Bacterial Isolates from Cell Phones and Hands of Health Care Workers: A Cross Sectional Study in Pediatric Wards at Black Lion Hospital, Addis Ababa, Ethiopia

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Abstract

Background: Hospital-acquired infections are one of the major problems in hospitals resulting not only in increased morbidity and mortality but also increased healthcare costs. Inanimate devices are vectors for transmission of nosocomial pathogens.

Objectives: To describe the role of cell phones in transmitting bacteria to dominant hands of HCWs in pediatric wards at Black Lion Hospital.

Methods: A cross-sectional descriptive study was used. All staff nurses, pediatric residents and medical interns attached to the Pediatric department within the study period were included in the study. Samples were taken from dominant hands of each study participants and their cell phones.

Results: Eighty five percent of the study participants never cleaned their cell phones. 78% of health care workers use their cell phones while working. Out of total 100 samples taken from hands and cell phones each, bacteria were isolated in 78% of hand swabs, in 62% of cell phones and in 18% of hand swabs taken after decontamination. The most common bacterial isolates obtained from hand swabs were Staphylococcus aureus (56.4%) and coagulase negative Staphylococcus (34.6%) while from cell phone swabs were similarly S. aureus (95.7%) and CONS (37.1%). The resistance pattern of S. aureus from hand swab was 24% & 44% respectively for vancomycin and ceftazidime; 40% of them were methicillin resistant.

Conclusion: Cell phones harbour pathogenic and potential pathogenic bacteria which can be transferred to health care workers dominant hands that may increase risk of nosocomial infection. Therefore, hand washing should be exercised strictly. Alcohol hand rub is a solution if applied correctly and consistently before and after patient care.

Keywords: Cell phones; Bacterial isolates; Drug sensitivity; Ethiopia

Abbreviations: CONS: Coagulase Negative Staphylococcus; HAIs: Hospital Acquired Infections; ICU: Intensive Care Unit; MRSA: Methicillin Resistant S. aureus; NICU: Neonatal Intensive Care Unit; OPD: Outpatient Department; S. aureus: Staphylococcus aureus; SOP: Standard Operative Procedures

Introduction

Hospital-acquired infections are one of the major problems in hospitals, resulting in increased morbidity and mortality, and increased healthcare costs [1]. In developed countries, between 5% and 10% of patients acquire one or more infections, and 15–40% of patients admitted to critical care are thought to be affected [2]. In resource-poor settings including Ethiopia, rates of infection can exceed 20% [3,4]. Because most hospital-acquired infections are primarily nosocomial and not auto infections, their acquisition in the hospital environment adds to morbidity, mortality, and economic costs [5,6].

Hospital operating rooms (OR) and Intensive care units (ICUs) are the workplaces that need the highest hygiene standards, also the same applies for the personnel working there and the equipment used by them. Pediatric wards and NICU are not exceptions [7]. Studies have demonstrated pathogenic and potential pathogenic bacteria were contaminated frequently hand touched materials [8-11]. Cell phones are among non-medical devices used routinely all day long but not cleaned properly, as health care workers (HCWs) do not wash their hands as often as they should before and after touching cell phones [12,13]. Frequent hand touch, keeping habit of cell phones and heat generate by it create optimum growth environment for multiplication of the bacterial contaminants. Hence, mobile phones are particularly problematic when compared to immobile devices and may facilitate transmission of bacterial isolates from patient to patient in wards or hospitals [14].
Many studies have shown that both medical and non-medical devices used in the hospitals are the major sources of HAIs [8,9,15,16]. In one controlled study done in India on 200 mobile phones of HCWs, bacteriological analysis revealed that 144 of the 200 (72%) were contaminated with bacteria [17]. Among 144 bacterial isolates, 18% were MRSA, 32% MSSA, 13% CONS, and 33% aerobic spore bearers. Hence, 36% of the mobile phones were contaminated with Staphylococcus aureus, bacteria which are well known to be associated with hospital associated infections [17].

In Ethiopia, such study was not done and the prevalence of microorganisms on the cell phones handled by HCWs is unknown. Accordingly, the risk of handling personal cell phones in the working area is not known and also there is no guideline on how to cleanse cell phones while on work and no regulation whether to handle it or not either. The aim of this study was to evaluate the level of bacterial contamination of cell phones of health care workers and the role of these cell phones in relation to transmission of bacteria to the healthcare workers' hands.

Methods

Study design

A cross-sectional descriptive study was conducted from May to August 2012. All 100 nurses, interns and pediatric residents at the department of Pediatrics and Child Health of Black Lion Hospital were included.

Study area

Black Lion Hospital is largest tertiary hospital in Ethiopia. It is located in the capital city, Addis Ababa, and is part of Addis Ababa University Health Science College. NICU is again one of the few centres in the country taking the majority share with neonatal admissions, care and treatment. The samples were collected from dominants hands and cell phones of technical health care workers of pediatric residents, staff nurses and interns who were assigned to pediatric OPD, pediatric wards and NICU in the study period.

Data and sample collection

Data and samples were collected by two trained laboratory technologists after written consent was obtained from study participants. Self-administered questionnaires were used to collect demographic data, hand and cell phone cleaning and handling of cell phones. Swab samples were collected from cell phone of study participants using sterile swab moistened with normal saline rotated all over the surfaces of both sides of mobile phones (1st and 2nd swab). At the same time, 3rd swab was rubbed over the ventral surface of the dominant hand up to the tip of all fingers and the 4th swab was taken from the same hand after decontamination of the hand with 5 ml of 70% ethyl alcohol. Collected swabs were immediately put in to the transport media and samples were transported to laboratory with correct and complete labelling.

Laboratory isolation of bacterial contaminants

After gentle mixing, the eluted specimen was inoculated on 5% defibrinated sheep blood agar (Oxoid UK) and incubated at 37°C for 24 to 48 hours. Growth was checked every 24 hours. Growths were identified to genus and species level following standard bacteriological technique. The antimicrobial sensitivity tests of the isolates were determined using the Modified Kirby-Bauer disc diffusion method. The isolates susceptibility was tested for antibiotics listed in the national guideline for standard treatment. Data analysis was performed using SPSS version 20.

Results

Of 100 study participants 61% were males and 39% were females (Table 1). Seventy four percent of the study participants reported that they clean their hands before touching their patients. Eighty one percent of them use alcohol and 19% use water and soap to clean their hands. Nineteen percent of them reported that they can get cleaning agents always, 40% mostly, 20% get infrequently and 21% reported cleaning agents are not available at all.

| Ward               | Gender | Profession |
|--------------------|--------|------------|
|                    | Male   | Female     | President | Nurse | Intern |
| NICU ward          | 15     | 16         | 8         | 12    | 11     |
| Pedi OPD ward      | 19     | 9          | 10        | 10    | 8      |
| B7 ward (under 5)  | 12     | 8          | 8         | 5     | 7      |
| C7 ward (5-12 years) | 15 | 6      | 6         | 7     | 8      |
| Total              | 61     | 39         | 32        | 34    | 34     |

Table 1: Socio demographic data of health care workers at Black Lion Hospital Pediatric wards, Addis Ababa, May to August, 2012.

Out of total 100 samples taken from dominant hand and cell phone each, bacteria were isolated in 78% and 62% respectively. Among the samples taken from the same dominant hands after decontamination with 5 ml of 70% ethyl alcohol, bacterial growth was seen in 18% of sample. From the total organisms isolated, Staphylococcus aureus constitutes 56.4% and 59.7% from hand and cell phone swabs respectively. Coagulase negative Staphylococcus was the second most common isolate constituting 34.6% from hand swabs and 37.1% from cell phones (Table 3).
### Table 2: Patterns of cell phone handling and hand hygiene of health care workers at Black Lion Hospital, Addis Ababa, May to August, 2012.

| Gender | Profession | Male % | Female % | President % | Nurse % | Intern % |
|--------|------------|--------|----------|-------------|---------|----------|
|        |            |        |          |             |         |          |
| Using cell phone while working |          | 78.7   | 76.9     | 100         | 47.1    | 88.2     |
| Cleaning cell phone |            | 16.7   | 23.3     | 9.4         | 68.9    | 3.3      |
| using alcohol for cell phone cleaning |          | 50     | 71.4     | 100         | 54.5    | 0        |
| Cleaning cell phone daily |          | 37.5   | 42.9     | 0           | 36.4    | 100      |
| Cleaning cell phone per month |          | 25     | 14.3     | 0           | 27.3    | 0        |
| Cleaning hand before touching patients |          | 68.9   | 82.1     | 84.4        | 82.4    | 55.9     |
| Using alcohol for hand cleaning |          | 9.5    | 15.6     | 92.6        | 60.7    | 94.7     |
| Cleaning hand always |          | 4      | 37.5     | 29.6        | 32.1    | 21.1     |
| Cleaning hand infrequently |          | 30.9   | 12.5     | 14.8        | 25      | 31.6     |
| Hand cleaning reagent always available |          | 9.5    | 46.9     | 3.7         | 42.9    | 31.6     |
| Hand cleaning reagent mostly available |          | 66.7   | 37.5     | 66.7        | 28.6    | 73.7     |
| Hand cleaning reagent infrequent available |          | 28.6   | 25       | 29.6        | 35.7    | 10.5     |
| Using water and soap for hand cleaning |          | 11.9   | 6.3      | 74.4        | 39.3    | 15.8     |
| Having finger ring |          | 13     | 46       | 31          | 44      | 3        |
| Having finger ring and hand swab positive for bacterial growth |          | 4.9    | 33.3     | 15.6        | 29.4    | 2.9      |

### Table 3: Microorganisms Isolated from cultures of cell phone and hand swabs of health care workers at Black Lion Hospital Pediatric wards, Addis Ababa, May to August, 2012.

| Isolates                  | From cell phone swabs (%) | From hand swabs (%) | From hand swab after decontaminating with 5 ml of 70% ethyl alcohol (%) |
|---------------------------|---------------------------|---------------------|-----------------------------------------------------------------------|
| *Staphylococcus aureus*   | 59.7                      | 56.4                | 20.1                                                                  |
| *CONS*                    | 37.1                      | 34.6                | 18.5                                                                  |
| *Acinetobacter spp.*      | 8.1                       | 11.5                | 0                                                                     |
| *Pseudomonas spp.*        | 11.3                      | 8.8                 | 0                                                                     |
| *Enterobacter spp.*       | 4.8                       | 2.6                 | 0                                                                     |
| *Klebsiella ozonae*       | 3.2                       | 0                   | 0                                                                     |
| *Citrobacter spp.*        | 1.6                       | 1.3                 | 0                                                                     |
| *Klebsiella oxytoca*      | 1.6                       | 1.3                 | 0                                                                     |
| *Klebsiella pneumoniae*   | 0                         | 5.1                 | 0                                                                     |
| *Streptococcus viridans*  | 0                         | 1.3                 | 0                                                                     |

From 100 cell phones swab samples, 30.6% of the isolates were from pediatric residents, 29% from nurses and 40.3% from medical interns. The distribution of culture results from hand swabs were 32.1%, 29.5% and 38.5% for the respective professionals. It was found that 80.7% of cultures from cell phones grew one bacterial species, 16.1% two different species and 3.2% three or more different species. Those cultures from hand swabs grew one, two and three or more bacterial species in 78.2%, 18% and 3.8% respectively. Distributions of the isolated microorganisms from cell phones were similar to hand isolates (Table 4).
Table 4: Patterns of bacterial growth by gender and profession at Black Lion Hospital Pediatric wards, Addis Ababa, May to August, 2012.

*S. aureus* strains isolated from hand swabs were resistant to oxacillin, vancomycin and ceftazidime in 46%, 24% and 44% respectively. The resistance pattern of *S. aureus* from cell phone isolates were 51.6%, 14% and 51% respectively for oxacillin, vancomycin and ceftazidime. CONS isolated were also resistant to commonly prescribed antibiotics (Table 5).
Discussion

Less number of interns (55.9%) washes their hands than nurses (82.4%) and Pediatric residents (84.4%) before patient examination. This may indicate that interns were not well aware of universal infection prevention precautions.

Out of total 100 cell phone swabs, growth was obtained in 62%. This is slightly higher when compared to a study done in India, which showed positive results in 40.6%. But, other studies showed higher rate of contamination in Turkey (94.5%), India (72.5 %) and in Cairo (96.5%) [7,19,20]. This variation may be due to difference in cell phone handling and hand washing practice.

This study revealed that the most common isolated organism from hand swabs was Staphylococcus aureus (56.4%). This is in line with the study done in Turkey showing contamination rate of 59.62% [7]. The similarity of the studies [21-23] showed CONS as the most common isolate. CONS were the second most common bacterial isolates in our study. Gram negative bacteria were isolated from 24% of hand swabs.

In this study S. aureus was found to be resistant to ceftriaxone in 32% and ciprofloxacin in 18% of growth from hand swabs. This is in contrast to the study done by Shitaye et al. which showed 6.7% and 0% respectively [25]. The resistance pattern for CONS in this study is 19% for ceftriaxone and 22% for ciprofloxacin again in contrast to 10% and 0% respectively to the study done by Shitaye et al. This difference may suggest the emergence of drug resistant isolates as this study was done in the same hospital after 6 years.

Conclusion

Cell phones harbor a lot of bacteria which can be transferred to HCWs dominant hands that may increase risk of nosocomial infection. The types, frequencies and resistance patterns of bacterial species isolated from hand swabs are similar to cell phone swabs isolates. Alcohol hand rub significantly decontaminates when used properly and consistently. The two commonest bacterial isolates (S. aureus and CONS) are multidrug resistant even to potent drugs like vancomycin & ceftazidime.

| Oxacillin | 40 | 37 | - | - | - | - | - | - | 0 |
| Cefoxitin | 40 | 22 | 32 | 71 | 0 | 100 | 100 | 100 | 50 | 0 |
| Cefazoxime | 36 | 44 | 22 | 29 | 0 | - | 0 | - | 50 | 0 |
| Penicillin | 71 | 59 | - | - | - | 100 | - | 100 | - | 0 |
| Cefaclor | 29 | 33 | 56 | 71 | 0 | 100 | 0 | - | 50 | 0 |
| Cefotaxime | 20 | 15 | 22 | 14 | 0 | 50 | 0 | 100 | 50 | 0 |
| Vancomycin | 24 | 11 | 11 | - | - | - | - | - | - | 0 |
| Tetracycline | 49 | 48 | 22 | 14 | 50 | 50 | 0 | 100 | 50 | 0 |
| Cotrimoxazole | 36 | 37 | 11 | 57 | 0 | 100 | 0 | 100 | 50 | 100 |
| Ceftriaxone | 31 | 19 | 22 | 14 | 0 | 50 | 0 | 0 | 50 | 0 |
| Doxycycline | 31 | 48 | 11 | 14 | 0 | 100 | 0 | 100 | 50 | 0 |
| Norfloxacin | 27 | 33 | 89 | 0 | 0 | 100 | 0 | 0 | 25 | 0 |
| Amikacin | 2 | 0 | 0 | 0 | 0 | 50 | 0 | 0 | 100 | 0 |
| Ciprofloxacin | 20 | 19 | 11 | 0 | 0 | 100 | 0 | 0 | 25 | 0 |
| Rifampicin | 29 | 22 | - | - | - | - | - | - | - | 0 |

Table 5: Drug Sensitivity testing for Hand isolates (Percentage of resistance for 22 antibiotics) taken from health care workers at Black Lion Hospital Pediatric wards, Addis Ababa, May to August, 2012.
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References

1. Haley RW, Culver DH, White JW, Morgan WM, Emori TG, et al. (1985) The Efficacy of Infection Surveillance and Control Programs in Preventing Nosocomial Infection in US Hospitals. Am J Epidemiol 121: 182-205.

2. Gastmeier P, Groneberg K, Weist, Rüden H (2003) A Cluster of Nosocomial Klebsiella pneumonia Bloodstream Infections in a Neonatal Intensive Care Department. Identification of Transmission and Intervention. Am J Infect Contr 31: 424-430.

3. Pittet D (2002) Improving Compliance with Hand Hygiene in Hospitals. J Infect Dis 185: 1275-1276.

4. Pittet D, Mourouga P, Perneger (1999) Compliance with Hand washing in a Teaching Hospital. Ann Intern Med 130: 126-30.

5. Hoogkamp-Korstanje J, Cats AB, Senders RC, Ertbruggen IV (1982) Analysis of Bacterial Infections in a Neonatal Intensive Care Unit. J Hosp Infect 3: 275-284.

6. Parmar RC, Valvi C, Sira P, Kamat JR (2004) A Prospective, Randomised, Double-Blind Study of Comparative Efficacy of Immediate versus Daily Cleaning of Stethoscope Using 66% Ethyl Alcohol. Indian J Med Sci 58: 423-430.

7. Ulger F, Eser S, Dilek A, Yanik K, Gunaydin M, et al. (2009) Mouthwash and associated risk factors in nosocomial infection surveillance. J Med Microbiol 58: 585-592.

8. Isaacs D, Daley A, Dalton D, Nallusamy R (1998) Swabbing computers in search of nosocomial bacteria. Ped Infect Dis J 17: 533.

9. Rusin P, Maxwell S, Gerba C (2002) Comparative surface-to-hand and fingertip-to-mouth transfer efficiency of gram-positive bacteria, gram-negative bacteria, and phage. J Appl Microbiol 93: 385-592.

10. Singh V, Aggarwal V, Bansal S, Garg SP, Chowdhary N (1998) Telephone mouthpiece as a possible source of hospital infection. J Assoc Physicians India 46: 372-373.

11. Uneke CJ, Ogbonna A, Oyibo PG, Ekuma U (2009) Bacteriological Assessment of Stethoscopes Used by Medical Students in Nigeria. Implications for Nosocomial Infection Control. Healthc Q 12: 132-138.

12. Ramesh J (2008) Use of mobile phones by medical staff at Queen Elizabeth Hospital, Barlados. Evidence for both benefit and harm. J Hosp Infect 70: 160-5.

13. Voss A, Widmer AF (1997) No time for hand washing. Hand washing versus alcoholic rub: can we afford 100% compliance? Infect Control Hosp Epidemiol 18: 205-208.

14. Brady RR, Fraser SF, Dunlop MG, Paterson-Brown S, Gibb AP (2007) Bacterial contamination of mobile communication devices in the operative environment. J Hosp Infect 66: 397-8.

15. Tambekar DH, Gulhane PR, Dahikar SG, Dudhane MN (2008) Nosocomial Hazards of Doctors’ Mobile Phones in Hospitals. J Med Sci 8: 73-76.

16. Butz AM, Fosarelli P, Dick J, Cusack T, Yolken R (1993) Prevalence of rotaviruses on high risk fomites in day-care facilities. Pediatr 92: 202-205.

17. Goldblatt JG, Krief I, Klonsky T, Hallerd D, Milloul V, et al. (2007) Use of cellular telephones and transmission of pathogens by medical staff in New York and Israel. Infect Cont Hosp Ep 28: 500-3.

18. Bhat SS, Hegde SK, Salian S (2011) Potential of Mobile Phones to Serve as a Reservoir in Spread of Nosocomial Pathogens. J Health Allied Scs 10: 14.

19. Ananthakrishnan S, Gunasekaran D (2006) Bacterial Contamination of Mobile Phones of Health Care Workers. Indian J Med Microbiol 55: 165-9.

20. Elkholy MT, Ewees IE (2010) Mobile phones contamination with bacteria in ICU. Med J Cairo Univ 78: 2.

21. Arora U, Devi P, Chadha A, Malhotra S (2009) Cell phones, A Modern Stay house For Bacterial Pathogens. JK SCI 11: 127-129.

22. Chandra TJ, Lakshmiprasanna T, Venkateswarao A (2011) A study on isolation and identification of bacteria causing nosocomial infections on mobile phones of health care workers. Calicut Medical Journal 9: 2.

23. Karabay O, Kocoglu E, Tahtaci M (2007) The role of mobile phones in the spread of bacteria associated with nosocomial infections. J Infect Dev Ctries 1: 72-73.

24. Demissie M, Lulesed S (2009) The Prevalence of Nosocomial Infections and Associated Risk Factors in Pediatric Patients in Tikur Anbessa Hospital. Ethiop J Pediatr Child Health.

25. Shitaye D, Asrat D, Yimtubinash W (2010) Neonatal Sepsis: Bacterial etiologic agents and their antibiotic susceptibility pattern in TAH. Ethiop Med J 48: 11-12.