

## 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* (59.7%) 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 Paediatrics 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 dominant hands and cell phones of technical health care workers of paediatric residents, staff nurses and interns who were assigned to paediatric OPD, pediatric wards and NICU in the study period.

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*

### 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 (1<sup>st</sup> and 2<sup>nd</sup> swab). At the same time, 3<sup>rd</sup> swab was rubbed over the ventral surface of the dominant hand up to the tip of all fingers and the 4<sup>th</sup> 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. The rate of routine cleaning of HCW's cell phones was 15% and 85% of the participants never cleaned their mobile phones. Seventy eight percent of HCWs use their cell phones while working (Table 2).

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).

	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 2:** Patterns of cell phone handling and hand hygiene of health care workers at Black Lion Hospital, 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 (%)
<i>Staphylococcus aureus</i>	59.7	56.4	20.1
CONS	37.1	34.6	18.5
<i>Acinetobacter</i> spp.	8.1	11.5	0
<i>Pseudomonas</i> spp.	11.3	8.8	0
<i>Enterobacter</i> spp.	4.8	2.6	0
<i>Klebseilla ozonae</i>	3.2	0	0
<i>Citrobacter</i> spp.	1.6	1.3	0
<i>Klebseilla oxytoca</i>	1.6	1.3	0
<i>Klebseilla pneumonea</i>	0	5.1	0
<i>Streptococcus viridans</i>	0	1.3	0

**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.

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).

	Gender		Profession		
	Male %	Female %	Resident %	Nurse %	Intern %
Growth obtained from hand swab	81.9	71.8	78.1	67.6	93.8
Growth obtained from cell phone	72.1	46.1	59.4	52.9	78.1
Only one type bacteria grew from hand	84	67.8	72	78.3	83.3
Two different types of bacteria grew from hand	16	21.4	16	13	10
Three or more different bacteria grew from hand	0	10.7	8	4.3	0
Only one type bacteria grew from cell phone	86.4	66.7	68.4	83.3	88
Two different types of bacteria grew from cell phone	13.6	22.2	21	16.7	12
Three or more different bacteria grew from cell phone	0	11.1	10.5	0	0
<i>S. aur</i> positive from hand swabs	58	57.1	64	60.1	46.7
<i>S. aur</i> positive from cell phone swabs	56.8	66.7	63.2	77.8	44
CONS positive from hand swabs	36	28.6	36	21.7	43.3
CONS positive from cell phone swabs	40.9	27.8	36.7	22.2	48
Acine positive from hand swabs	10	14.3	12	4.3	16.7
Acine positive from cell phone swabs	6.8	11.1	10.5	11.1	4
Pseudo positive from hand swabs	14	10.7	8	13	6.6
Pseudo positive from cell phone swabs	6.8	22.2	15.8	0	16
Entero positive from hand swabs	0	7.1	8	0	0
Entero positive from cell phone swabs	2.3	11.1	15.8	0	0
<i>Klebozaenae</i> positive from hand swabs	2	10.7	0	8.7	0
Citro positive from hand swabs	0	3.6	0	0	3.3

KEY: Acine: *Acinetobacter* spp, Pseudo: *Pseudomonas* spp, Entero: *Enterobacter* spp; Kleb: *Klebsiellaozaenae*, Citro: *Citrobacter* spp.

**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).

	<i>S. aur</i>	Cons	Acine	Pseudo	Enter	Kleboz	Citro	Klebox	Klebp	vird
Ampicillin	64	44	56	79	50	100	-	100	100	100
Augmentin	13	4	33	29	0	100	-	100	25	0
Clindamycin	24	30	-	-	-	-	-	-	-	0
CAF	40	22	56	57	0	50	0	100	50	0
Erythromycin	42	44	-	-	-	-	-	-	-	0
Gentmycin	27	44	22	14	0	50	0	0	50	100
Ceftazidime	44	59	22	29	0	50	0	100	50	0

Oxacillin	40	37	-	-	-	-	-	-	-	0
Cefoxitin	40	22	32	71	0	100	100	100	50	0
Ceftazoxime	38	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
Cotrimoxazo	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.

## 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 differences 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]. But, majority 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. This is comparable with results of Mohamad et al. [20] and Chandra et al. [22] which showed 32% and 30% respectively.

After using alcohol hand rub with 5ml of 70% of ethyl alcohol, contamination rate decreased from 78% to 18%. This is slightly lower than the study done by Usha et al. which showed decontamination efficacy of (98%) [21].

Study done in Black Lion Hospital in 2003 showed that *E. coli* (17.7%) was the most common cause of nosocomial infection followed by *Klebsiella* species, *Pseudomonas* species, CONS and *S. aureus* in that order [24]. Another study conducted by Shitaye et al. in the same hospital showed that *Klebsiella* species [39%] and *S. aureus* [22%] were found to be the most common pathogens isolated from blood cultures

in neonates admitted with neonatal sepsis [25]. Our findings also showed that similar bacterial isolates are the contaminants of mobile phones and dominant hands of the health care providers in the same hospital. Among *S. aureus* grew from hand swabs, 40% showed methicillin resistance which is comparable result with the study conducted by Arora et al. (37.7%) [21], but lower than the study conducted by Shitaye et al. [25] where MRSA was detected in 66%. The difference may be due to variation in selective pressure and rational drug use in the study settings.

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.

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