Original Article

The comparison of printed resources bacterial contamination in libraries of Al-Zahra Hospital and Sciences Faculty of Isfahan University and the determination of their antibiotic sensitivity pattern

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ABSTRACT

Introduction: During the library loan process, the printed resources can be a carrier of pathogenic bacteria. In this study, it was tried to compare the Bacterial Contamination Rates and their antibiotic sensitivity pattern in printed resources of a hospital and a non-hospital library. **Methods:** This is a cross-sectional study. Returning books from the Al-Zahra hospital library and library of Sciences faculty of Isfahan University provides the research community. The sample size, 96 cases, was calculated using quota sampling. For sampling sterile swab dipped in trypticase soy broth medium and transfer trypticase soy broth medium were used. To identify different type of isolated bacteria from Gram-staining test and biochemical tests such as; TSI, IMViC and etc., were used. **Results:** 76 (79.2%) and 20 (20.8%) of cultured samples were negative and positive, the respectively. Of 20 positive samples, 11 samples (55%) belong to the family Enterobacteriaceae that after detecting by Differential teste identified all 11 samples of Enterobacter that all of them were sensitive to Gentamicin and Ofloxacin. Also the most resistance to Nitrofurantoin and Amikacin was observed. 9 cases remained (45%) were coagulase-negative Staphylococcus that all of them were sensitive to the Trimethoprim-sulfamethoxazole and Cephalexin antibiotics also the most resistance to Cefixime was observed. **Conclusion:** Considering that the Enterobacter sp and coagulase-negative Staphylococcus were separated from the books, the books as well as other hospital and medical equipment can transmit the infection to librarians, library users, patients and hospital staff, and also it can produce serious infections in patients with immune deficiency.

Key words: Antibiotic sensitivity, bacterial contamination, hospital libraries, university libraries

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INTRODUCTION

It is clear that patient awareness of that disease is how can improve the quality of treatment. However, do patients and

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nurses that think only to disease sorrow have the opportunity to seek knowledge? This is where the role of libraries and librarians are important to the hospital. Hospital library, the library is deployed in hospitals to service patients and their families, doctors, nurses, and staff.[1] With increasing patients' awareness of the importance of health and disease prevention at the community level, medical librarians will follow the growing trend and direct interaction with patients. Patients, especially those who had to be hospitalized for a long time they by reading books and magazines and taking part in a program that is from library, they fill effectively their spare time as well as find preparation to the treatment of either during treatment or after it.[2] Following this interaction, the possibility of valuable product contamination of library that is a book during of loan process until return to the shelves of the library, in every part of the hospital through medical equipment and people who are easily the carrier of infectious bacteria in hospital, is undeniable.[3-5] Thus, the book can also be considered as one of the agents in the transmission of infection that transfer contamination to other librarians and library other users. Due to this, the investigation of contamination level in books with the aim of the prevention and care of human resources is essential. Research Community of Jalalpour *et al.* (2011) is alike with current research population. Their results showed that the most common bacteria existing in the Al-Zahra Hospital are species of *Staphylococcus*, *Bacillus*, *Enterobacteriaceae* and *Pseudomonas*.[6,7] Wiener-Well *et al.* on clothing for doctors and nurses,[8] Dohmae *et al.* on medical towels,[9] Creamer and Humphreys on the beds, mattresses, pillow and other industries related with patients sleep,[10] Zobeiri and Karami-Matin with sampling from hand of hospital staff[11] and Aslani *et al.* studying on the medical equipment and supplies[12] confirmed the prevalence of four species listed in their research hospitals. On the other hand, during treatment because of the increased level of drug resistances to many antimicrobial compounds we are face with the lack of successful treatment of infections caused by these bacteria,[12] therefore, the determination of antibiogram pattern of these bacteria causes acceleration of the recovery process and can prevent the occurrence of drug resistance in the bacteria. Findings of Arab *et al.*, Jalalpour *et al.* and Panagea *et al.* (2005) suggest that the emergence of antibiotic-resistant bacteria are rising.[6,7,13,14] Accordingly, in this study was investigated the contamination level of printed references returned from loan in the library of Al-Zahra Hospital and the Library of Sciences Faculty of Isfahan University to bacteria and also will be determined their antibiogram pattern.

MATERIALS AND METHODS

This study is descriptive and cross-sectional and was conducted in 2012. The study population was returning books to the library of Al-Zahra Hospital of Isfahan University and also were returned books to the library of the faculty of sciences. The sample size was based on statistical calculations, with sampling error of 1%, 96 samples was estimated that these samples were analyzed in proportion to the number of inter-library sources of Al-Zahra Hospital (60 samples) and the library of the Isfahan sciences faculty. At the time of study, the number of library books of Al-Zahra Hospital, the largest medical library in Isfahan province was 13,504 and the number of books for the library of the sciences faculty of Isfahan University was 8000 volumes. A sampling of books surfaces returned was done by a sterile swab. At sampling, books sampled were included as books returned to the library. Because the cover and spine of books are exposed greatest contact with users and different levels, therefore it is more susceptible to contamination from these areas. The experimental works were conducted in three stages. The first step was involved preparing and sterilizing the equipment and materials as well as the constructing required culture media. The second stage was involved sampling, the cultivation and identify the bacterial agents. In order to sampling from swabs dipped in the trypticase soy broth medium (TSB) or sterile saline was used, after pulling on surfaces of book, swap with flame entered into the tube containing transitional medium of TSB. At the end of sampling, the transitional medium was transferred to the laboratory and was placed for 24 h at 37°C temperature. Then, it was examined in term of bacteria growth, and also it cultured in media blood agar and Merck-Eosin Methylene Blue agar linearly, and then the plates were incubated at 37°C temperature for 24 h. After colony growth of bacteria, the identification of bacteria species by performing bacteriology diagnostic procedures including Gram-staining, DNase, IMViC, triple sugar iron agar, catalase, oxidase tests, and also the use of the different diagnostic media were carried out. After the identification of bacteria and purify the culture, in the third round, disk diffusion method and Clinical and Laboratory Standard Institute was used to determine the drug sensitivity pattern. To do this, bacterial suspension at a concentration of 0.5 McFarland was prepared and was placed in Mueller-Hinton agar medium. The antibiotic discs were put on the medium and plates were incubated for 24 h at a temperature of 35°C. After this period of incubation, the nongrowth halo around the disc of antibiotics was measured with a ruler and using the standard table of discs, the results were reported as sensitive, relative sensitive, and resistant. To control and accuracy for the detection of bacteria and drug sensitivity patterns common standard strains as a positive control were used as follows: *Escherichia coli* PTCC 1763, *Staphylococcus aureus* PTCC 1189, *Pseudomonas aeruginosa* ATCC 9027, *Bacillus subtilis* ATCC 6633, after collecting and recording data analysis was performed using SPSS software version 19 (SPSS (Version 19, SPSS Inc., IBM Corp., Chicago, USA)) and Chi-square test was used that at next the results obtained is presented.

RESULTS

In this study, 96 samples were analyzed that 60 samples (62.5%) were referred to Al-Zahra Hospital libraries and 36 samples (37.5%) were referred to the Library of Sciences Faculty of Isfahan. Out of 96 samples, 76 samples (79.2%) in term of culture were negative cultures and 20 samples (20.8%) were positive, respectively [Table 1].

Culture results in terms of growth and the nongrowth of bacteria and libraries type for samples are shown in Table 2.

Microbial growth results in the separation of the type of bacteria and the sampling location are shown in Table 3.

Out of the 20 positive samples, 11 samples (55%) were member of the family *Enterobacteriaceae* that after diagnosis with differential tests showed that all 11 samples are *Enterobacter*, and also 9 samples (45%) remained were member of the *Staphylococcus* genus, which after diagnostic tests was revealed that all of they are *S. aureus*, coagulase-negative.

Sensitivity and resistance of enterobacteria isolated from 11 against different samples has been shown in Tables 4 and 5. All of the enterobacteria isolated were sensitive to antibiotics gentamicin and ofloxacin, and out of the 11 samples, 7 samples to trimethoprim-sulfamethoxazole, 10 to ceftriaxone, 8 samples were sensitive to nalidixic acid, and 1 sample to amikacin. The highest resistance of these bacteria was for amikacin antibiotics and nitrofurantoin.

Sensitivity and resistance of coagulase-negative *Staphylococcus* isolated from 9 samples against different antibiotics are shown in Tables 6 and 7. Coagulase-negative *Staphylococcus* isolated all of them were sensitive to nitrofurantoin and ciprofloxacin, 4 samples to doxycycline, and 2 samples were sensitive

to oxacillin. The highest resistance in these bacteria was observed with respect to cefixime antibiotic.

A significant difference was observed between bacterial contamination levels in two libraries using the Chi-square test ($P < 0.05$). Furthermore, there is no significant difference between patterns of drug sensitivity of antibiotics used between the coagulase-negative *Staphylococcus* in two libraries, only the antibiotic nitrofurantoin showed significant difference and other antibiotics did not show significant difference.

DISCUSSION

One of the major problems in hospitals worldwide is hospital infections. Hospital infection is an infection that derives from a hospital or other health and care centers.[3] Transmission of pathogens and potential pathogens from hospital staff to patients and create disease resulting from them has been proved. In addition, the contamination of personnel private equipment and general equipment of hospital parts and transmission of pathogens through them to patients and staff has been reported in several studies.[15-18]

Since the hospital library, the library housed in the hospital services in wide range, so book can be considered as one of the ways of pathogens transmission in loan cycle to return to the library such as other equipment and medical equipment[1,2] that can transfer hospital infections to librarians and other library users, staff, and patients.

In this study, 96 samples were examined of which the 76 samples (79.2%) were negative in term of negative culture, and the 20 samples (20.8%) were positive in term of culture. This study was done the first time in Iran and according to the review of documented and written papers, a similar study has not been observed. In various parts of Iran and the world *Enterobacteriaceae*, *Staphylococcus*, and *Bacillus* have been introduced as the most common cause isolated from hospital surfaces, staff gown, equipment, and medical instruments, etc.[7-9,11,13,19] In this study, the most commonly pathogen isolated belongs to the family *Enterobacteriaceae*, of which *Enterobacter* has been dedicated highest number (55%) and at next step that were all coagulase-negative *Staphylococcus* (45%) was isolated. In the study of Alighardashi *et al.* samples were collected from hospital staff mobile in the city of Hamadan. The most bacteria isolated were coagulase-negative *Staphylococcus* (56.25%), which is consistent with current study.[20]

Aslani *et al.* also researched to determine the microbial contamination level of medical different devices such as phones, refrigerator door handle, and dossier cover. The results showed that there are microbial contamination with Gram-positive and Gram-negative bacteria and fungi in medical devices at alarming rate. Most bacterial contamination was related to *Bacillus*, *S. aureus*, coagulase-negative *Staphylococci* and positive.[12]

Table 1: Frequency distribution of positive and negative subjects of samples cultured from studied libraries books	
Samples	*n* (%)
Total	96 (100)
Growth	20 (20.8)
No growth	76 (79.2)

Table 2: Distribution of absolute and relative frequency as a result of microbial culture in the separation of libraries			
Library	*n* (%)	Growth (%)	No growth (%)
Al-Zahra Hospital library	60 (62.5)	15 (15.6)	45 (46.9)
Sciences Faculty of Isfahan University	36 (37.5)	5 (5.2)	31 (32.3)
Total %	96 (100)	20 (20.8)	76 (79.2)

Table 3: Frequency distribution resulted from bacterial culture in term of bacteria type grown and library		
Bacteria type	Al-Zahra Hospital library *n* (%)	Sciences Faculty of Isfahan University *n* (%)
Negative	45 (46.9)	31 (32.3)
Staphylococcus spp.	7 (7.3)	2 (2.1)
Enterobacteriaceae	8 (8.3)	3 (3.1)
Bacillus spp.	0 (0)	0 (0)
Pseudomonas spp.	0 (0)	0 (0)
Total	60 (62.5)	36 (37.5)

Table 4: The results of the determination of antimicrobial sensitivity isolated from libraries

Sample number	Sampling location	Antimicrobial agents						
		Gentamicin	ofloxacin	Trimethoprim-sulfamethoxazole	Ceftriaxone	Nalidixic acid	Amikacin	Nitrofurantoin
3	1	S	S	S	S	S	R	R
8	1	S	S	I	S	S	I	I
18	1	S	S	I	S	S	I	R
22	1	S	S	S	S	S	R	R
35	1	S	S	S	S	S	I	R
43	1	S	S	S	S	S	R	I
59	1	S	S	I	S	I	I	R
60	1	S	S	S	S	S	S	I
81	2	S	S	I	I	I	R	R
87	2	S	S	S	S	I	R	R
89	2	S	S	S	S	S	I	R

S=Sensitive, I=Intermediate, R=Resistant, 1=Al-Zahra Hospital Library, 2=Sciences Faculty of Isfahan University

Table 5: Absolute and relative frequency distribution of enterobacteria isolated from libraries in terms of resistance and sensitivity to different antibiotics

Sensitivity antibiotic	Sensitive n (%)	Intermediate n (%)	Resistant n (%)	Total n (%)
Gentamicin	11 (100)	0 (0)	0 (0)	11 (100)
ofloxacin	11 (100)	0 (0)	0 (0)	11 (100)
Trimethoprim-sulfamethoxazole	7 (63.6)	4 (36.4)	0 (0)	11 (100)
Ceftriaxone	10 (90.9)	1 (9.1)	0 (0)	11 (100)
Nalidixic acid	8 (72.7)	3 (27.3)	0 (0)	11 (100)
Amikacin	1 (9.1)	5 (45.5)	5 (45.5)	11 (100)
Nitrofurantoin	0 (0)	3 (27.3)	8 (72.7)	11 (100)

Brook and Brook in a study conducted in 1994 in America on library books reported that most bacteria isolated is *Staphylococcus epidermis*.[21] Presence of infectious patients as well as high traffic density leads to accumulation of bacteria in the hospital environment and this eventually will be led to the rise of antibiotic-resistant strains and the increasing prevalence of drug-resistant hospital infections. Studies in recent years indicate that antibiotic-resistant bacteria are rising. On the other hand, the sensitivity of bacterial isolates to different antibacterial drugs is different.[6,7]

The study showed that of the 20 samples with microbial growth 15 cases were of Al-Zahra Hospital library and 5 cases were of science faculty library, the percentage of infection were reported 25% and 13.9%, respectively, that using the test Chi-square was found that the difference between the bacterial contamination in two libraries is significant ($P < 0.05$). Moreover, this result because the books existed in the library of Al-Zahra Hospital usually are used by hospital personnel, therefore, are exposed to contamination. However, in the library of sciences faculty because its users are not hospital personnel and are usually not associated with a hospital environment, thus, the bacterial contamination of books is less and this low level of pollution is more related to the normal flora bacteria of the hand and skin and have a less important role in the transmission of bacterial infectious agents.

In this study, isolated enterobacteria all were sensitive to antibiotics of gentamicin and ofloxacin that is similar to the study of Hashemian *et al.* (2003) is[22] and the most resistant of these bacteria was related to antibiotics amikacin and nitrofurantoin. Coagulase-negative *Staphylococci* isolated from all of the nitrofurantoin and ciprofloxacin, doxycycline 4 samples and 2 samples were sensitive to oxacillin. Most resistance out of these bacteria was for antibiotic cefixime.

In the study of Jalalpour *et al.* the most antibiotic resistant in isolates from hospital surfaces was against penicillin and the least resistant was related to gentamicin that is different with the current study.[7]

In another study done by Ghazi-Saeedi (2007) on hospital infections and bacteria isolated from such infections, reported coagulase-negative *Staphylococcus*, to floxacin, dicloxacilin, and cloxacilin sensitive that is similar to current study.[23]

Successive isolation of Gram-positive cocci, *Bacillus* species and in some cases isolation of *Enterobacteriaceae* family members of hospital staff hand, suggesting the lack of an efficient lotion used and the contamination of hospital surfaces and medical and is nonmedical equipment. With regard to this fact that maintaining personal hygiene, especially hand hygiene of staff, causes reduce hospital infections, as well as with regard to the role of hospital staff hand and their direct contact with patients and medical and nonmedical equipment in addition to the microscopic precise control of surfaces and equipment as well as increasing level of surface disinfectants, hand-washing liquid quality used in hospitals be upgraded, on the other hand, appropriate, and effective usage of these materials will also be trained to staff.[6] In addition to these methods of disinfection and hand-washing techniques, it may be appropriate to use of strategies such as sound waves and radiation to destroy pathogens.[24] The hospital staff be trained that at time of working in the hospital is not suitable time for study and book reading and it is better do this action inside hospital libraries and or special location of study in sector such that before use of book hand-washing will be done thoroughly. The library users also use gloves.

Table 6: Results of the antibiotic sensitivity determination for coagulase-negative *Staphylococcus* isolated from libraries

Sample number	Sampling location	Antimicrobial agents						
		Trimethoprim-sulfamethoxazole	Nitrofurantoin	Cefalexin	Ciprofloxacin	Doxycycline	Oxacillin	Cefixime
7	1	S	S	S	S	I	I	I
13	1	S	S	S	S	I	I	R
16	1	S	S	S	S	S	I	R
33	1	S	S	S	I	I	I	R
36	1	S	S	S	S	S	I	R
51	1	S	S	S	S	I	S	R
55	1	S	S	S	S	S	I	I
70	2	S	R	S	S	I	I	R
76	2	S	S	S	S	S	S	I

S=Sensitive, I=Intermediate, R=Resistant, 1=Al-Zahra Hospital library, 2=Sciences Faculty of Isfahan University

Table 7: Absolute and relative frequency of coagulase-negative *Staphylococcus* isolated from libraries in terms of resistance and susceptibility to different antibiotics

Total	Sensitive n (%)	Intermediate n (%)	Resistant n (%)	Total n (%)
Trimethoprim-sulfamethoxazole	9 (100)	0 (0)	0 (0)	9 (100)
Nitrofurantoin	8 (88.9)	0 (0)	1 (11.1)	9 (100
Cefalexin	9 (100)	0 (0)	0 (0)	9 (100)
Ciprofloxacin	8 (88.99)	1 (11.1)	0 (0)	9 (100)
doxycycline	4 (44.4)	5 (55.6)	0 (0)	9 (100)
Oxacillin	2 (22.2)	7 (77.8)	0 (0)	9 (100)
Cefixime	0 (0)	3 (33.3)	6 (66.7)	9 (100)

Therefore, additional studies in a wider time range when use of high sample size, will be provided the results definitively and reliable to the medical community. Hence, that by identification of the most common causes of infection and microorganisms through them can be prevented the spread of nosocomial infections, increased costs, increased length of hospital stay and most importantly indiscriminate use of broad-spectrum antibiotics and subsequently antibiotic multiple resistance as possible.

CONCLUSIONS

The study showed that Al-Zahra Hospital library books has higher bacterial contamination than the library books of sciences faculty, so they can act as the transmission agent of infection and carriers of pathogenic bacteria infection that transmission of these agents to library users, patients and hospital staff can result in serious infections and dangerous and or even in patients with immune deficiency be fatal. Hence, it is necessary that for the hospitals infection control debate, book also be considered as a transmission agent of pathogen microorganisms and hospital library like other parts of the hospital be target of infection control timing schedules and bacteria isolated evaluated in term of drug sensitivity and the results informed to physicians so that make contributions to the treatment and prevention of drug-resistance.

Conflicts of interest

There are no conflicts of interest.

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