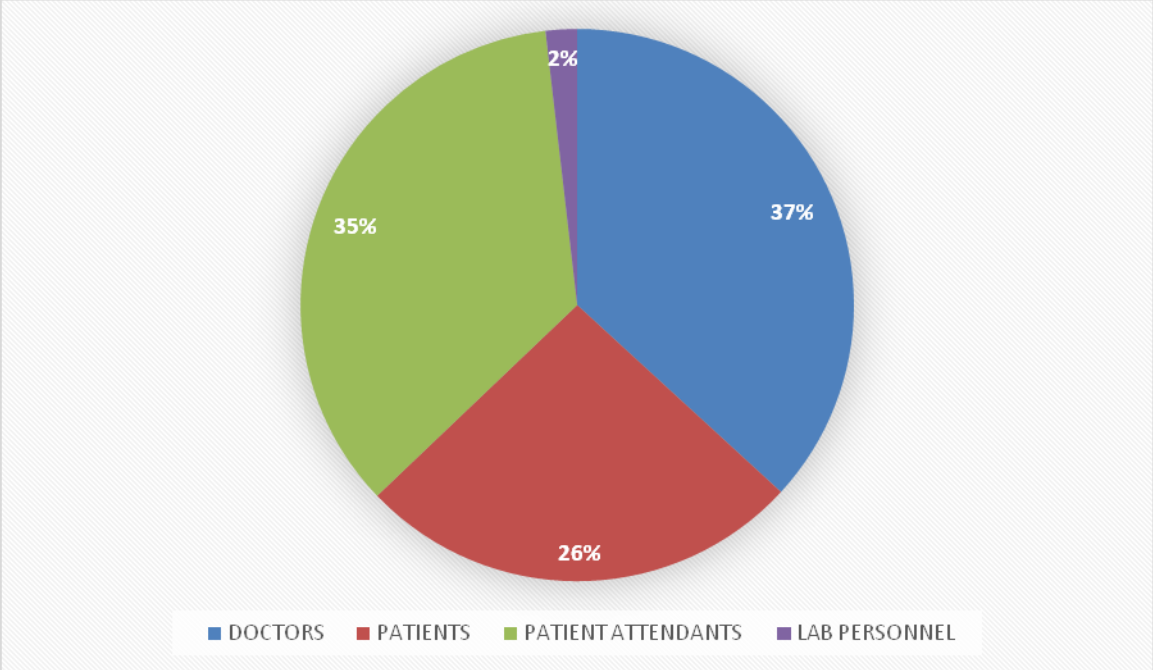


Fig.3 microbial contaminations



In conclusion, with the rampant use of mobile phones in healthcare settings their chances of being vehicle of transmitting pathogens especially the multidrug resistant ones has increased many fold. Isolation of MRSA and Gram-negative bacteria from mobile phones of clinicians treating patients is of a major concern, and calls for efforts to consider

guidelines for mobile phone disinfection and its restricted use. Only minority of clinicians have ever disinfected their mobile phones, which is not an optimal practice and highlights the need to increase the awareness about mobile phones disinfection among clinicians, given that banning mobile phones in ICU settings is losing momentum. Finally, further research is needed in order to provide evidence that better mobile phone hygiene will lead to a reduction in HAIs.

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