



The 3-year Trend of Nosocomial Infections in Intensive Care Unit: A Case Study in Iran

KEYWORDS

Iran, Nosocomial Infections, Intensive Care Unit (ICU), Clinical Guideline, Hospital Accreditation

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ABSTRACT *The possibility of nosocomial infection exists for all patients with the beginning of treatment in hospitals; moreover, this will lead to skyrocketing costs, length of stay, and increase in mortality. This study was a descriptive-analytical that performed retrospectively in one of the teaching hospitals of Tehran in 2013. Data analyzed here were related to 2290 patients hospitalized in the ICU from 2010 to 2012. The data were collected by a checklist in accordance with national nosocomial infections surveillance system and analyzed by SPSS v.22. The prevalence rates of nosocomial infection in the years of study are as 2010 (15.33%), 2011 (13.17%) and 2012 (9.59%) and the highest frequency is related to urinary tract infections (38.4%) and the lowest is related to pneumonia (16.66%). Among the factors for infection, E. coli with 21.28% has the highest frequency and candida albicans and klebsiella with 9.15% and 8.61% respectively are the least frequent factors. Statistical tests revealed that there is a significant relationship between length of stay and nosocomial infections ($p < 0.001$) but no significant relationship between patients' age and gender and nosocomial infections ($p < 0.186$). Nosocomial infections have dropped through the period of study, this has coincided with offering educational programs by the infection control unit, codification of guidelines and clinical procedures, and with hospital accreditation; these may have led to decrease of nosocomial infections.*

Introduction

Nosocomial infections have existed since the establishment of first hospitals and despite tremendous scientific and technological advances, patients still get infected (1). According to standards, an infection acquired 48 to 72 hours after the patient is admitted to hospital is called nosocomial infection provided that at the time of admission the patient does not show the infection's symptoms and the disease is not in its incubation period (2-5). One standard definition of nosocomial infection makes it possible to correctly compare the results of various studies (6). For it is directly related to mortality, length of stay, hospital costs, etc... nosocomial infections are seen as a critical problem in health system (6-11). As studies have shown, nosocomial infections incur 4.5 billion dollars and lead to 88 thousands of deaths (12); while studies suggest that costs of infection control are far less than the costs of treating patients infected (13-15).

The prevalence rate of nosocomial infection, type of infection, its causes and the ward patient has been hospitalized in are the objects covered in various studies. In a research on 2688 patients, the infection rate was estimated 40.06% and patients' age was revealed a significant risk factor for infection (16). In a study carried out in 27 hospitals of Mediterranean region the rate of nosocomial infection was 10.5%. 4634 patients were included in this study and the most common factor for nosocomial infection (17.2%) was reported to be E. coli (17). Another study performed on 6352 patients the rate of nosocomial infection was estimated 7.6%. The highest and lowest infection rate was for

urinary tract infections (28.4%) and lower respiratory tract infections (17.6%) respectively (18). The possibility of nosocomial infections exist for all hospitalized patients but with different degrees in various wards. For example despite the small number of patients hospitalized in the Intensive Care Unit (ICU) compared to other wards, the infection rate is 3 to 5 times greater in this unit than other wards (19). The prevalence rate of nosocomial infection in the ICU is 20% and the resulting mortality rate is estimated to be 8-10 percent (12). Other studies report 13-43 percent and 50% rate for infections and mortality respectively (20,21). Increased implementation of invasive methods such as vascular catheters, ventilator machine, etc. in diagnostic and therapeutic procedures is a factor in nosocomial infections (1). This is also the case with patient intubation, long-term catheterization, immunosuppression, blood transfusion, failure in regular replacement of bandages, and no use of gloves (13,22,23).

Other studies also support the claim that infections are higher in the ICU than other hospital wards. One research reported urinary tract infection with a rate of 33% as the most common infection. It argued that the highest percentage of patients' infection was in the ICU at 31.6% and that the most common factor for infection (18.2%) was staphylococcus aureus (24). Several studies examined nosocomial infections in the ICU. One study found pneumonia (45.5%) as the most common nosocomial infection in the ICU and gram-negative bacteria as the most common factor for infection and identified length of stay as one of the main factors for nosocomial infections (25). In

a research performed in Turkey, the rates of nosocomial infections in the ICU were examined for three years and found to be 53%, 29.15% and 28.85% for the years 2007, 2008, and 2009 respectively. Here the most common infection was bloodstream infections and surgical site infections were the next common types. Results also indicated that among the factors for nosocomial infections, gram-negative bacteria had the highest frequency (56.68%) and candida albicans (12.3%) had the lowest frequency (26).

It is not possible yet to completely remove nosocomial infections and actions taken are just to reduce them. Actions such as hand washing by clinical staff, patients' personal hygiene, hospital's environmental hygiene and controlling indiscriminate use of antibiotics(27). Given these issues, the aim of the present study is examination of the prevalence rate of infection, its types, factors, and also of relationships between age, gender, and length of stay and nosocomial infections among patients hospitalized in the ICU.

Materials & Methods

This study was a descriptive-analytical that performed retrospectively in one of the Teaching hospitals of tehran in 2013. Data analyzed here were related to 2290 patients were selected via census sampling (an overall 20067 days of hospitalization) hospitalized in the ICU from 2010 to 2012. They include patients' gender, age, and length of stay, recorded cases of infection, their types, and factors (based on results of laboratory tests). Inclusion criteria for this study were all of patient with nosocomial infections that hospitalized and exclusion criteria were deficiencies in the records. For data collection, the researcher himself visited the statistics unit and infection control unit and in some cases referred to patients' files. Infections and its different types are determined by national nosocomial infection surveillance system. The study protocol was approved by the Ethics Committee of Shahid beheshti University of Medical Sciences.

Statistical Analysis

For a descriptive representation and analysis of data, the researcher employed SPSS v. 20. Chi-square and t-tests were used to investigate the significance of relationships among variables of infection and age, gender, and length of stay.

Results

The research examined data related to 2290 patients. In total 1233 of patients (53.84%) were men and 1057 of patients (46.16%) were women. The mean ages of all men and women in the whole period of study were 67.74 and 68.56 respectively and the mean age of the whole sample (men and women) was 68.18. The whole mean length of stay in the period of study was 8.76 days. The total prevalence rate of nosocomial infections was 12.5% in the whole period of study.

Table 1: Demographics of patients hospitalized

| Demographic factor | 2010 | 2011 | 2012 | Total |
|--|-------------|------------|-------------|--------|
| Gender | | | | |
| Male | 246(54.66%) | 487(57.3%) | 500(50.55%) | 1233 |
| Female | 204(45.34%) | 363(42.7%) | 490(49.50) | 1057 |
| Age | | | | |
| Male | 69.3 | 67.92 | 68.80 | 68.56 |
| Female | 66.82 | 67.60 | 68.24 | 67.74 |
| length of stay(Day) | 9.9 | 8.7 | 8.3 | 8.76 |
| prevalence rate of nosocomial infections | 15.33% | 13.17% | 9.59% | 12.05% |

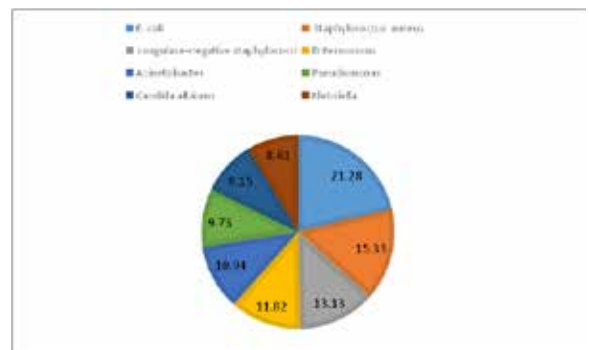
Table 2 represents four types of infections (urinary tract infection, pneumonia, bloodstream infection, and surgical site infection).

Table 2: Frequency of nosocomial infections from 2010 to 2012

| Type of infection | Frequency | Cumulative frequency (%) |
|---------------------------------|-----------|--------------------------|
| Urinary Tract Infections (UTIs) | 106 | 38.4 |
| Pneumonia | 46 | 16.66 |
| Bloodstream Infections (BSIs) | 71 | 25.72 |
| Surgical Site Infections (SSIs) | 53 | 19.2 |

Among the factors for infections, E. coli has the highest frequency (21.28%) and the next frequent factor is staphylococcus aureus (15.33%). The lowest frequency is related to candida albicans and klebsiella at 9.15% and 8.61% respectively (Figure 1).

Figure 1: frequency percentage of factors for infections from 2010 to 2012



Results of Independent t-test(95% confidence interval) show that there are a significant relationship between length of stay and nosocomial infections(p<0.001) but no significant relationship between age and nosocomial infections(p<0.186). Chi-square test was also employed to investigate the relationship between gender and nosocomial infections and p-value (p< 0.32) indicates that there is no significant relationship between the two variables.

Discussion

The prevalence rate of nosocomial infection in the three-year period of the present research is identified as 12.5%. This is in line with the rate reported in reference books (5-20 %)(1). It also agrees with a study(28) performed in Iran and that of Bai-Hrong's et al(29) which reported this rate 10.58% and 11.4% respectively. The rate identified here is lower than the rate (30.4%) reported by Luzzati et al(25) and those of Dereli et al(26) during a three-year period which were 53%, 29.15%, and 16.62% respectively. The reason may be traced back to respiratory intensive care unit (RICU) of the hospital under study because the highest prevalence rate of nosocomial infections in the ICU is that of respiratory tract infection caused mostly by the use of ventilators and other related devices(25,30,31); this is the case while in this hospital, patients with respiratory problems are hospitalized in the respiratory intensive care unit.

The most frequent nosocomial infection identified here is urinary tract infection (38.4%) while it is the respiratory tract infection reported in most studies as the most frequent(25,28,30-32).The reason as mentioned before is the

existence of a separate respiratory intensive care unit in the hospital investigated in this research. *E. coli* also has the highest frequency (21.28%) among the factors identified here for nosocomial infections. This can be accounted for by the fact that the dominant infection is the urinary tract infection and its major cause according to other studies(25,33)is *E. coli*.

The rate of nosocomial infections has consistently dropped during the three-year period of study decreasing from 15.33% in 2010 to 9.59% in 2012. Such changes can be observed in the study of Dereli et al(26) where infection rate dropped from 53% in the first year to 16.62% in the third year. Since the efficiency of infection control programs in reducing nosocomial infections up to 30% is proved by Hughes et al(34), the drop in nosocomial infections in the present study may be related to the revisions of infection control unit's programs, codification of guidelines and clinical procedures and also to periodical training of personnel by the mentioned unit in the years of study. Since nosocomial infections are also considered in hospitals accreditation as a major factor for quality of services and patients' safety and given the fact that it has started in the last three years, the decrease in nosocomial infections can also be accounted for accordingly.

No significant relationship was found between patients' age and nosocomial infection; this is in line with findings of Pailaud et al(35) and of a study done in Iran(28) but not with those of Ganguly(32), Luzzati(25), Serrano(36), and Richards(37) where there was a significant relationship between age and nosocomial infections. The average of patients in the present research was high (68.18) with a small standard deviation (3.03) and this may be the rea-

son why no significant relationship was found between the two variable. Gender was not also significantly related to nosocomial infections which is supported by the findings of Serrano et al(36). Results also indicated that there was a significant relationship between patients' length of stay and nosocomial infection ($p < 0.001$). This agrees with the study carried out in Iran(28) and with findings of Serrano et al(36). One of the limitations of this study include external validity, or the generalizability of the study. Since the data used in this study were collected from patients hospitalized in one hospital and it had special facilities (respiratory intensive care unit), results cannot be certainly generalized to other hospitals (38-40).

Conclusion

Nosocomial infections dropped during the three years of the present study and since the changes happened in this period were related to the consistency and enhancement of infection control programs, codification of guidelines and clinical procedures, and hospital accreditation (with quality improvement and patient's safety approach), these factors can be considered then effective in reducing nosocomial infections and more research is needed to examine their effect in wider scopes. The recommendation for practical implications and policy making is more attention to these programs that reduce nosocomial infection.

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Conflicts Of Interest

The authors declare that they have no competing interests.

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