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Bacteriological Profile of Mobile Phones Health Care Workers (HCW'S) working in ICU, NICU and OPD'S at A Tertiary Care Hospital, Northern India

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A B S T R A C T

Cell phone and writing pen has become part and parcel of modern life. To live a life without cell phone is an impossible task for maximum people. Health care providers are also integral part of this era of mobile phones. During various activities linked to health care services health care professionals used to touch their cell phones and writing pens many a time. Hence, mobile phones and writing pens are found to be contaminated with various microorganisms. Aim: To find out bacteriological profile of cell phones and writing pens used by different categories of health care providers in a tertiary care hospital, Kanpur U.P. India and antibiotic resistance pattern of the isolates. Materials and Methods: A cross sectional study was conducted in a tertiary care hospital, U.P. Kanpur India during academic last 6th months. Swabs from 80 mobile phones and 20 from writing pens belonging to doctors, nurses, ward boys, laboratory technicians, according to the availability were collected in OT's and OPD's. The swabs were processed to isolate and identify the bacteria. Antibiotic sensitivity tests of these isolates were done following Clinical Laboratory Standard Institute guidelines. Results: Out of 80 cell phones and 20 writing pens (total 100) sampled 87 were found contaminated with various numbers of bacteria's. 47% cell phones had single bacterial contamination while 30% cell phones and 10% writing pens were contaminated with two or more types of bacteria's. Cell phones and writing pens of laboratory technicians were hundred percent contaminated, followed by nurses (96%). Differences in rate of contamination in different groups of health professionals were statistically significant.

Introduction

Mobile phones have become one of the most indispensable accessories of professional and social life (Jaya Madhuri *et al.,* 2015; Bodena Dagne *et al.,* 2019). A mobile or cellular phone is a long-range, portable electronic device for personal communication (Jaya Madhuri *et al.,* 2015). In under two decades, mobile phones have gone from being uncommon, costly pieces of equipment used mainly by the business elite, to

common, low-cost personal items. In many countries, mobile phones outnumber landline telephones, as many adults and children now own their own personal mobile phones (Al-Abdalall and Amira, 2010). Mobile phones are popular with healthcare workers (HCWs) and patients alike (Ramesh *et al.,* 2008; Rana Radhika *et al.,* 2013), with approximately 98% of HCWs owning a mobile phone and 84.5% bringing them to work every day (Brady *et al.,* 2006). Their popularity is due to ease of access, low cost, user-friendliness and potential to be carried anywhere (Brady *et al.,* 2006). With all the benefits of mobile phones, it is easy to overlook the health hazard they might pose to their users (Rana Radhika *et al.,* 2013). The constant use of mobile phones by HCWs and the lack of disinfection make them possible routes for transmission of bacterial pathogens, including multi-drug- resistant organisms (Famurewa and David, 2009; Banawas Saeed *et al.,* 2018). The mobile phones of HCWs writing pen can serve as reservoirs of healthcare-associated pathogens and other organisms (Selim and Abaza, 2015) particularly bacteria associated with skin colonization, due to the moisture and ideal temperature of the human body, particularly the palms of the hands (Tagoe *et al.,* 2011). These factors, and the heat generated by mobile phones, contribute to harboring bacteria on the device. In addition, these bacterial organisms can survive on inanimate surfaces for weeks (Kramer Axel *et al.,* 2006; Weber *et al.,* 2010). Hence, mobile phones may cause microbial cross-contamination between HCWs and patients, and may be a source of healthcare-acquired infections (HAIs) (Ulger Fatma *et al.,* 2009; Brady *et al.,* 2011). Data at the burden of sicknesses international are frequently published through the World Health Organization (WHO) to tell health-care workers, policy-makers, and the general public of the maximum important sicknesses in phrases of morbidity and mortality (Allegranzi *et al.,* 2011). Health care employees and sufferers admitted in numerous hospitals in numerous hospitals use cellular telephones for communication. As per the class of Earle Spaulding, a cellular tele cell smart phone comes below non-essential objects as it will not touch mucous membranes and/or non-intact skin. Mobile telephones of fitness care employees offer a reservoir of microorganism regarded to reason nosocomial contamination however the infection of cellular telephones of important's and their pass infection is presently unknown and to date, there's no file on antimicrobial resistant bacterial infection of cellular telephones of inpatients. Hence, the prevailing look at changed into finished to determine infection of antimicrobial resistant micro-organism on cellular telephones of sufferers admitted in numerous hospitals (Kumar *et al.,* 2014). Many research have proven that each scientific and non-scientific gadgets used with inside the hospitals are the predominant reasserts of HAIs. In one managed take a look at achieved in India on two hundred cellular telephones of HCWs, bacteriological evaluation found out that a hundred and 44 of the 200 (72%) have been infected with microorganism. Among a 144 bacterial isolates, 18% have been MRSA, 32% MSSA, 13% CONS, and 33% cardio spore bearers. Hence, 36% of the cellular telephones have been infected with *Staphylococcus aureus*, micro-organism which can be widely known to be related with clinic related infections (Chaka Tolossa *et al.,* 2016). Mobile telephones have also been suggested to be a reservoir for micro-organisms. It has been suggested that a telecellsmartphone can harbor more microorganism than a man's bathroom seat, the only of a shoe or the door handle. Mobile telephones can be infected thru reasserts such as human pores and skin or hand, bags, pockets, surroundings and meals particles, those reasserts are links through which micro-organisms colonized the telecellsmartphone, thus inflicting sicknesses that variety from moderate to chronic (Shahaby *et al.,* 2012). In some countries, they lead to substantial morbidity, mortality and increased healthcare costs (Burke, 2003; Allegranzi *et al.,* 2011). Studies have reported the isolation of various bacterial species from the surfaces of mobile phones, with coagulase negative staphylococci (Cons), a normal skin commensal, being the most common (Tagoe *et al.,* 2011; Kumar *et al.,* 2014; Chaka Tolossa *et al.,* 2016). Potentially pathogenic organisms such as *Methicillin- Susceptible Staphylococcus aureus, Methicillin-Resistant Staphylococcus aureus (MRSA), Escherichia coli, Corynebacterium species, Enterococcus faecalis, Clostridium perfringens, Klebsiella species, Enterobacter species., Pseudomonas species*., *Aeromonas hydrophilia species, Acinetobacter baumannii species, and Stenotrophomonas melophilia* have also been reported and may be potential threats to infection control practices, increasing the rate of hospital associated infection (Selim and Abaza, 2015; Shahaby *et al.,* 2012). The use of MPs occurs in hospital, by patients, visitors, and healthcare workers (HCWs). Smart phones provide better communication, and sharing of information among healthcare workers (HCWs) and between HCWs and patients; they can lead to improved quality of healthcare, especially in terms of faster communication and promoting a prompt clinical diagnosis. Due to their many benefits, any associated risk with their use is minimized or not considered.

Materials and Methods

The collected samples were streaked onto suitable media like Blood agar and MacConkey's agar, incubated overnight at 37^0C for bacterial isolation. Bacterial isolates were identified on the basis of Gram staining and appropriate biochemical tests. For bacterial isolates, antibiotic susceptibility test (AST) was performed using Kirby-Bauer disc diffusion method on Mueller-Hinton agar (MHA) according to CLSI antibiotic disc susceptibility guidelines (Tagoe *et al.,* 2011). Health care people cell tele cell smart phone and writing pens have been swabbed the use of sterile swabs. Before taking a swab, each arm of the swab collects or have been wiped clean the use of an alcohol-primarily based totally hand sanitizer, and sterile powder loose disposable globes have been warmed (in step with sample) all through the paintings to save you go infection the swab have been moisten with sterile ordinary saline earlier than swabbing over the un covers surfaces of the cell tele call smart phone. The keypad, contact screen, ear pad, and lower back of the tele cell smart phone and additionally greater usable components of pens have been swabbed as those are the regions which have common touch the user. Sample have been inoculated in tryptic soy broth (TSB) media, given specific identity wide variety and transported to the laboratory. Thereafter the cell telecellsmartphone became disinfected the use of alcohol primarily based totally wipes and exceeded lower back to the user.

Inclusion Criteria

Healthcare workers: (Doctors, Nurses, Technicians, Ward Staff, OT Staff, ICU staff,).

Exclusion Criteria

Non health care workers

Results and Discussion

Total number of sample (128) were exposed to different types of clinical research for laboratory diagnosis of microorganism. Out of 128 samples, 87 were cell phones and 41 were writing pens among which 88 (68.75%) were contaminated with varied number of bacteria, followed by 54 cell phones (61%) and 34 writing pens (39%). Cell phones and writing hundred percent pens of laboratory technicians were contamination, followed by nurses (96%). Differences in rate of contamination in different groups of health professionals were statistically significant. Total 100 bacteria were isolated, comprising of 12 species. Of which the study isolates were gram positive organism. The most common organisms isolated were *Staphylococcus aureus, Enterococcus Faecalis, Streptococcus*. Fourteen (14%) health care personnel were totally not aware of the fact that microorganisms could be present in cell phones. Among them 57.14% were doctors followed by ward boys (35.7%) and nurses (7.14%). Ninety three percent health professionals never even thought of cleaning their cell phones. Most of the individuals (78%) keep their mobile phones into their clothing (pockets). These were more contaminated than those kept in bags. Out of 27 *Staphylococcus aureus*, 8 (38.09%) were methicillin resistant (MRSA), but among *coagulase negative Staphylococcus* only one was resistant to Cefoxitin.

Out of the total 128 (87 cell phones & 41 writing pens) samples, 88 were found contaminated with varying number of bacteria. Incidence of contamination in our study was less than that of the studies. Cell phones were contaminated respectively but it was more than that were observed. Wide range of variation might be due to difference in awareness regarding usage of mobile phones, maintaining hand hygiene and frequency of handling cell phones in hospital during patient care. In the present study 40% cell phones had poly microbial growth which was in concordance with that isolated by Bhat *et al.,* (2011) (38.8%) but it shows contrast to a study conducted by Tagore *et al.,* (2011) where 91% of cell phones showed polymicrobial growth. Results from this study showed 100% of the cell phones belonging to Laboratory technicians were contaminated whereas only 70% of doctors possessed contaminated phones. Category wise carriage rate was found statistically significant in this study.

Direct exposure to body fluids, tissues etc. consisting of different pathogenic organisms might be the reasons of higher carriage rate in Laboratory technicians. In the current study, Cons was the main organism isolated (14.77%). Similar results were observed in different studies revealed that *Staphylococcus aureus* was the predominant organism and *Bacillus spp*. was most common organism contaminating the cell phones in Cape coast. Most of the studies done in this field reflect the same feature except a few. Predominance of Cons reflects the fact that normal commensal of the skin can easily be transferred to the object that comes in contact with body surface.

Table.1 Isolates bacteria in Mobile Phones

Isolates	Doctors N=20	Lab Technicians N=16	Ward staff N=30	Nurses N= 22
Staphylococcus epidermidis	8	6	14	8
Staphylococcus aureus	8	8	12	11
Cons	4	2	4	3

Table.2 Total MRSA isolates in ward staff and nurses

Isolates	Ward Staff N=30	Nurses N=22
MRSA	3	5

Table.3 Antibiotic susceptibility pattern of Gram-positive bacteria

Antibiotics	*Staphylococcus aureus (39)*	*Staphylococcus epidermidis* (36)	Cons (13)
Amikacin	30 (76.92 %)	32 (82.88%)	10 (76.92%)
Gentamycin	28 (71.79 %)	33 (91.66%)	11 (84.61%)
Tobramycin	25 (64.10 %)	30 (83.33%)	9 (69.23%)
Vancomycin	39 (100%)	36 (100%)	13 (100%)
Linezolid	39 (100%)	36 (100%)	13 (100%)
Tetracycline	35 (89.74 %)	32 (88.88%)	10 (76.92%)
Oxacillin	38 (97.43%)	35 (97.22 %)	12 (92.30%)
Cefoxitin	38 (97.43%)	34 (94.44%)	13 (100%)
Clindamycin	30 (76.92%)	28 (77.78%)	10 (76.92%)
Erythromycin	31 (79.48%)	29 (80.55%)	11 (84.61%)

Figure.1 Sample Collection for Phone

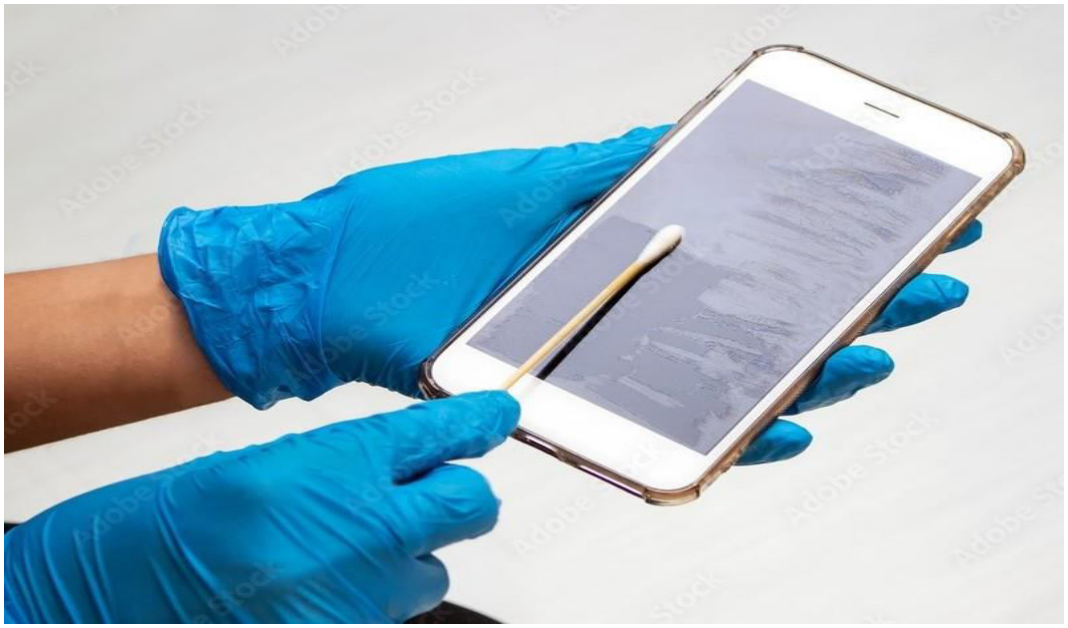

Figure.2 The presence of Gram-positive cocci (GPC) in various arrangements, such as singles, pairs, and clusters

Figure.3 Oxacillin disk diffusion plate showing methicillin-resistant *Staphylococcus aureus*

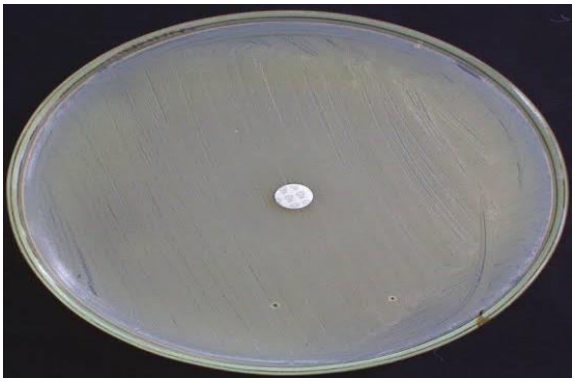

Figure.4 MRSA detection by Cefoxitin (30µg) disc).
(Disk diffusion plate showing methicillin-resistant *Staphylococcus aureus)*

Combination of constant handling and heat generated during receiving phone call might facilitate the survival and growth of the microorganisms on the cell phone surface. Though, Cons is a component of normal skin flora but in hospital set up it could emerge as a pathogen, increasing number of microorganisms causing

nosocomial infections. Study revealed that conventional key pad had higher rates of contamination than touch screen phones (p value= 0.001). This might be due to the fact that chance of retention of bacteria in cracks and crevices present in the conventional keypad was more. Almost equal rate of contamination was found in the cell phones used by male and female health personnel. But proportion of contamination of mobile phones of male resident doctors was more than female resident doctors. A high isolation of bacteria was observed in those phones which were kept in clothing like pocket, than those kept in bags. But that was not of statistical significance. The warmth of clothing conferred a good breeding ground for the microorganisms mainly *Staphylococcus* species, that resist drying. So the warm and favorable environment in the pocket surrounding mobile phones coupled with its regular handling creates a main breeding ground for microorganisms. All the 128 Health care provider used same phones in and outside the hospital. 14% of health professionals including doctors were totally not aware about the fact that cell phone could act as a source of bacteria. 93% of the participants never cleaned their mobile phones. Almost all of the health care workers do not wash their hands after receiving phone calls and before touching patients except 3 persons working in neonatal wards. Antibiotic sensitivity pattern of the isolates showed that *Staphylococcus aureus were* resistant to methicillin (MRSA). Incidence of MRSA isolated from cell phones was variable in different geographical areas. Though gram negative organisms were multidrug resistant but extended spectrum beta lactamases producing organism was not found. In this study, isolates showed good sensitivity pattern against Amoxicillin-clavulanic acid and amikacin. Variation in antibiotic resistance pattern in different geographic areas or different time frame in same place might depend on antibiotic policy of the hospital at that particular time.

From this study it can be concluded that more than three fourth of cell phones and two fourth of writing pens belonging to healthcare personnel harbored potential pathogens including some multidrug resistant strains but health care workers were quite unaware of the fact. As there is paucity of information about suitable mobile disinfection methods that are both effective and at the same time do not damage the mobile phones, restricted use of mobile phones in hospital is to be emphasized. Moreover, hand washing after or before attending a call and use of writing pens is to be recommended strictly. Use of headset or ear set during hospital hours might be a good alternative for using hand set. Furthermore study of appropriate disinfection methods for mobile phones and establishment of transmission of bacteria from hand to phones and vice versa may be considered.

Author Contributions

Munish Rastogi: Investigation, formal analysis, writing—original draft. Dolly Rastogi: Validation, methodology, writing—reviewing. Shivani, Tushar Sharma:—Formal analysis, writing—review and editing. Anjali Verma: Investigation, writing—reviewing. Anjali Yadav: Resources, investigation writing—reviewing. Ujjwal Kumar: Validation, formal analysis, writing—reviewing. Mohit Kumar: Conceptualization, methodology, data curation, supervision, writing—reviewing the final version of the manuscript.

Data Availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethical Approval Not applicable.

Consent to Participate Not applicable.

Consent to Publish Not applicable.

Conflict of Interest The authors declare no competing interests.

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