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MOBILE PHONE CAN TRANSMIT MORE THAN JUST A CALL- A MODE OF NOSOCOMIAL TRANSMISSION

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Abstract-

Background: Nosocomial infections continue to pose increased mortality and morbidity in patients. The mobile phone and hands of health professionals may harbor many harmful pathogens which can serve as reservoir of infections.

Objective: In this study, we investigated the rate of microbial contamination of mobile phones and hands of health professionals in our tertiary care hospital.

Methods: In this study we took 320 samples from different wards, ICUs and OT staff. The samples were taken from 2 groups i.e. doctors and nursing staff. Swabs were taken from dominant hands and mobile phones. Culture and antibiotic susceptibility was carried out as per standard microbiological procedures.

Results: From 160 samples of mobile phones and hands each, 70.62% and 64.37% of swabs demonstrated evidence of microbial contamination with different type of organisms, respectively. Most commonly found organisms were coagulase negative staphylococci (46.7%). Established nosocomial pathogens like *Staphylococcus aureus*, *Escherichia coli*, *Klebsiella* spp. & enterococci, were isolated from 56.6% of mobile and 42.7% of hand samples. Methicillin resistance was seen in 25.5% of staphylococcal isolates. The colonization of isolates in hands was almost similar to that in mobile phones.

Conclusion: Simple measures like hand washing, cleaning of mobile phones with 70% isopropyl alcohol and a well practiced infection control plan to bring down the rate of hospital acquired infections are recommended.

Keywords- Mobile phone, Nosocomial infection, Hand Hygiene, Health Care Workers

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Introduction

Nosocomial infections are a serious problem in all modern hospitals [1]. As early as 1861, Semmelweis showed that bacteria are transmitted to the patients by the contaminated hands of healthcare workers [2]. The aetiological agents of hospital infections may spread through the hands of healthcare personnel (HP), thermometers, stethoscopes, and even toys in the pediatric intensive care units of hospitals [3]. Today, mobile phones have become one of the indispensable accessories of professional and social life. Smart phone mobile applications like medical dictionary, drug references are very useful in day to day practice. The use of cell phones often occurs in hospital wards, laboratories, and/or intensive care units when dealing with severely ill patients. However one aspect that has not been covered is its hazard to health.

This constant handling of the phone exposes it to an array of microorganisms and makes it a good carrier for microbes, especially skin pathogens & commensals. Research has shown that the mobile phone could be a health hazard with 10,000 microbes per inch^2 of the phone [4].

Mobile phones are continuously used all day long but never cleaned. Furthermore, guidelines for proper disinfection and decontamination of mobile phones are lacking. Thus mobile phones act as reservoirs of infection which they may spread from patient to patient in a hospital setting.

In this mobile era, the increased use of mobile phones by Health Care Workers (HCWs) in Operation theaters (OT), intensive care units (ICU) and burn wards may have more serious hygiene consequences, because they are often used in these areas close to the patients and these patients are more vulnerable to hospital acquired infections [5-7]. This tempted us to investigate possibility of hospital acquired infections due to usage of mobile phones.

Thus, in this study, we investigated microbial contamination of the mobile phones of the healthcare professionals employed in a tertiary care teaching hospital, located in the Ahmedabad. We tried to identify the microbes contaminating mobile phones and their pathogenicity. Suggestions pertaining to infection control practices for handling of mobiles are proposed.

Materials and Methods

Study Area and Design

The test group included 160 medical professionals working in various areas of the hospital. These included 80 doctors (resident doctors, interns) and 80 nursing staff (sisters, nursing students). From each participant two samples were collected during duty hours, one from the dominant hand and another from the mobile phone. Hospital areas are i.e. different wards (medical, surgery, orthopedics, obstetrics & gynecology, pediatrics), OT, ICU, trauma center. 40 samples from each area were collected. The control group consisted of 100 attendants of patients in OPDs not working in any health care setting and who consented for sample collection without prior intimation.

Sample Collection

A sterile cotton swab moistened with sterile water was rolled all over the exposed surfaces of the cell phones. Care was taken to make sure that all the buttons of the keypad, mouth piece and earpiece were properly swabbed since these areas are the most frequently in contact with the fingers. Swab from hand were taken by rotating it over palm and tip of fingers of the dominant hand.

Transportation and Inoculation of the Sample

These swabs were immediately transferred in sterile tubes containing Brain Heart Infusion medium (BHI) and incubated at 37°C for 24 hrs. Later subcultures were made on 5% sheep blood agar and MacConkey Agar plates. Plates were incubated aerobically at 37°C for 24-48 hrs. for bacteriological investigation.

Isolation and Identification of Organisms

Plates were observed for growth and colony morphology of the isolates. Isolated microorganisms were identified using gram stain & biochemical tests [8].

Test for identification of staphylococci included mannitol fermentation and coagulase production. Coagulase test differentiated *Staphylococcus aureus* from others. Methicillin resistance among staphylococcal isolates was detected by cefoxitin disc diffusion test [9]. Enterococci were identified by growth on 6.5% NaCl containing media, esculin hydrolysis in presence of bile salts and fermentation of arabinose and raffinose.

For identification of gram negative bacteria a battery of biochemical tests were performed [8]. They were identified by inoculating triple sugar iron medium, citrate utilization, urease production, indole production and phenylalanine deaminase test and other tests. Antibiotic susceptibility testing was done using modified Kirby-Bauer disc diffusion method on Mueller-Hinton agar according to latest CLSI guideline [9]. Drugs used routinely in hospital were included for testing. ESBL (Extended spectrum β-lactamase) production was detected by ceftazidime and ceftazidime-clavulanic acid combination disc test. Carbapenem resistant isolates were further tested by modified Hodge test and imipenem-EDTA combined disc test.

Results and Discussion

Results from this study showed high levels of bacterial contamination of mobile phones used by medical professionals. This rate was much higher than that found in a study by Goldblatt, et al at New York where it was only around 20% [10].

In this study, 64.37% of hand samples and 70.62% of mobile phones from all the study groups were found to be contaminated by microbes in comparison to control group where the rate was 24% and 18% respectively which is statistically significant [Table-1].

Table 1- Contamination rates of mobile phones and dominant hands

	Mobile	Hand
Doctor	58	46
Staff	55	57
Total	113 (70.62%)	103 (64.37%)

Further, 38.75% mobile phones from study group were harboring more than one organism. The present study showed higher rate of hand contamination in nurses than doctors. This may be due to poor hand hygiene & infection control practices. Equal rates of mobile phone contamination in both the groups suggest lack of awareness of cleaning of phones & their potential for pathogen transmission. It also proves that although better hand hygienic practice was seen in doctors, due care was not taken in any of the groups for mobile phones. The same microbes were isolated from dominant hands & mobile phones in 78% of participants. Overall higher contamination rates were seen in orthopedic, gynecology and trauma center [Fig-1].

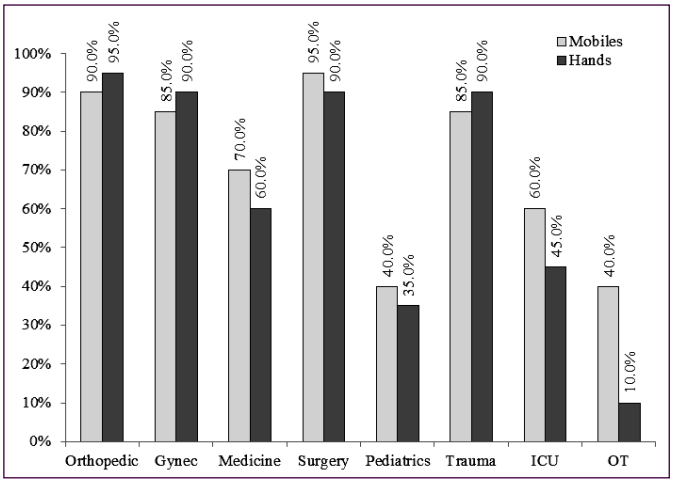

Fig. 1- Contamination rates across different wards

In above wards, hand contamination rate was slightly higher than mobiles. In operation theatres hand contamination rate was very less, still 40% of mobiles were harboring microbes. In ICUs both the rates were much higher than expected.

In our study, coagulase negative staphylococci (CoNS) dominated. This was expected as they are part of normal skin flora, but we cannot ignore them, as their potential for pathogenesis has already been established. Nosocomial pathogens such as staphylococcus aureus, enterococci and various gram negative rods were also isolated [Table-2].

Table 2- Types of isolated organisms

	Mobile	Hand	Total
CoNS	46	55	101
S. aureus	33	27	60
Enterococcus spp.	4	2	6
Acinetobacter spp.	12	5	17
Pseudomonas spp.	9	7	16
Klebsiella spp.	4	2	6
E. coli	2	1	3
Candida spp.	3	4	7
Total	113	103	216

The broad spectrum of bacteria isolated here is indicative of the potential of the mobile phones to act as a fomite in similar fashion to paper currency, stethoscopes, ball point pen etc. [11-14]. This aspect of mobile phones is still unexplored and needs research.

Attending a call while doing any procedure can easily contaminate the phone, as in health care setting it is difficult to avoid its use completely. Depending on environmental conditions, pathogens may remain infectious on surface or crevices for weeks after being contaminated. The combination of heat generated by constant use with humid conditions inside pocket or snug pouch creates a prime breeding ground for microbes. This is a cause for concern since they are used in close proximity to patients and these patients are more vulnerable to nosocomial infections.

Clinical Significance & Pathogenicity of Microorganisms Found in the Study

It is a well-known fact that organisms like staphylococcus aureus and coagulase negative staphylococci (CoNS) resist drying and thus can survive and multiply rapidly in the warm environments like mobile phones. In a similar study Khivsara, et al reported 40% contamination of mobile phones by staphylococci in health care workers in Mangalore hospital [15].

Present study shows that most common organism isolated were CoNS. Their ability to form biofilm on plastic surfaces adds to survival benefit of other microorganisms also. We found that 21.8% of CoNS were methicillin resistant. This becomes important for hospital infection control as infections by CoNS are increasing [Fig-2].

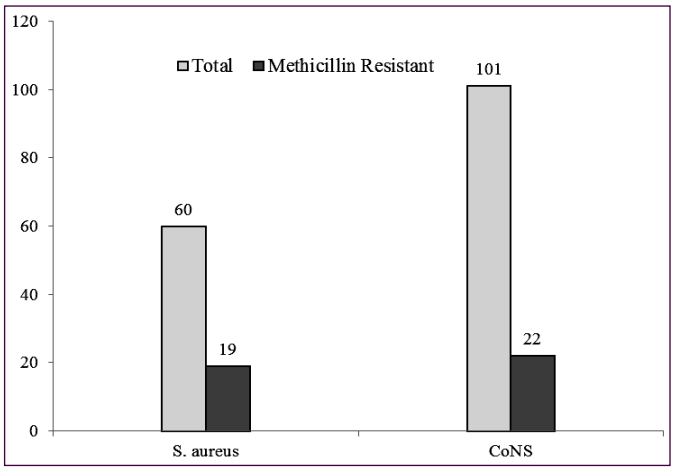

Fig. 2- Methicillin resistance among isolated staphylococci

We found that 31.7% isolated *Staphylococcus aureus* were methicillin resistant. One of the important sites of MRSA carriage is anterior nares from where it can easily transfer to cell phone. Methicillin Resistant *Staphylococcus aureus* (MRSA) is a multidrug resistant and responsible for several difficult-to-treat infections in humans. Control of MRSA is especially important in hospitals where patients may undergo invasive procedures or may be immunocompromised.

Organisms like *E. coli*, Klebsiella etc. may contaminate mobile phones especially in surgical wards where laparotomy surgeries are common. They are important cause of nosocomial gram negative sepsis.

Pseudomonas and Acinetobacter spp. are environmental habitants but can produce life threatening infections in susceptible patients. These species are inherently resistant to various drugs. Pseudomonas is known to survive even in disinfectant solutions like cetrimide.

Skin and mucosal infections caused by candida can get transferred to the mobile phones where it grows well in deep crevices and holes of the device.

The overall implication of these results is that mobile phones which make communication easy and accessible also form good carriers of pathogenic agents of disease transmission. If due care is not taken, they could be vehicles for the transmission of biological agents.

Antibiotic Susceptibility Testing (AST) indicates marked resistances of bacterial isolates to commonly used antibiotics. All of the isolated staphylococci including the methicillin resistant ones were found sensitive to vancomycin. Similarly out of 6 isolated enterococci, none were vancomycin resistant. In gram negative isolates high resistance was seen to second and third generation cephalosporins, cotrimoxazole and tetracycline antibiotics while moderate resistance was seen to fourth generation cephalosporins, β lactam- β lactamase inhibitor combinations and aminoglycosides group [Fig-3].

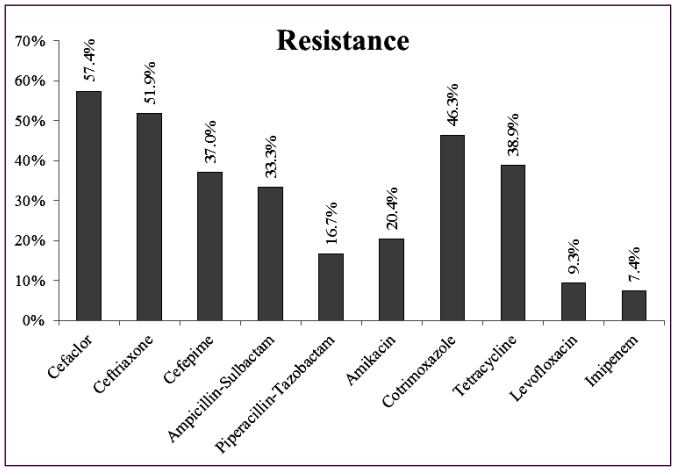

Fig. 3- Antibiotic susceptibility pattern of gram negative rods

Among enterobacteriaceae 77.7% isolates showed ESBL production. Among 4 isolates showing imipenem resistance, 3 were metallo β lactamase producers while one was carbapenemase producer. These multidrug resistant organisms on mobile can serve as a source for outbreaks in hospital.

Today, mobile phones are important equipment for physicians and other health workers. Currently in India, there are no rules restricting medical staff to carry mobile phones into the sterile environment of the OT or ICU. A study on anesthetists carrying mobile phone inside OT observed 10% contamination rate of their phones [5]. Since restriction on the use of mobile phones by health care providers is not feasible all the time, a more practical solution would be to strictly adhere to infection control practices e.g. hand hygiene. In addition, awareness campaign emphasizing role of these devices as a source for transmission of hospital-acquired infections to and from the community, should be conducted.

Currently there is no established method for cleaning of mobile phones. Cell phone manufacturers even warn explicitly against using cleaning agents. Scientist have studied efficacy of a variety of disinfectant for cleaning mobile phones, but none are found satisfactory. Further studies in this direction are need of the time.

Conclusion

70.62% mobile of health care workers demonstrated evidence of

microbial contamination with at least one type of pathogenic organism. Mobile phones of the HCWs were significantly (p <0.05) more contaminated than mobile phones of people not related to any medical services. Strict hand hygiene practices, will not only reduce mobile phone contamination but lead to reduction of nosocomial infection by other route also. Decontamination of mobile phones with 70% isopropyl alcohol is recommended. Use of cell phones in hospital setting should be limited to emergency calls only. Creating awareness in HCWs regarding the role of mobile phones as fomites in transmission of nosocomial infections would go a long way in nosocomial disease prevention.

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Conflicts of Interest: None declared.

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