Microbiological profile of bacteria present on mobile phones of health care personel that cause nosocomial infections

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Abstract

Introduction: Smart phones have become omnipresent in Clinical and Non clinical environment. They have been implicated as a source of bacterial contamination. Drug resistant pathogens such as methicillin resistant staphylococcus aureus (MRSA), Gram negative bacteria.
Aims and Objectives: To evaluate the role of mobile phones in relation to transmission of bacteria from mobile phone to health care workers and their pathogenicity.
Inclusion Criteria: Medical faculty present on the days of data collection.
Exclusion Criteria: Who ever don't give consent.
Materials and Methods: In total, 200 mobile phones were sampled. Two senior medical students were trained by a senior microbiologist to obtain the swabs in a standardized manner. The sides, screen and back of mobile phones were swabbed using a sterile cotton swab. The swabs were taken to the laboratory without delay and are incubated in brain heart infusion broth and incubated at 37 degrees for 24-48 hrs. Positive samples were further sub cultured on different growth media; mannitolsaltagar to isolate Staphylococci, MacConkey-agar to isolate Gram negative bacteria and Entero coccosel-agar to isolate fecal Enterococci.
Results: Out of 200 cell phones sampled, 66 were found contaminated with varied number of bacteria. The most commonly isolated organism was aerobic spore bacilli 33(16.5%) followed by Pseudomonas 13(6.5%), Proteus 11(5.5%), Escherichia coli 7(3.5%), Klebsiella 1(0.5%), Staphylococcus aureus 1(0.5%).

Keywords: Nosocomial infections, Drug resistance, Sterile swab, MRSA, Antibiotic susceptibility testing.

Introduction

Smart phones have become omnipresent in Clinical and Non clinical environment. They have been implicated as a source of bacterial contamination. Drug resistant pathogens such as staphylococcus aureus which are resistant to methicillin (MRSA), and other bacteria which belong to Gram negative group like E.coli, Pseudomonas, Clostridium difficile, Vancomycin resistant Enterococci, Streptococcus families etc. are raising important safety corners over the use of such devices in clinical areas.[1] A number of studies have consistently reported that 5-21% of persons who areworking in hospitals, their mobile phones acts as the reservoir for bacteria that cause nosocomial infections.[2]

Nosocomial Acenetobacter baumannii is commonly acquired through transmission because of its tendency to survive in hospital environment and highly contaminate fomites.[3] Nosocomial infections are increasing day by day and are causing increased morbidity and mortality in human beings and its sources can comprise health care workers, the patient's own microbial flora and inanimate hospital objects.[4] Repeated use by medical fraternity makes mobile phones perfect vehicle for hospital acquired infections.[5] In many countries cellular phones are owned by most adults and children, so they outnumber landline telephones. Microbiologists say that persistent handling of mobiles and generation of heat by the phones may acts as incubation temperature for many pathogens that are normal residents on skin, which may leads to the spread of different microorganisms from users to users.[6]

According to Sir Ignaz "Semmelweis" (1861), bacteria were transferred to patients by infected hands of health care personal. Operation theatre, surgery wards and intensive care units (ICU) need more hygienic practices, also the same level of hygiene for the faculty and the instruments used by them.[7] Generally mobile phones are difficult to clean. Disinfecting hands by using alcohol-based hand rubs (ABHRs) that are available among hospital settings is simple, but most of the health care personnel ignore that. This may lead to contamination of devices with many microbes.[8] Multi-drug resistant (MDR) organisms are more prevalent in hospital acquired infections (HAIs) and can be difficult to exclude.[9] However, for several years now their usage has become common place, because of the unavailability of reports on serious problems in connection with them.[10] A survey of doctors performed in 2004 in an English teaching hospital found that 64% had their telephones on in areas such as operation theatres and high dependency units where vital electronic medical devices are present, which may leads to contamination of those surfaces.[11] According to surveys in 2005, there were more than 6.7 billion wireless telephone users worldwide. Today, it has been supposed that almost every health care professional has a mobile phone, which focuses its significance in the medical profession.[12]

The extensive utilization of mobile phones among health care personal in hospitals is not advisable. The medical staff must know how to utilize the mobile phones sensibly, reducing the contamination and getting their comforts. In some emergency situations, surgeons can call their seniors and colleagues for immediate help, for an opinion from the biomedical or electrical staff in case failure of any machine or instrument failure in the middle of the surgery.[13] If mobile phones are used without proper care in surgical wards Or intensive care units (ICU), they may act as source of contamination to patient, during bandaging of surgical

wounds.[14] In view of the above reasons, the present study attempted to know the burden of nosocomial infection causing bacteria present on the surface of mobile phone of Health care personnel.

Review of Literature

Lets review what literature reveals about mobile technology contamination.

1. Brady RR et al mentioned precautionary measures in order to avoid HAIs and cross transmissions and those measures named as WHO five moments i.e. carefully washing their hands, alcohol based products must be used for disinfecting hands, should be followed by every health care workers after using mobile phone and before they examine the patients.[15]
2. According to Tekerekoglu MS et al re-contamination of hands with mobiles occurs due the use of the hands for recording the pulse rate or for the measurement of blood pressure or searching regarding medicines and treatment on internet, and they also mentioned that mobile phones are heat labile and sensitive to liquids they cannot be disinfected frequently. So it is better to use silicon cases for mobiles in order to disinfect them without causing damage to the phone using chemical products.[16]
3. The above mentioned use of silicon cases was proved by La Fauci V et al by contaminating the silicon cases by S.aureus then cleaned and disinfected and after the use of disinfectant they were sterile.[17]

Aims and Objectives

1. To assess the mobile phones role in transmission of bacteria and their pathogenicity from mobile phone to health care workers.
2. To advice regarding improvement measures among the health care workers to maintain hand hygiene and regular cleaning of mobile phone.
3. To evaluate antibiotic susceptibility testing of isolates from mobile phones of health care personal in tertiary hospitals.

Materials and Methods

Type of Study
Cross sectional study
Study Setting
Tertiary care teaching hospital
Study Population
Medical faculty attending general medicine, general surgery, pediatrics, obstetrics & gynecology, ENT, ophthalmology, orthopedics and psychiatry departments.
Sample Selection
Random selection
Sample Size: 200
Inclusion Criteria
Medical faculty who were present on the days of data collection
Exclusion Criteria
Those who are not willing to give consent

Method of Data Collection

The study has involved mobile phones of 200 health care workers.

The questions asked them are regarding mobile phone cleaning; like the type of disinfectant used by them to clean their mobiles and the time of interval for mobile phone disinfection. Other questions were also asked to collect data relating to participant, like sex, age and their acknowledgement of the possible role of health care workers in spreading infections in hospital settings. Swabs were collected from his/her mobile phone(S) for culture, Clinicians were asked whether they carry one mobile phone or more than one mobile phone, and in case of more than one, separate swabs were collected from each mobile phone (15 participating clinicians had two mobile phones). A total number of 200 mobile phones were sampled. In order to obtain the swabs in a standardized manner senior microbiologist trained two senior medical students. The mobiles phones were swabbed using a sterile cotton swab both sides, screen and back. Those mobile phones with cover, the swab was taken from the outer surfaces of the cover in addition to the screen of the mobile phone. Spirit was used to disinfect the hands of the data collectors before swabbing each mobile phone In order to avoid cross contamination. The collected samples were given specific identification numbers and were labeled with clinician details like name, age, dept. and name of the unit.

As the study is conducted on the non-living objects there is no need to take informed consent regarding the sample collection.

We have used sterile cotton swabs to collect samples from the mobile phones of health care workers. During the collection of the sample, the swabs were moistened with brain heart infusion broth and swiped, for a few seconds to the surface coming into contact with the palm of the hands. Immediately after the collection of the sample they were taken to the laboratory and are incubated in brain heart infusion broth and incubated in the incubator at a temperature of 37ºC for 24-48 hrs. Samples showing growth were further sub cultured on different growth media. For isolation of Staphylococci- mannitol salt agar and to isolate Gram negative bacteria- MacConkey-agar and to isolate fecal Enterococci -Entero coccosel-agar was used.

Plates showing pure growth were reported as positive; those without growth were considered as sterile. From positive growth the individual bacteria are isolated using routine biochemical reactions. Antibiogram was done by using routine antibiotics like penicillin, amino glycosides, erythromycin, ciprofloxacin, chloramphenicol, tetracycline cephalosporin and meropenem.

Observations and Results

Out of 200 cell phones sampled, 66 were found contaminated with varied number of bacteria, and all 66 phones had single bacterium contamination. Total 66 bacteria were isolated comprising of 5 species. Of which 17% were of gram positive organisms and 16% were gram negative organisms. The most commonly isolated organism was

aerobic spore bacilli 33(16.5%) followed by Pseudomonas 13(6.5%), Proteus 11(5.5%), Escherichia coli 7(3.5%), Klebsiella 1(0.5%), Staphylococcus aureus 1(0.5%). Table 2 & 3

The mean of age was 31.05 yrs. Of 200 clinicians 116 were females 84 were males. More than 36% of clinicians examine on average more than 10 patients per day. Out of 200 clinicians, 16(8%) are using more than one mobile phone. Among 200 clinicians 3/4th (75%) of them reported that they usually answer their mobile phone calls while attending patients in all Intensive care units. Almost more than half (62%) of the medical staff reported that they use their mobile phones to browse for medical information or to take photos of the cases. Very few (11%) clinicians explained that they do not have the habit of disinfecting their mobile phones. Every clinicians have agreed that they are using liquid personal hand disinfectant like sterilium and a very few are using alcohol wipes. While 5% clinicians used to disinfect their mobile phones only when they get soiled. Table 4

Mobile phones showing growth were considered as positive for contamination, while mobile phones with no growth of organism were regarded as negative.

More than 60% of clinicians had an idea about clinician's role in spreading infection through mobile phones.

Among 200 clinicians, 64(36%) reported that their frequency of hand washing in a day depends on the number of cases examined per day. Out of 200 HCWs, 108(54%) clinicians supported to ban mobile phones in ICUs, PICUs, and NCUs. All health care workers who were participating in the study carried their mobile phones to different areas inside the hospital like operation theatres, post-operative wards, ICU and elsewhere outside the hospital. They told that they would answer and make out going phone calls on their mobiles while examining patients. None of them used headsets or not cleaned his mobile or washed his hands after using mobile phones. Table 5

There is no antibiotic resistance seen among the organisms that were isolated from mobile phones of HCWs in our study. Table 6

Table 1

Gram negative bacteria	Gram positive bacteria
Pseudomonas	Aerobic spore bacilli
Proteus	Staphylococcus aureus
E.coli	
Klebsiella	

Table 2: Percentage of growth from total samples

Total population size	No growth	No of isolated organisms	No of gram positive organisms	No of gram negative organisms
200(N)	134	66	34	32
100(%)	67%	33%	17%	16%

Table 3: Different microbial isolation with percentage

Isolated organism	Number(n=66)	Percentage (%)
Aerobic spore bacilli	33	16.5
Pseudomonas	13	6.5
Proteus	11	5.5
Escherichia coli	07	3.5
Klebsiella	01	0.5
Staphylococcus aureus	01	0.5

Table 4: Socio demographic characteristics, rank, mobile hygiene practices and work load of 200clinicians in ICUs, NCUs, & PICUs in tertiary care hospital

Gender:-	Total(N)	Percentage (%)
Male:-	84	42
Female:-	116	58
Age(mean)	31.05(N)	
Rank		
professors	102	51%
post graduates	60	30%
trainees	38%	19%
No of patients examined per day:	Total(N)	Percentage (%)
<10	12	6%
10-15	54	27%
15-20	56	28%
>20	78	39%

Answering mobile phone calls inside ICU, PICU, NCU		
Never	22	11%
Sometimes	74	37%
Always	104	52%
Ever disinfected		
Yes	22	11%
No	178	89%
Believe mobile phone role in spread of infections		
Yes	152	76%
No	48%	24%
Support banning of mobile phones use in ICUs, PICUs, NCUs		
Yes	112	56%
No	88	44%

Table 5: Pattern of mobile phones used among 200 clinicians in ICUs, PICUs, NCUs

Use of more than one mobile phone:-	N(%)
Yes	16(8%)
No	184(92%)
Answering mobile phone calls in ICUs, PICUs, NCUs:-	N(%)
Never	22(11%)
Sometimes	74(37%)
Always	104(52%)
Other areas in hospital:-	N%
Never	5(2.5%)
Sometimes	89(44.5%)
Always	106(53%)
Use of mobile phones at bedside:-	N%
Search for medical information	127(63.5%)
Take photos of cases	66(33%)

Table 6: Resistance pattern for both gram negative and gram positive bacteria

Antibiotics	Pseudomonas	Proteus	Klebsiella	E.coli	Staphylococcus Aureus
Penicillin					s
Ampicillin	S	s	s	s	
Gentamycin	S	s	s	s	s
Amikacin	S	s	s	s	s
Erythromycin					s
Levofloxacin	S	s	s	s	
Ciprofloxacin	S	s	s	s	
Cotrimoxazole	S	s	s	s	
Cefotaxime	S	s	s	s	s
Linezolid					s
Vancomycin					s
Imipenem	S	s	s	s	s

Discussion

Hospital acquired infection caused by multidrug-resistant organisms is a growing problem in many health care institutions.[18] Hands, instruments, mobile phones or other inanimate hospital objects used by HCWs may serve as vectors for the nosocomial infections causing microorganisms.[19] A part from fixed phones, mobile phones are often used in these areas close to the patients and these

patients are more prone to hospital acquired infections (HIAs) HCWs ma.[20]

The investigation was focused on bacteriological contamination of mobile phones in ICUs, PICUs, & NICUs in tertiary care hospital. In our present study nearly 66(33%) are contaminated which is lower than that reported in Kuwait, the work which was done by the author Al-Abdalall A. where 74% of mobile phones that belong to clinicians in ICUs, PICUs, and NCUs were contaminated.[7] And in India work

done by Saxena et al[21] where 42% of clinicians mobile phones were contaminated in different wards which is approximately nearer to the present study.

In our present study, mobile phones were colonized with pathogenic bacteria, namely Gram positive and Gram-negative bacteria. MRSA strain was not identified. The rate of staphylococcus aureus 1 (0.5%) contamination in health care persons mobile phones is slightly lower in our study on comparison with other literature, in which it is 1.4%.[7] Antibiotic susceptibility test for Gram negative bacteria was also done but the isolated strains were susceptible to all antibiotics. But in future they may become more powerful and show resistance to antibiotics, so careful precautions must be taken in order to control spreading of infections through mobile phones.

In present study isolation of aerobic spore bearers is 16.5% even though it is relatively higher on comparison with the other studies like work done by Tambe and Pai et al(2012)[22] which is only 3%, isolation of ASBs are not that much problematic as they are pathogenic potentially.

In the present study, isolation of Pseudomonas is 13(6.5%), which is almost nearer to the study conducted by Tagore et al [(23)] which is 4%. The isolation of Escherichiacoli in the present study is 7(3.5%) which is almost same as that in the study conducted by Rana et al.[24] There is a great variation regarding the isolation of Klebsiella comparing with other studies, as we have only 0.5% isolation other studies like work done by Abdellatif Daoudi et al[25] shows 66.6%. A study conducted in eastern Saudi Arabia by Amira H.A. Al Abdalall et al isolated proteus mirabilis 27(3.7%) which is nearer to that of our study where it is 5.5%.[26]

Almost all the HCWs used the mobile phones and most of them use it for other than regular calls and text messages. Most of the clinicians revealed that they use mobile phones for taking pictures (for case presentations) of the patients in the ward and even in operation theatre (OT). Day by day as there is development of internet facilities in the mobile phones, its use has been increased for browsing and gathering information regarding the cases. Use of mobile phone while attending patients is not recommendable as it has the vital health indications.

Our investigation revealed that clinicians disinfecting their mobiles were less likely to have contaminated when compared to those who don't sterilize their mobile phones, so it is of great importance to train health care workers regarding hand hygiene and environmental decontamination.

Other wise use of mobile phones by the HCWs for personal communication in Intensive care units or operating rooms would cause harm to hospital hygiene. Hence, along with the hands, cleaning of these mobile phones should be considered as an important thing. Prevention of cross contamination risk of nosocomial pathogens and infections should be considered in mind.

The health care personnel must inculcate measures like regular cleaning and disinfection of mobile phones with chemical disinfectant materials will decrease cross-infection and use of disinfectant additive materials. We can avoid bacterial contamination spreading just by using regular

cleansing agents. In the future mobile phones could be manufactured by using protective material against the bacterial infection.

Conclusion

1. Most of the clinician's mobile phones are contaminated by so many microorganisms in the critical wards. Microorganisms present in ICU and NCU settings are mostly dangerous, though they are regarded as nonpathogenic in normal circumstances, when patient is critically ill in ICU, they are more prone to infections.
2. Some mobile phones may be contaminated with harmful bacteria, such as MRSA or ESBL mediated drug resistant strains among Gram negative organisms, which may cause patients situation worse and leads HAIs.
3. This indicates that it is compulsory to disinfect mobile phones along with hands after contact with a phone since it is a source of disease transmission.
4. Our conclusion based on cleaning of mobile phones and other objects that clinicians may carry.
5. It also highlights the immediate need to reduce nosocomial infections, along with promoting hand hygiene
6. So it is must to create awareness among the HCWs about the important role of mobile phones in transmission of infectious agents in hospital sector. The regular cleaning of the mobile phones and following proper disinfection with disinfectants would decrease the transmission rate; still mobile phone usage should be restricted for emergency calls only.
7. Infection control committee in the hospital should format guidelines regarding the utilization of mobile phones.

Summary

1. The main purpose of this research is prevention of transmission of nosocomial infections causing bacteria from health care workers mobile phones to inpatients and to make them know the importance of cleaning mobile phones after their usage.
2. I have taken cotton swabs from 200 mobile phones of Health Care Workers which were then cultured for the isolation of microorganisms. While collecting samples, HCWs were asked to fill questionnaire which includes mobile hygiene practices, their pattern of usage, work load and so on.
3. Out 200 mobile swabs, total 66 were contaminated of which 32 were gram negative and 34 were gram positive. Isolated organisma were aerobic spore bacilli 33(16.5%) followed by Pseudomonas 13(6.5%), Proteus 11(5.5%), Escherichia coli 7(3.5%), Klebsiella 1(0.5%), Staphylococcus aureus 1(0.5%).
4. Final conclusion is to disinfect mobile phones after its usage, reduce its use in ICUs and to manufacture mobile phones with protective material against disinfections.

Implications

1. Now a days mobile phones are the most common carriers for nosocomial infection causing pathogens like S.aureus

found in skin & in the noses of up to 25% of healthy people.

2. By this we can reduce bacterial transmissions.

3. By this we can also create awareness among health care workers.

4. We can also recommend that patients are educated by infection control committee regarding guidelines and counseling on regular cleaning of phones and to avoid sharing of phones with the other inpatients in order to prevent transmission of bacteria.

Conflict of Interest: None.

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