

Original Research Article

An overview of the prevalence of multidrug-resistant gram negative bacterial species among healthcare workers and in community in Iran

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Abstract: The antimicrobial resistance among gram negative bacteria is increasing among patients, community and healthcare workers. Determination of these species and their resistance profile is mandatory for successful empiric antibiotic therapy. The aim of the current study was to investigate the prevalence of drug resistant gram negative isolates from community and healthcare workers in Iran. A total of 10 previous published studies were found while searching internet searching engines including PubMed, Google scholar, Sciverse, and so on. The key words of “gram negative”, “drug resistant”, “healthcare workers”, “community” and “Iran” were searched in the noted searching engines. The publications related to the healthcare, patients and hospital settings were excluded from the study. Moreover, healthcare workers of children and adults/ageing and in addition, community settings were included in the study. Data were analyzed with Exel software. Among the published studies, most of bacterial species among healthcare workers and community were in Enterobacteriaceae family, mostly *E. coli* (3.75%) and *K. pneumonia* (3.74%), *A. baumannii* (3%), *P. aeruginosa* (1.25%), *E. aerogenes* (1.2%), *Proteus spp* (0.1%) and other species. Two publications were about caregiver’s mobile phones and 2 were associated with hands. Moreover, community and workers hands were more contaminated than phone and coats. The results showed that community and healthcare workers can play a role in contamination spread. Hands of healthcare workers were the highest level of contamination. The publications on MDR isolates were scarce.

Keywords: Gram negative spp., community setting, drug resistance, healthcare workers, Iran.

INTRODUCTION

Healthcare workers and community settings are reservoirs of drug resistant bacterial species [1]. It has been uncovered that these workers can be contaminated and thus disseminating these drug resistant species [2]. Moreover, recent reports have disclosed the increasing rate of multidrug resistant gram positive and negative isolates in community [3]. Hands, cloths and mobile phones are most routes of contamination among healthcare workers, and then spread of drug resistant strains [4]. Furthermore, with the development in technology, mobile era has advanced and the world may mostly be on the tip of finger. It has been reported higher prevalence of contamination among women than men, and also higher on mobiles kept from bags than those from pockets. Among bacterial species found in this regard, gram positive isolates such as *Bacillus spp*, *Staphylococcus epidermidis*, micrococci, *Staphylococcus aureus* and enterococci have been detected at a higher prevalence [4, 5]. On the other hand among gram negative isolates, *Pseudomonas aeruginosa*, *Escherichia coli*, *Acinetobacter baumannii* and *Klebsiella spp* are prevalent

at the highest rate from Iran [6-8]. All these pathogens from patients have been found to be multidrug resistant in most of cases and sometimes resistant to all the commonly used antibiotics [9]. In the hospital environment, there is a high burden of these isolates and therefore healthcare workers may potentially serve as vehicles of dissemination of them [10-12]. The strict adherence to the infection control, such as hand washing and mobile disinfection is necessary. Components of Ethyl and Isopropyl alcohol have been highly effective for removing or decontaminating of pathogenic bacteria on surface of mobile phones [13]. However, the relative role of health care workers in the horizontal transmission of these pathogens remains to be elucidated. The aim of this study was evaluating the prevalence of drug-resistant gram-negative isolates and their antibiotic susceptibility profile among healthcare workers and community settings in Iran according to the previous studies.

MATERIALS AND METHODS

A total of 8 previous published studies from 2006 to 2013 were found while searching internet

searching engines including PubMed, Google scholar, Sciverse, and so on. The key words of “gram negative”, “drug resistant”, “healthcare workers” “community” and “Iran” were searched in the noted searching engines. The publications related to the healthcare, patients and hospital settings were excluded from the study. Moreover, healthcare workers of children and adults/ageing and in addition, community settings were included in the study. Data were analyzed with Exel software.

RESULTS

From the assessed studies including healthcare workers hands, mobile phones and white coats and community settings most prevalent isolates were gram-positive bacilli and cocci and then gram-negative

isolates [14]. Isolates such as *Bacillus spp*, *Staphylococcus epidermidis*, *Staphylococcus aureus* and other gram-positive cocci were detected at a higher prevalence. On the other hand among gram negative isolates, *Pseudomonase aeruginosa*, *Escherichia coli*, *Klebsiella spp*, *Acinetobacter humani* and *Enterobacter* were prevalent at the highest rate according to previous surveys of community and health worker’s hands and mobile phones and community countrywide (fig1). In one study from Ahvaz, Gram-negative *K. pneumoniae*, and *Enterobacter spp*. bacilli were predominant isolates from food staff hands [15]. Among white coats, the abdominal part was the most area of contamination.

The mean prevalence of these species among each population has been depicted in table1.

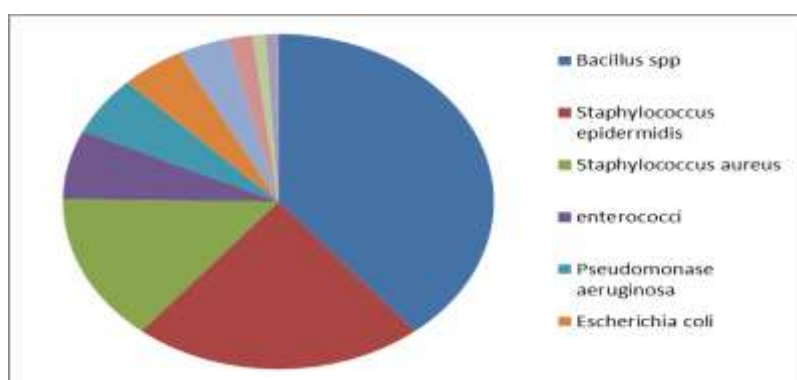


Fig-1: Prevalence of bacterial species among healthcare workers mobiles, hands and community settings

Table-1: Prevalence of gram negative species among each population of specimens, ND: none detected.

Species /samples (%)	Community settings	Mobile phones	Health workers hands	White coats	Pr>F
<i>P. aeruginosa</i>	1.3	0.4	2	1.3	<0.001
<i>E. coli</i>	12	0.4	1.5	1	<0.001
<i>A. humanii</i>	3	0.3	1	8	<0.001
<i>K. pneumonia</i>	8	0.1	1	6	<0.001
<i>E. aerogenes</i>	0.2	1.1	0.2	4	<0.001
<i>Proteus spp</i>	ND	0.4	ND	ND	-

Table-2: Duncan analysis of four populations

Mean	Sample
4.08 ^a	Community
0.45 ^b	Mobile phone
0.95 ^c	Hands
3.38 ^a	Coats

The results showed that *E. coli* and *K. pneumonia* were significantly higher in the community settings than samples from healthcare workers ($p=0.02$), while *A. humanii*, *K. pneumonia* and *E. aerogenes* determined significantly higher from white coats of health workers ($p=0.01$). Furthermore, analyses showed that samples from the four populations were significantly different ($F<0.001$, table1). Duncan analysis showed that contamination were significantly different between each community, mobile phone

contamination and hands of healthcare workers, but not between community and coats. The analysis of drug resistance among these isolates in published studies that have examined the antibiotic susceptibility test, showed that among gram-negative isolates, almost all isolates of Enterobacteriaceae were resistant to ampicillin (100%), and almost all were susceptible to piperacillin (3.7%). The antibiotic susceptibility profile of the isolates has been shown in table 2. The rate of resistance in nosocomial infections in two studies was higher than

that of community-acquired ones. In one study, the ESBLs were detected in 4% of community isolates of *E. coli* and *Klebsiella* species. On the other hand, according to these studies, among isolates of Enterobacteriaceae from patients (2 studies have been assessed both hospital and community settings) the

majority has been collected from urine (70%) and wound (14%) samples. There was a report of significant relationship between age and MDR isolates of *E. coli* and *K. pneumonia*. Furthermore it was found that education of students in university in a lecture alone can significantly reduce hands contamination [16].

Table-3: The antibiotic susceptibility pattern of gram-negative isolates from community and healthcare workers

Species /disks (%)	ampicillin	amikacin	Ceftriaxone	cefazolin	gentamycin	cefixime	ciprofloxacin	ceftazidime	imipenem
<i>P. aeruginosa</i>	-	-	-	-	-	-	-	-	-
<i>E. coli</i>	100	31	30.5	63.8	34.4	64	4.2	8.5	4.2
<i>A. humanii</i>	-	-	-	-	-	-	-	-	-
<i>K. pneumonia</i>	100	34	40	63	33	63.3	6.7	10	6.7
<i>Enterobacter</i>	100	0.0	100	50	0.0	100	0.0	0.0	0.0
Non-fermenters	-	-	-	-	-	-	-	-	-

DISCUSSION

According to the previous studies from Iran, among gram-positive isolates, most of identified isolates have been *Bacillus spp.*, *Staphylococcus epidermidis*, *Staphylococcus aureus* and enterococci at a higher prevalence respectively. On the other hand among gram negative isolates *E. coli*, *K. pneumonia*, *Pseudomonas aeruginosa*, *Acinetobacter baumannii*, *Enterobacter* and *Proteus spp.* have been prevalent at the highest rate from community and health worker's hands coats and mobile phones countrywide. The results showed that there are a scarcity of publications on the prevalence of these potential pathogens and drug-resistant species among healthcare workers and community in the country. The results showed that *E. coli* and *K. pneumonia* were significantly higher in the community settings than samples from healthcare workers ($p=0.02$), while *A. baumannii*, *K. pneumonia* and *E. aerogenes* determined significantly higher from white coats of health workers ($p=0.01$). Furthermore, analyses showed that samples from the four populations were significantly different ($F<0.001$, table1). Duncan analysis showed that contamination were significantly different between each community, mobile phone contamination and hands of healthcare workers, but not between community and coats. In fact, contamination in the community and coats were significant higher than other samples. Researches from other countries have shown similar with some different results. A cross-sectional study by Bhoonderowa, Of 192 mobile phones (102 males and 90 females), a total 176 personal phones (91.7 %) showed bacterial contamination. Coagulase negative *Staphylococcus* was the most prevalent (69.3 %) species followed by *Micrococci* (51.8 %), *Klebsiella* (1.5 %) and *Pseudomonas* (1 %). Moreover, the mean colony forming units was higher among females than males ($p < 0.05$; 95 % CI 0.021–0.365) and higher on mobile phones which were kept in bags than in pockets ($p < 0.05$; 95 % CI 0.019–0.369) [4]. In another study from 183 mobile phones, 94 (51.4%) from nurses, 32 (17.5%) from laboratory workers, and 57 (31.1%) from health care staff, 179 (97.8%)

specimens were culture-positive. Furthermore, from the 183 mobiles, 17 (9.5%) were identified as MRSA and 20 (11.2%) were ESBL-positive *E. coli* species. Forty-four (24.6%) were isolated from mobile phones of ICU workers, including two MRSA and nine ESBL positive *E. coli*. A significant ($p = 0.02$) difference was in isolation of ESBL-producing *E. coli* between ICU workers and non-ICU workers [17]. In another survey, of 34 healthcare workers in a single surgical intensive care unit, bacterial population was analyzed over a short (3 week) time period using glove-juice. Analysis showed a slightly more similar microbial species within individual hand samples over time than between hands of different individuals [5].

The results of this study emphasize the contamination of community settings and health workers coats that may crucial role in spread of contamination in the country. Drug-resistant *E. coli*, *K. pneumonia*, *A. baumannii* and *P. aeruginosa* were the most prevalent pathogens isolated from healthcare workers and community that showed high resistance according to previous studies. The most important route of control the dissemination of nosocomial infections via hands and community is to disinfect or clean them regularly. Moreover, few studies have been conducted concerning sterilization of surgical instruments and medical devices such as endoscopes. Cleaning must also precede sterilization or high-level disinfection [18]. These findings propose several considerations such as [1] High level of contamination on surface of hospital environments [2]. Needing for a standard procedure of continuous sampling, interpretation and documentation [3]. More hygiene training of healthcare workers [4]. Control and increase the number of nurses particularly infection surveillance nurses [5]. Use more proper disinfectant and reagent quality [6]. The hospital personnel should be familiarized with hand washing procedures and using proper gloves too. Some re-educational programs for health care workers is also suggested.

CONCLUSION

Previous publications regarding prevalence of multidrug-resistant gram negative species in healthcare workers and community were few from Iran. However, hospital environment, Healthcare workers mobile phones and hands are potential vectors for transferring these strains between workers, patients, and the community. Hospital environment is a complicated ecosystem and many interventions are needed for optimal infection control. We also propose the future studies to evaluate gram-positive species in hospital environment and personnel.

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