Original Article

National nosocomial infection surveillance system–based study in the North Eastern of Iran

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Abstract

Background: Hospital-Acquired Infections (HAIs) are a major public health problem that occur among about 10% of hospitalized patients. HAIs increase mortality and morbidity and prolonged hospital stay not to mention considerable costs they impose on the health care system**.** The present study was conducted in order to evaluate the prevalence of HAIs based on National Nosocomial Infection Surveillance System in hospitals of Mashhad, Iran.

Methods: The current prevalence study of HAI was carried out in 26 hospitals using a protocol updated yearly in Mashhad, Iran. The Centers for Disease Control and Prevention–National Nosocomial Infections Surveillance were used to define four HAIs. All patients admitted to the hospitals during a one-year period (March 1, 2015-February 30, 2016) were recruited in the study. Data was extracted using Iranian nosocomial infection surveillance software.

Results: The overall prevalence rate of HAI in our study was 0.8% among the hospitals with the most frequent HAIs found to be pneumonia (25%), followed by urinary tract infections (20%), and blood stream infections (19%)**.** The highest prevalence rate was observed in 15- to 65-year old patients with more than 50% related to surgical site infection. Also, the most frequently isolated micro-organism was acinetobacter. In addition, the highest seasonal prevalence was seen in winter with pneumonia as the most frequent infection. A total of 4988 pathogens were isolated with 30.33% of clinical confirmation and 69.66% of positive culture.

Conclusion: These findings emphasize the need for appropriate measures for prevention, screening, labeling, and isolation precautions for infected patients.

Keywords: Cross Infection; Disease; Hospitals; Infection Control; Nosocomial

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Introduction

A Hospital-Acquired Infection (HAI) is defined as an infection that is present at 48–72 hours after admission to a hospital (1). HAIs are a major public health problem that occur among about 10% of hospitalized patients (2). HAIs increase mortality and morbidity as well as prolonged hospital stay. In addition, they impose considerable costs of the health care system (3,4).

The control of HAIs is a priority for health care systems and a comprehensive approach is needed to reduce the incidence of infections (5). In this regard, surveillance systems are cost effective strategies to reduce the incidence of HAIs (6). In fact, surveillance of HAIs is regarded as an important component of infection control program. The gold standard for surveillance of HAIs is prospective, uninterrupted, on-site, hospital-wide surveillance; however, these incidence surveys require comprehensive resources. Prevalence studies are cheap and easy to perform and are helpful in establishing priorities for nosocomial infection control. In addition, prevalence surveys, which have been used for political and administrative purposes, are suitable for assessment of HAIs, as well. The results of these surveys are valuable in understanding the general dimension and features of the problem of HAI and providing priority baseline data for resource allocation (7). Moreover, reporting HAIs is a challenge for all health systems; the challenge may include under-reporting of infections due to insufficient training or lack of requirement for reporting these infections.

Thus, since knowing the current status of HAIs prevalence is necessary for conducting preventive measures, the current study was conducted to evaluate the prevalence of HAIs based on National Nosocomial Infection Surveillance System in hospitals of Mashhad, Iran.

Methods

Patients with hospital acquired infection were enrolled in the present cross-sectional study. All the patients with primary diagnosis of HAIs admitted to hospitals in Mashhad province, Iran, were recruited in the current investigation. Only the first episodes of nosocomial infection during a one-year period (March 1, 2015-February 30, 2016) were assessed. Patients, previously infected prior to the study were excluded and no post-discharge surveillance was performed. Data was extracted using Iranian Nosocomial Infection Surveillance (INIS) software of hospitals, which is a prevalence database of HAI in 26 hospitals with a yearly updating protocol. The CDC NNIS system was used to define four nosocomial infections (8). Data was collected daily by physical examination of patient's signs and symptoms and assessment of medical records were performed by infection control staffs of the hospitals.

Definitions

Surgical Site Infection (SSIs) were defined as those infections occurring within 30 days after the operative procedure and involving the site of incision, having a minimum of one of the following characteristics: purulent discharge from the site of incision, or diagnosis of infection by the surgeon or physician. Also, the categorization type was taken into consideration.

Urinary Tract Infection (UTI) was defined as having the following signs or symptoms with no other recognizable cause: fever (temperature >38˚ C), urgency, frequency, dysuria, or supra pubic tenderness, and positive dipstick for leukocyte esterase and/or nitrate, or diagnosis of a UTI by a physician or both.

Pneumonia (PNEU) case was defined as a patient having rales or dullness to percussion on physical examination of the chest; a chest radiographic examination showing new or progressive infiltrate; consolidation, cavitation, or pleural effusion; or new onset of purulent sputum or change in specification of sputum.

Blood Stream Infection (BSI), defined as either a laboratory-confirmed bloodstream infection or clinical sepsis. A case of BSI was defined a patient who had at least one of the following clinical signs or symptoms with no other recognized cause: fever (temperature >38˚C), hypotension (systolic pressure <90 mm Hg), or oliguria (<20 cm3/h); blood culture not done or no organisms or antigen detected in blood; and no apparent infection at another site

and physician instituted treatment for sepsis (6).

We assessed and analyzed data after data mining. The analysis was performed using descriptive tests in SPSS software 16 (SPSS Inc., Chicago, IL, USA).

Results

During the study period, 4008 cases of nosocomial infections were reported. The total prevalence rate of HAI in the present study was 0.8% among the hospitals. The most frequent HAI was PNEU (25.34%), followed by UTI (20.08%) and BSI (19.41%) (Table 1). Other infections that are not mentioned in this table include bone infection, endocarditis, sinus infection, breast abscess, brain abscess, and so on.

Also, the incidence of infections occurred in men was slightly more than that in woman (Table 2), with the highest prevalence rate observed in 15-to-65-year-olds. (56.26 %) and most of them were SSI (Table 3).

Most infections occurred in winter and most of them were pneumonia (Table 4). Totally, 4988 pathogens were isolated; 30.33 percent of the infections were confirmed by clinical diagnosis and 69.66 percent with positive culture (Table 5).

The most frequently isolated micro-organisms were as follows: acinetobacter (17.2%), klebsiella (8.2%), Escherichia coli (8.19%), and candida (8.07%). Microorganisms with less than 1 percent prevalence, i.e. Staphylococcus saprophyticus, Coagulase-positive staphylococcus, mycobacterium tuberculosis, campylobacter, proteus, etc., were excluded from this Table (Table 6).

Table 1. The distribution of HAI, according to the site of infection

Site of infection	N (%)
SSI	644(16.06)
UTI	804 (20.08)
BSI	778 (19.42)
PNEU	1016 (25.34)
Other	766 (19.1)
Total	4008

SSI: Surgical Site Infection, BSI: Blood Stream Infection, PNEU: Pneumonia, UTI: Urinary Tract Infection

Table 2. distribution of infections based on sex of the participants

Sex	UTI N (%)	SSI N (%)	BSI N (%)	PNEU N (%)	Other N (%)	Total N (%)
Male	318 (39.55)	325 (50.53)	409 (52.58)	570 (56.1)	387 (50.52)	2009 (50.15)
Female	486 (60.45)	318 (49.47)	369 (47.42)	446 (43.9)	379 (49.48)	1998 (49.85)
Not declared	0	1	0	0	0	1
Total	804 (100)	644 (100)	778 (100)	1016 (100)	766 (100)	4008(100)

Table 3. Distribution of infections based on age groups of the participants

Age	UTI N (%)	SSI N (%)	BSI N (%)	PNEU N (%)	Other N (%)	Total N (%)
<5	81 (10.34)	7 (1.08)	257 (33.03)	100 (9.8)	127 (16.6)	572 (14.27)
5-14	20 (0.08)	22 (3.41)	42 (5.4)	16 (1.5)	48 (6.26)	148 (3.69)
15-65	446 (55.6)	499 (77.48)	367(47.17)	495 (48.8)	448 (58.7)	2255 (56.26)
65<	257 (33.98)	116 (18.03)	112 (14.4)	405 (39.9)	143 (18.7)	1033 (25.77)
Total	804 (100)	644(100)	778(100)	1016(100)	766(100)	4008(100)

Table 4. Distribution of infections based on season

Season	UTI	SSI	BSI	PNEU	Other	Total
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Spring	174 (21.64)	153 (23.75)	168 (21.6)	246 (24)	234 (30.54)	975 (24.3)
Summer	241 (29.97)	174 (27.03)	197 (25.32)	263 (26)	170 (22.16)	1045 (26.06)
Autumn	185 (23)	180 (27.95)	177 (22.75)	244 (24)	134 (17.5)	920 (22.94)
Winter	204 (25.39)	137 (21.27)	236 (30.33)	263 (26)	228 (29.8)	1068 (26.7)
Total	804	644	778	1016	766	4008

Table 5. Distribution of infections diagnosis based on clinical diagnosis or positive culture

Diagnosis	UTI	SSI	BSI	PNEU	Other	Total
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Clinical diagnosis	195 (24.25)	283 (43.94)	240 (30.84)	241 (23.72)	257 (33.55)	1216 (30.33)
Positive culture	609 (75.75)	361 (56.06)	538 (69.16)	775 (76.28)	509 (66.45)	2792 (69.67)
Total	804	644	778	1016	766	4008

Table 6. Distribution of infections based on microorganism

Microorganism	UTI	SSI	BSI	PNEU	Other	Total
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Staphylococcus epidermidis	22 (2.47)	11(2.5)	72 (9)	38 (3.4)	34 (4.5)	177 (4.16)
Staphylococcus aureus	52 (5.85)	46 (10.47)	87 (10.8)	117 (10.45)	54 (7.14)	356 (8.88)
Coagulase-negative staphylococcus	18 (2)	22 (5)	19 (2.35)	18 (1.6)	17 (2.24)	94 (2.34)
Acinetobacter	90 (10.13)	76 (17.31)	91 (11.3)	354 (31.63)	238 (30.48)	849 (21.18)
Escherichia coli	184 (20.72)	44 (10)	63 (7.8)	74 (6.61)	44 (5.82)	409 (10.2)
Enterobacter	27 (3)	24 (5.5)	56 (7)	41 (3.6)	30 (4)	178 (4.4)
Enterococcus	90 (10.13)	19 (4.32)	56 (7)	44 (4)	15 (2)	224 (5.58)
Pseudomonas aeruginosa	32 (3.6)	29 (6.6)	64 (8)	68 (6)	65 (6.5)	258 (6.43)
Candida	165 (18.6)	22 (5)	59 (7.12)	122 (11)	35 (4.62)	403 (10)
Klebsiella	86 (9.7)	52 (11.95)	64 (8)	123 (11)	89 (18.5)	414 (10.32)
Other microorganisms	46 (5.2)	39 (8.8)	44 (5.4)	58 (5.18)	47 (5.21)	234 (5.83)
No culture	76 (8.6)	55 (13)	131 (16.25)	62 (5.53)	88 (9.64)	412 (10.68)
Total	888	439	806	1119	756	4008

Discussion

In the present study, 4008 cases of nosocomial infection, obtained from 26 hospitals, were evaluated. Data analysis showed that the overall prevalence rate for HAI was 0.8%. The most frequent HAI in our study was found to be pneumonia (25.34%), followed by urinary tract infection (20%), bloodstream infection (19.41%), and surgical site infection (16.06%). The most prevalent HAI reported in Gikas et al. study was lower respiratory tract infections (LRTI) (30.3%) followed by UTI (22.7%) (3). Also, pneumonia was reported to be the most common HAI in Italian studies with the highest prevalence rate observed in ICU patients (7). UTIs accounted for 34% of the infections in a Norwegian study (2). Also, UTIs, followed by lower respiratory tract infection and then surgical site infection, were reported to be the most frequent nosocomial infection in an Iranian study (6).

The total prevalence rate of the four most common HAIs in the present study was 0.8%, while the overall prevalence of HAI in Europe was reported to be between 3.5 and 10% (9-12). Also, the overall prevalence of HAIs in Norway was between 5.1% and 5.4%, in 2002 and 2003 (2). Moreover, in Italian studies, the HAI rate was reported 4.9% (7). Regardless of methodological differences, there were

similarities in the prevalence of nosocomial infections (13-15). These differences between our study and other studies may have influenced reporting the method or quality of reporting. In the present study, we have presented Iranian data regarding the prevalence of HAIs and estimated the additional attributing factors to these infections using NNIS system criteria. The low prevalence of HAI could be due to the lack of reporting associated with early discharge or admitting patients for diagnostic purposes only, or due to inadequate provision of outpatient services. Patient selection, investigator's qualifications and training, as well as the definitions used in identifying HAI were the important differences that can explain the discrepancies between findings of the studies. They concluded that the comparison of HAI rates between different studies should be avoided or performed with caution (6).

SSI was the fourth most frequent infection in the patients of the present study (16%). The prevalence rates of SSI ranged between 11% and 22% in similar studies (15,16). Also, the total rate of SSI was 0.16% and the prevalence was increased in contaminated and dirty procedures. Noel et al. reported similar low infection rates of SSI, but also noted that post-discharge surveillance increased the rate threefold compared with that found by a hospital surveillance program (17). In some studies, 53% of SSI were diagnosed in the community, although the average length postoperative stay was longer (18).

In the present study, UTI was found to be the second most frequent infection. UTI was the commonest site of HAI in other studies (19,20). UTIs were recently identified as contributing to long-term care as well as increase in the use of rehabilitation facilities (9,21). Further efforts should be directed to investigate the correct use of urinary catheterization, especially on the closed urinary drainage system. Also, most infections have occurred in winter and most of them were related to pneumonia.

In our study, the most frequently isolated micro-organisms were: acinetobacter, klebsiella, Escherichia coli, and candida. The proportion of Candida spp. from all sites of infections seems to have increased in the recent years. This is believed to be due to the increase in immunocompromised patient population (22,23).

There are also some limitations in the present study. Involving several people in registration was a potential weakness of our surveillance system. In addition, subjectivity in the reporting of HAIs can be another limitation.

We believe that in our study the reporting of HAIs is low. Firstly, some patients with HAIs were excluded from our study for various reasons. Secondly, we used patient-based NNIS definitions for the diagnosis of HAI; therefore, we may have labeled some patients as having HAIs when they were not infected, as other studies did. Thirdly, we did not have post-discharge surveillance for HAIs; some of these infections occur after the patient leaves the hospital and can cause readmission or the need for outpatient care.

Findings of the present study emphasize the need for appropriate measures for prevention, screening, labeling, and isolation precautions for infected patients. Improving HAI case finding methods and reducing subjectivity in the reporting of nosocomial infections, holding of training courses for infection control nurses to ensure similar understanding of the survey protocol, and definitions of the nosocomial infections. Implementation of infection control programs and public awareness to patients can help us to obtain more accurate reporting. Finally, such data comparisons may be of great help in improving health care facilities and the quality of the care provided to patients.

Conflict of interest

Authors declare no conflict of interests.

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