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Efficacy of Disinfectants on Bacteria; Case Study of Isfahan Hospitals

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Abstract

Aims: The internal unit and ICU of hospitals are a suitable environment for growing of bacteria such as *Staphylococcus epidermidis*, *Pseudomonas* and *Acinetobacters*. The aim of this study was to evaluate the efficacy of using disinfectants on bacterial remove in Isfahan City, Iran, hospitals.

Instrument & Methods: This descriptive study was performed in Isfahan City, Iran, hospitals in 2015. 200 samples were taken from random locations of the hospitals. Sampling was carried out at the end of the business day and before disinfecting the surfaces with sterile cotton swabs moistened by sterile saline. After identification of bacteria, the numbers of bacterial colonies were counted before disinfection in 1ml (CFU/ml).

Findings: The highest isolates were detected from emergency unit before disinfection included *Pseudomonas aeruginosa*, *Staphylococcus spp.*, *Escherichia coli*, *Proteus spp.*, *Klebsiella spp.*, *Acinetobacter spp.*, and *Enterobacter spp.* 255 cases of bacteria were found at 27 positive samples. The most common isolated bacteria after disinfection were *Staphylococcus epidermidis* (76 cases), *E. coli* (42 cases) and *Micrococcus luteus* (39 cases).

Conclusion: The disinfecting process of Isfahan Hospitals is effective in removing bacterial infections.

Keywords

Hospitals [<https://www.ncbi.nlm.nih.gov/mesh/68006761>];
Disinfectants [<https://www.ncbi.nlm.nih.gov/mesh/68004202>];
Gram-Negative Bacterial Infections [<https://www.ncbi.nlm.nih.gov/mesh/68016905>];
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Introduction

The increasing of nosocomial infections is one of the problems of educational health centers all over the world, especially Iran [1]. Hospitals are currently faced with different hospital-acquired infections and patients' contact surfaces are infected by epidemiological important microorganisms, which are survived at different levels [1]. Many Gram-negative bacteria, such as *Acinetobacter*, can remain on dry surfaces of the environment from 3 days to 5 months, and especially create high antibiotic resistance, which is increasing these days [5]. Burn unit and internal part of hospitals are suitable places for the growth of bacteria, e.g. *Pseudomonas*, *Enterobacter*, and *Staphylococcus* [2].

Hospital-acquired infections (HAI), also known as nosocomial infections, are transmitted from the environment or healthcare staffs and facilities and easily spread between patients and nurses [2]. This kind of infections spread in the hospitals environment, nursing home environment, rehabilitation facility, and other clinical settings that use for patients [3]. Infections are spread to the susceptible patient in the clinical setting by a number of means, such as cloths or clinical settings [4]. Although, the hospitalized patients may have contacted to the infection from their own skin or surfaces, the infections are still considered nosocomial since it develops in the health care setting.

Many types of microorganisms are difficult to treat with antibiotics, because of antibiotic resistance development. In addition, antibiotic resistance can complicate the treatment too [7]. *Pseudomonas aeruginosa* and *Staphylococcus aureus* are the bacteria with low required food for growth and can remain and grow in the environment and can easily be transferred to susceptible patients, and genetically increase antibiotic resistance [5-7].

According to current available studies in Iran and other countries, these hospital-acquired bacteria are the main bacteria to cause nosocomial infections in medical centers, therefore, these infections are often popular in risk factor patients that hospitalized in health care centers [8]. Weis *et al.* have reported the frequency of *Staphylococcus*, *Enterococcus*, *Coliforms*, *Pseudomonas*, *Acinetobacter* and *Enterobacter* in burn patients and their clinical settings.

Acinetobacter baumannii is also an important pathogen of burn wound infections, especially in immune compromised patients and risk factor patients who were hospitalized in the intensive care units [9].

The contamination of environmental surfaces may play a significant role in transferring the infections. The infection incidence in hospitals and education-health centers cause contaminants to enter the environment from the various ways and mechanisms; therefore, several factors can have roles in infection transferring. An important factor in the spread of nosocomial infections, especially hospital-acquired infections, is an improper use of disinfectants [10-12].

Disinfection is the process to remove all or most of pathogenic microorganisms on inanimate surfaces except bacterial biofilms or bacterial spores. Disinfection should be done following the cleanup methods, because the cleaning methods by detergents may be insufficient to kill the pathogens in the hospitals environment [13]. Sanitizers or disinfectants are the methods that used for sterilization and disinfection of medical devices, the operating rooms and maternity, burn sections, ICU, internal sections, physical surfaces, and hallways every day. Effective use of disinfectants is an important factor for preventing nosocomial infections or hospital-acquired bacteria. Activity against key pathogens and lethal speed are the most important factors in disinfectant choice [14].

The aim of this study was to evaluate the efficacy of using disinfectants on bacterial remove in Isfahan City, Iran, hospitals.

Instrument & Methods

This descriptive study was performed in Isfahan City, Iran, hospitals in 2015. According to similar studies [15-19], 200 samples were taken from random locations of the hospitals (Kashani, Al-zahra, Shariati hospitals).

Sampling was carried out at the end of the business day and before disinfecting the surfaces with sterile cotton swabs moistened by sterile saline. Each sample was placed in the tube containing 3ml of tryptic soy broth (TSB) medium. Then, Deconex 50 AF, Epimax SC, Descoscid, and Silvosept were used as disinfectants. Sampling were repeated after disinfecting process.

For culturing the isolated samples, a tube

containing the sample was mixed by Vortex, and 100µl of it was transferred to plates which containing blood agar or Eusion-Metilen-Blue agar media (Merck; Germany) by a sampler. Isolates were cultured in the whole culture medium by a sterile loop and laboratorial methods and were incubated at 37°C for 48 hours [19]. After incubation, plates containing cultured samples were investigated (before and after disinfection by disinfectants). Suspected colonies of gram-negative bacteria were identified by gram staining and routine biochemical tests [20-22]. Physiologic serum was used as positive control. Each disinfectant was used according to the manufacturer's recommended concentration for surfaces disinfection [23]. After identification of bacteria, the numbers of bacterial colonies were counted before disinfection in 1ml (CFU/ml) [24-26].

Findings

32.5% of the samples were isolated from floors and walls, 13% from surgery rooms, 11% from beds, 10.5% from staffs' desks, 7% from suction, 7% from patients' records, 6% from kitchens, 5.5% from operating rooms, 4% from rehabilitation zone and 2% from anesthesia masks.

Most samples were taken from emergency (59 cases) and ICU (32 cases) wards. 27 samples were positive for bacteria after disinfection process (Figure 1).

Figure 1) Distribution of microbial cultures before and after disinfection

Section name	Positive samples before disinfection	Positive samples after disinfection
Emergency of women	34	10
Emergency of men	25	6
Internal of men	18	0
Internal of women	17	0
Urology	12	0
Surgery room	29	5
ICU	32	3
Isolation room	18	1
Triage	15	2

255 cases of bacteria were found at 27 positive samples. The most common isolated bacteria after disinfection were *Staphylococcus epidermidis* (76 cases), *E. coli* (42 cases) and *Micrococcus luteus* (39 cases; Figure 2).

Figure 2) The frequency of fungal and bacterial samples isolated from Isfahan hospitals

Type of isolates	Number	Percent
<i>E. coli</i>	42	16.4
<i>Staphylococcus epidermidis</i>	76	29.8
<i>Micrococcus luteus</i>	39	15.2
<i>Pseudomonas aeruginosa</i>	27	10.5
<i>Klebsiella pneumoniae</i>	14	5.4
<i>Enterobacter aerogenes</i>	2	0.8
<i>Proteus vulgaris</i>	18	7.1
<i>Streptococcus pneumoniae</i>	17	6.6
<i>Staphylococcus aureus</i>	10	3.9
<i>Acinetobacter baumannii</i>	2	0.8
<i>Penicillium spp</i>	3	1.1
<i>Aspergillus spp</i>	3	1.1
<i>Candida albicans</i>	2	0.8

Discussion

In this study, we tried to evaluate the efficacy of the current disinfectants on bacteria isolated from Isfahan hospitals. Despite the differences in bacterial species, the differences in mechanisms of resistance to disinfectants, the different ecological niches and the different infections that caused by these pathogens, there are different similarities in the variables determining nosocomial spread [27]. The frequency and existence of each of these multi-drug resistant microorganisms and their concurrent spread seem to create from extensive antibiotic use, controlling hospitals infections, antibiotic resistance and lapses in compliance with controlling infections [26]. Problems with these bacteria became evident as monoclonal outbreaks that soon followed by establishment of endemicity, especially in internal, burn and intensive care units [28-30].

In the present study, gram-negative and gram-positive bacteria isolated from different burn parts were randomly detected. According to the average of bacteria isolated before and after disinfection, all studied disinfectants can reduce existing infection especially in internal section of hospitals in our research.

De Andrade *et al.*, was tried to perform the evaluation of the microbial situation of hospitals mattress before and after disinfection and identify bacteria that are significant in the epidemiology of nosocomial infections (*Staphylococcus* and *Pseudomonas*). In their study, they have found that 500 of 1040 total culture plates from 52 mattresses were obtained positive results (48%/1) [31].

A study by Shams *et al.* was carried out to appraise the contamination disinfections of ICUs in the Hamadan Hospitals. They have shown that the most commonly isolated bacteria were gram-negative bacilli such as *E. coli*, *Enterobacter*, *Klebsiella*, and *Pseudomonas*, and at the next level, gram-positive cocci were *Micrococcus* and *Staphylococcus epidermidis* [32]. In general, gram-negative bacteria that isolated from hospitals were the dominant factors of infection in studied hospitals that communicate with some part of the results in the present study [33]. A study that was done in England on the sensitivity of nosocomial gram-negative bacteria to disinfectant has shown that tetravalent ammonium compounds on the bacteria have been less effective than chlorhexidine [34]. Ehrampoush *et al.* have evaluated the combination of hydrogen peroxide and silver on the steel area that Infected by some pathogens [35]. They concluded this compound to prevent the growth of pathogenic bacteria on the surface as well. Hamadan Hospitals study by Youssefi Mashouf *et al.* for investigation of bacterial contamination in operating rooms and comparing Deconex SB and Hayzhen in reducing pollution, has reported that the rate of infection in operating rooms of hospitals was comparison high and Deconex SB was relatively better of Hayzhen in reducing bacterial contamination [36]. Their results have shown that both solutions had appropriate disinfection effect after disinfection on bacteria isolated from operating rooms. Sharkhizan *et al.* have studied the efficacy of new disinfectants solutions, including Sanocil, Alprocide, Bib fort, Gavel-dose, that were compared with Micro10 and Deconex on isolated organisms from dentistry units. Their results have shown that out of 120 cultured samples, 98 positive cultures (81.6%) were obtained that 254 strains and 14 bacteria species were isolated that 72.1% of them were gram-positive and 27.9% were gram-negative bacteria. Their results also revealed that the most effective disinfectants on pathogenic strains were Deconex and Alprocide [37].

Different factors such as biofilm producing isolates can help its resistance too, as Nourbakhsh *et al.* have reported in 2016 [38].

Gram-negative bacteria of the Enterobacteriaceae such as *Klebsiella*, *Enterobacter*, *Serratia*, and *Proteus* are resistant to disinfectants especially resistance to ammonium chloride and phenol compounds. In our study, that focused on the more efficiency of Silvosept and Epimax SC in the elimination of Gram-negative and Gram-positive bacteria (*E. coli* and *P. aeruginosa*) is probably due to the basis of their composition [31]. Silvosept has a combination of Nano-colloidal silver, Epimax SC has a basic combination of hydrogen peroxide, ammonium tetravalent, and alcohol that in this study, and Deconex 50AF has less effect on isolated bacteria according to its ammonium chloride combination [39].

Also, it is clear that having enough, complete and complete data about microorganisms of different parts of the hospitals and recognition of its resistance, cleaning and disinfection methods, percent and effectiveness of disinfectants that used on them, caused the increasing the authorities knowledge and ability for eliminating the sources of contamination and reducing nosocomial infections [40].

Conclusion

The disinfecting process of Isfahan Hospitals is effective in removing bacterial infections.

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