

Evaluation of Shift Work on Bacterial Contamination of Cellular Phone of Health Care Staff at Adult Trauma Intensive Care Unit

Mansoor Masjedi,¹ Azin Hamidi,^{2,*} Monireh Feizi,³ and Hamidreza Abbasi⁴

¹Anesthesiology and Critical Care Research Center, Shiraz University of Medical Sciences, Shiraz, IR Iran

²Anesthesia and Intensive Care Department, Shiraz University of Medical Sciences, Shiraz, IR Iran

³Rajaei Trauma Hospital, Shiraz University of Medical Sciences, Shiraz, IR Iran

⁴Trauma Research Center, Shiraz University of Medical Sciences, Shiraz, IR Iran

*Corresponding author: Azin Hamidi, Anesthesia and Intensive Care Department, Shiraz University of Medical Sciences, Shiraz, IR Iran. Tel: +98-9177196146, Fax: +98-07136474270, E-mail: azin_h67@yahoo.com

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Abstract

Background: The goal of this study was to explore the effect of a shift work at adult trauma intensive care units on microbial contamination of cellular phones. Prevalence and type of microorganisms on intensive care unit (ICU) staff mobile phones is considered as a major route for transmission of infection.

Methods: As a cross sectional study, cultures of mobile phone of 80 staff working at six adult trauma ICUs (54 beds) of a tertiary university affiliated hospital in Shiraz (Iran), were obtained, upon start and at the end of a shift. Samples were sent to the microbiologic laboratory of the hospital and cultured on specified media.

Results: From 80 cell phones, 74 (92.5%) were contaminated upon entrance to ICU. Microorganisms included *Staphylococcus* coagulase negative 48 (60%), *Bacillus* 16 (20%), *Acinetobacter* 3 (3.75%) and others (*Enterobacter*, non hemolytic *Streptococcus*, *E. coli* and *Serratia*) with prevalence of 7 (8.75%). In comparison, exit cultures were positive for 49 (62.6%) of the cell phones that comprised of 34 (43.8%) coagulase negative *Staphylococcus*, 8 (10%) *Bacillus*, 2 (2.5%) *Acinetobacter*, and 5 (5.3%) contaminations with other microorganisms. Results showed a significant reduction in positive cultures at exit time from ICU. No correlation could be found between age, marital status, work experience in either hospital or ICU and changes in contamination of mobile phones. There was only a relationship between shift time and microbial colonization, which was more prevalent in night shifts followed by afternoon and morning shifts. *Acinetobacter* contamination of mobile phones of healthcare workers was more prevalent upon entrance to ICU than at exit time.

Conclusions: High prevalence of cellular phone contamination with potential microorganisms is a major concern in adult trauma ICUs. Contamination of this equipment is more prevalent upon start of shift work, so a reverse transmission of bacteria may take place. Prevalence of *Acinetobacter* on entrance cultures necessitates special consideration. Infection control strategies to reduce cell phone colonization of trauma ICU staff, should be applied.

Keywords: *Acinetobacter* Cellular Phone, Contamination, Shift Work, Trauma Intensive Care Unit

1. Background

Hospital acquired infection is associated with increased mortality and morbidity. Patients admitted to intensive care units are specifically prone to infection because of underlying problems and also intensity of care, which necessitates more indwelling catheters. The majority of trauma intensive care unit (ICU) infections are hospital acquired. Patients are mostly not infected by any microorganism upon arrival to the ICU. In addition, trauma patients are at higher risk of infection because of many factors such as emergency operation, frequent transport to radiology unit, more invasive monitoring, frequent catheterization decreased immunity, loss of skin and mucosal bar-

riers and so on.

Both ICU staff and their equipments may contribute to transmission of infection. Cell phones are one of the most frequent and widespread personal devices used during work time and may be easily contaminated by a wide range of infectious and non-infectious organisms and play a role as potential source for infection transmission.

2. Objectives

This study aimed to evaluate the effect of a shift work on microbial contamination of cell phones of trauma ICU staff. Results of this research can help the healthcare system employ an appropriate strategy for this possible route

of infection propagation.

3. Methods

After hospital ethical committee approval, informed consent was taken from participating personnel.

In this cross sectional study, 88 staff's mobile phone samples from six adult trauma intensive care units of Shahid Rajaei trauma hospital were collected. Samples from cell phones were taken upon entrance to the ICU floor before changing clothes and also at the end of the shift prior to uniform take off. All staffs scheduled for ICU shift work were included except staff of prior shift. Samples were prepared by rubbing sterile cotton swabs on different sides of cell phones. Collected samples were labeled, kept in Brain Heart Infusion (BHI) solution medium and sent under standard conditions to hospital laboratories for further analysis. Participants' characteristics including age, marital status, and job experience in hospital wards and intensive care unit were recorded.

Collected samples were incubated for 24 hours at 37°C and then sub-cultured on Blood and Eosin Methylene Blue (EMB) culture media. Gram-negative microorganisms were grown on both media while gram positives were grown just on Blood medium. DNase test medium was used to differentiate gram positives. Triple Sugar Iron (TSI), Urea, Sulfide Indole Motility (SIM) and Simmon citrate agar culture media were used to differentiate gram-negative bacteria. Finally culture results were recorded and analyzed.

Statistical analysis was conducted through chi square, NPar, one-way Analysis of Variance (ANOVA), Pearson and Kruskal Wallis tests. P values of < 0.05 were considered significant.

4. Results

This research was a cross sectional study conducted in six adult trauma intensive care units (54 beds) of a tertiary, university affiliated hospital, Shiraz, Iran. Among 88 participated staff, eight were excluded because of their missing exit cultures. The age of participants ranged from 21 to 37 years with an average of 29.1. Personnel's hospital working experience ranged between one and thirteen years with an average of 5.25 years and their ICU work experience ranged from 0 to 10 years, average of 3.84. Among 80 individuals, 39 (48.75%) were married and 41 (51.25%) were single, respectively. Samples were collected between shift work changes including 48 (60%), 22 (27.5%) and 10 (12.5%) participants for morning, evening and night shifts, respectively. All participants were allowed to respond to their calls while they were on shift.

From 80 cell phones, 74 (92.5%) were contaminated upon entrance to ICU. Cultures were positive for *Staphylococcus coagulase negative* 48 (60%), *Bacillus* 16 (20%) and *Acinetobacter* 3 (3.75%). Other microorganisms were *Enterobacter*, non-hemolytic *Streptococcus*, *E. coli* and *Serratia* with prevalence of 7 (8.75%). In comparison, exit cultures were positive for 49 (62.6%) of cell phones and microorganisms included 34 (43.8%) *Staphylococcus coagulase negative*, 8 (10%) *Bacillus*, 2 (2.5%) *Acinetobacter*, and 5 (5.3%) contaminations with other microorganisms. Results showed significant reduction in positive cultures from entrance to exit time (92.5% to 62.6%).

Regression analysis among different measured variables revealed that only time of shifts had significant correlation with prevalence of contaminated cell phones, which in decreasing order were as follows night, afternoon and morning shifts. Some microorganisms with a low percentage, remarked as others (Table 1).

The most frequent isolated microorganism was *staphylococcus coagulase negative* with 60% and 43.8% at entrance and exit cultures, respectively. In the second rank, *Bacillus* was isolated from 20% and 10% for entrance and exit samples.

Contamination of cell phones with *Acinetobacter* was 3.75% upon arrival to ICU, which was decreased to 2.5% at the end of the shift.

5. Discussion

Although the hospital environment and patients could be considered as a source of infection and play a significant role impacting public health, health care workers such as physicians, nurses and other members of health care system may additionally play a role as a source for transmission of infections. This transmission to patients may occur via routine habits such as using personal belongings during work shifts (1-8). Trauma victims admitted to the ICU require more intensive and sophisticated care, which predisposes them to infections. Mobile phones are considered as a medium for transporting germs because of their high grade of contamination and their role as a threat to public health (9, 10).

Several reports regarding contamination of staffs' equipment are available. *Staphylococcus coagulase negative* and *Staphylococcus aureus* and *Bacillus* were reported as the most frequent germs of mobile phone's cultures in a study in 2016 by Zakai et al. (11). Hayba et al. (2015) collected samples from cell phones of healthcare workers of Kuwait hospitals (12).

They detected Methicillin-resistant *Staphylococcus aureus* (MRSA) and gram-negative bacteria as the most common device contaminants. Another similar study in Egypt

Table 1. Type and Percentage of Isolated Microorganisms From 80 Trauma Intensive Care Unit (ICU) Staff Cell Phones Upon Entrance and Exit From the ICU

Microorganism	Entrance Culture	Exit Culture
Coagulase negative <i>Staphylococcus</i>	60%	43.8 %
<i>Bacillus</i>	20 %	10 %
Others ^a	8.75%	5.3 %
<i>Acinetobacter</i>	3.75%	2.5%
No growth	7.5 %	37.4 %

^a*Enterobacter*, non-hemolytic *Streptococcus*, *E. coli* and *Serratia*.

Table 2. Correlation of Entrance and Exit Cultures of Cell Phones of Trauma Intensive Care Unit Staff With Different Variables

Variables	P value	
	Entrance Culture	Exit Culture
Work experience at the hospital	0.293 ^a	0.698 ^a
Work experience at the ICU	0.747 ^a	0.254 ^a
Age	00.259 ^a	0.344 ^a
Marital status	0.982 ^a	0.861 ^a
Shifts	0.023 ^b	0.218 ^a

^anon significant.

^bsignificant at 0.05%.

by Selim et al. showed the most common microorganisms on healthcare worker's cell phones were MRSA and *Staphylococcus coagulase negative* (13). Other similar studies also reported *Pseudomonas species* in addition to previous germs (12-15). In 2012, Ustun et al. reported that among 183 samples that were collected from cell phones of physicians, nurses and laboratory staffs, 179 (97.8%) were contaminated including Extended Spectrum Beta-Lactamases (ESBLs) producing *E. coli* (11.2%) and MRSA (9.5%) (16).

Some other studies also revealed high prevalence of contamination of hospital staff mobile phones with different pathogens. In 2010, El kholy et al. reported contamination of mobile phones with *E. coli*, *pseudomonas aeruginosa*, *Proteus vulgaris*, *Klebsiella*, *Serratia* and *Staphylococcus aureus* (2). Some studies reported other microorganisms such as *Acinetobacter* and *Enterococcus faecalis* (1, 15, 17-29).

Even though our study was conducted in a specific situation (trauma ICU) yet type and prevalence of microorganisms were similar to previous studies. It has been proven that *S. aureus* is among the common pathogens of trauma victims. As an outstanding finding, there was a prominent decrease of positive cultures at ICU exit time. This may be the result of cleaning mobile phones with disinfectants during shift work. It was mostly affected by *Bacillus* (50% reduction), then other microorganisms (*Enterobacter*, non hemolytic *Streptococcus*, *E. coli* and *Serratia*) and *Acinetobacter* (30% reduction), followed by *Staphylococcus coagulase negative* (25.5% reduction). Different times of shift work affected contamination of staff mobile phones. Attendance

of intensivist, occasional check by infectious supervisors, previous shift time and sleepiness, all may have altered ICU staff compliance with infectious precautions.

Our study had some limitations. Frequency and type of disinfectant used for cleaning of mobile phones during shift was not recorded. We did not record whether participants came to work from a shift of another hospital or their home. Participants were not categorized to doctors, nurses and other health care workers.

5.1. Conclusion

High prevalence of cellular phone contamination with potential microorganisms is a major concern in adult trauma ICUs. Contamination of this equipment is more prevalent upon start of shift work so reverse transmission of microorganisms from out of the hospital to the hospital should be taken into consideration, especially for pathogenic microorganisms like *Acinetobacter*. Infection control strategies to reduce cell phone colonization of trauma ICU staff, should be applied.

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