RESEARCH ARTICLE

THE COST OF NOSOCOMIAL INFECTIONS: SAMPLE OF SIVAS NUMUNE HOSPITAL *

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ABSTRACT

A nosocomial infection is an important cause that increases the mortality rate, hospitalization duration, and costs. This descriptive and retrospective study was conducted to compare the costs of nosocomial infections in adult patients in surgical, internal, and intensive care clinics and their clinical, diagnosis, and admission types. 149 cases of nosocomial infections that developed in 2018 in a hospital with 905 beds are within the scope of the study. The data in the "Infection Surveillance Follow-Up Form" were calculated by recording the days of hospitalization, medication, laboratory, radiology consultation, and total costs of the cases. In variables, the Mann-Whitney U test was used for two independent groups and the Kruskal Wallis-H test was used for more than two groups. The average age of the patients is 72. Of these, 93% of the patients developed the infection during the hospitalization, and 52.4% of them died due to nosocomial infection. While ventilator-associated events were responsible for deaths, the most important risk was invasive catheter applications. While the invoiced total cost together as the main diagnosis and nosocomial infection is 2,079,925 dollars, the total cost of hospital infection alone is 652,838 dollars (1/3). The average cost of nosocomial infections per patient was determined to be 4,381 dollars. Nosocomial infections increased treatment costs by 45.7%, approximately 1.5 times. The costs in groups with intensive care clinics, emergency services, and LRTI diagnoses were found to be significantly higher than the other groups. In order to minimize these preventable deaths and costs, a national data bank should be established to record all kinds of attempts and costs for the treatment and follow-up of nosocomial infections. More effective feedback and training can be provided to healthcare workers to be aware of the importance of nosocomial infections on human health and costs, and especially invasive risk factors.

Keywords: *Nosocomial Infections, Nosocomial Infection Costs, Clinics*

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ARAŞTIRMA MAKALESİ

HASTANE ENFEKSİYONLARININ MALİYETİ: SİVAS NUMUNE HASTANESİ ÖRNEĞİ *

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ÖZ

Hastane enfeksiyonu mortaliteyi, yatış süresini ve maliyetleri artıran önemli bir nedendir. Bu çalışma cerrahi, dahili ve yoğun bakım kliniklerindeki erişkin hastalarda gelişen hastane enfeksiyonlarının maliyetlerini ve bunların kliniklere, tanılara ve başvuru tiplerine göre karşılaştırılması amacıyla tanımlayıcı tipte ve retrospektif olarak yapılmıştır. Yatak sayısı 905 olan bir hastanede, 2018 yılında gelişen 149 hastane enfeksiyonu vakası araştırmanın kapsamındadır. "Enfeksiyon Sürveyansı Takip Formu"ndaki verilerde vakalara ait yatış günü, ilaç, laboratuvar, radyoloji, konsültasyon ve toplam maliyetler kaydedilerek hesaplanmıştır. Değişkenlerde bağımsız iki grup için Mann-Whitney U, ikiden fazla grup için Kruskal Wallis-H testi kullanılmıştır. Hastaların yaş ortalaması 72'dir; %93'ünde enfeksiyonun hastanede yatış döneminde geliştiği ve %52.4'ünün hastane enfeksiyonu nedeniyle exitus oldukları belirlendi. Ölümlerden sıklıkla ventilatörle ilişkili olaylar sorumluyken en önemli riski invaziv kateter uygulamaları oluşturmaktaydı. Ana tanı ve hastane enfeksiyonu olarak birlikte fatura edilen toplam maliyet 2.079.925 dolar iken, sadece hastane enfeksiyonu toplam maliyeti 652.838 dolar'dır (1/3'ü). Hasta başına hastane enfeksiyonu ortalama maliyeti 4.381 dolar olarak tespit edilmiştir. Hastane enfeksiyonları tedavi maliyetlerini %45.7 oranında artırmış, yaklaşık olarak 1,5 katına çıkarmıştır. Yoğun bakım klinikleri, acil servisten başvuranlar ve ASYE tanısı olan gruplardaki maliyetler diğer gruplara göre anlamlı derecede yüksek bulunmuştur. Önlenebilir olan bu ölümleri ve maliyetleri en aza indirgemek için hastane enfeksiyonu tedavisi ve takibine yönelik her türlü girişim ve maliyetlerin kaydedileceği ulusal veri bankası oluşturulmalıdır. Hastane enfeksiyonlarının insan sağlığı ve maliyetler üzerindeki öneminin ve özellikle invaziv risk faktörlerinin farkındalığına yönelik sağlık çalışanlarına daha etkin geri bildirim ve eğitimler sağlanabilir.

Anahtar Kelimeler: *Hastane Enfeksiyonları, Hastane Enfeksiyonu Maliyetleri, Klinikler*

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I. INTRODUCTION

Health institutions provide health services, one of the most basic human needs. These institutions have quite different and complex structures from other service businesses. Service in health institutions should be provided in an uninterrupted and unerring way. Especially in hospitals with the most intensive service, besides many risk factors, one of the important ones is nosocomial infections (Biçer, 2019).

Nosocomial infections are the infections that are not present before patient admission or not in incubation but occur during hospitalization or develop within the first 10 days after discharge. Most of the time, it poses a serious problem for public administrations, hospitals, and patients due to the quality and high costs of the treatment process (Amberg, 2003; WHO, 2020). Such infections are charged at the expense of the main diagnosis and treatments as an additional cost; therefore, it imposes a considerable financial burden on hospitals, insurance and social security institutions, and patients (Fabry et al., 1982; Kurutkan et al., 2015; Umscheid et al., 2011).

Nosocomial infections bring an additional cost of 132 million dollars per year in Norway, but this cost is between 2 and 4 billion dollars in the USA (Yalçın, 2000). In the report of the Centers for Disease Control and Prevention (CDC), it was stated that nosocomial infections cause an additional cost of 5 million dollars annually (CDC, 2000). In a study conducted in Turkey in 2015, the total cost of nosocomial infections was reported to be $1,305,753 p.a. (Kurutkan et al., 2015).

Nosocomial infections have serious, vital and economic consequences for the affected patients as well as the increase in health expenditures due to treatment costs (Daschner, 1989; Haley, 1986; Jarvis, 1996). The frequency of nosocomial infections in the United States has increased by 36% over the past 15 years (Maurette, 2002). These infections have vital consequences for patients with a high rate of mortality. Economic consequences include the delay in returning patients and/or their caregivers to work or, in some cases, decreases in income due to unsuccessful returns (Byford et al., 2000; Drummond, 1992; Fabry et al., 1982).

While it is seen that nosocomial infections increase the vital risks and their costs have an important share in health expenditures, increasing the efforts and awareness to prevent them depends on the research to determine the cost of nosocomial infections and the sharing of their results. Nosocomial infection cost studies have been observed to be pioneered by the USA, and nowadays, many countries have started to put emphasis on the subject (Edmond and Wenzel, 1995; Wilcox and Dave, 2000). Despite the increasing number of studies carried out in Turkey on costs, the need for a great deal of advanced research is expressed in the literature (Çavdar, 2015; Esatoglu et al., 2006; Gökler, 2015; Özbek, 2008; Yalçın, 2000).

In addition, according to the Performance Audit Report of Combating Nosocomial Infections issued by Turkish Court of Accounts in 2007, the costs due to nosocomial infections were not determined at the national level by the Ministry of Health, and it was emphasized that there was a need for the determination of the total burden laid on the national economy by nosocomial infections that brought a load on the health expenditures. As a result of the situation analyses, it was emphasized that intensive source use can be prevented by determining mission, vision and policies, but this can be possible in the conclusion of necessary researches, and there is such a need (Court of Accounts Report, 2007). Making predictions based on scientific research to estimate the total costs of hospital infections, which cause an unnecessary burden on hospital costs and health expenditures to the country's economy, will help determine policies in this direction, and thus, waste in resource use will be prevented. Hence, the costs of nosocomial infections revealed in this study will enlighten both health expenditures and the country’s economy.

In this study carried out in a large-scale hospital in Turkey, it is aimed to determine the costs of nosocomial infections occurring in adult patients in surgical, internal, and intensive care clinics and their costs to the Social Security Institution.

II. THE COST OF NOSOCOMIAL INFECTIONS TO THE HOSPITAL

Considering that the cost of nosocomial infection as an additional cost to the main disease, the total treatment cost per patient normally increases in patients with this infection. According to the researchers, the average nosocomial infection cost varies between $1000 and $6500 depending on the country (Table 1).

Table 1. The Average Cost of Additional Treatment per Patient in Studies on Nosocomial Infections

Year	Researcher	Country	Average Cost ($)
1974	Westwood et al.	Canada	1.650
1980	Haley et al.	Atlanta/Georgia	1.018
1993	Diaz Molina et al.	Spain	1.909
1995	Eksik et al.	Turkey	6.643
1997	Yalçın et al.	Turkey	1.582
1998	Orrett et al.	Trinidad	1.910
1998	Anderson	Norway	2.200
1999	Açıkel et al.	Turkey	2.938
2001	Engin	Turkey	1.800
2003	Plowman	England	2.807
2005	Chen et al.	China	3.306
2006	Sanchez-Velazquez and Ponce de la Leon Rosales	Australia	3.715
2007	Yıldırım	Turkey	3.854
2008	Meriç	Turkey	4.421

Most of the treatment costs in patients with nosocomial infections arise from the cost of medication. Meriç (2008) found that the additional medication costs per capita are as an average of $1,268, and Rosenthal et al. (2005) found that the average cost of nosocomial infections as 996 dollars per person in patients with recurrent pneumonia in the intensive care unit. Özbek (2008) found that the medication cost per person in the case group is $2,247. Although the additional cost varies according to the clinics, the medication costs are approximately 7 times higher in patients with nosocomial infections. Treatment costs also vary significantly depending on the clinic where the patient is hospitalized. In a study conducted in patients with nosocomial infections in Turkey, the additional cost per patient was found to be 15,340 dollars in the anesthesiology clinic, and 6,995 dollars in intensive care (Özbek, 2008). In the study conducted by Plowman (2003) in England, it was found that the additional cost in general surgery is 5,464 dollars, and in the study conducted by Coello et al. (1993), the additional cost was found to be 3,263 dollars in orthopedics.

Another important factor which has an effect on the cost of nosocomial infection is the type of infection. In a study conducted in England on the additional cost per patient according to diagnosis groups, Jarvis (1996) found that the average is 576 dollars in urinary tract infection, 2,734 dollars in surgical site infection, 3,000 dollars in bacteremia, and 4,947 dollars in pneumonia. In the study conducted by Graves (2001) in Australia, the average was found to be 600 dollars in urinary tract infection, 700-2,800 dollars in surgical site infection, 5,000 dollars in pneumonia, and 5,000-50,000 dollars in bloodstream infection. In the study conducted by Özbek (2008) in Turkey, it was found that the average additional cost is 6,540 dollars in bacteremia, 6,278 dollars in urinary tract infection, 5,537 dollars in surgical site infection, 4,814 dollars in skin and soft tissue infections, and ventilator-associated events 3,512. Plowman (2003) found it to be 1.180 dollars in urinary tract infection, 1,872

dollars in surgical site infection, 1,960 dollars in skin infection, 3,342 dollars in lower respiratory tract infection, and 8,697 dollars in bloodstream infection. It can be said that there are higher costs in lung and septicemias.

Gender and the clinic admitted also appear to be other factors in the costs of nosocomial infections. Plowman (2003) determined the average cost of nosocomial infections in male patients as 6,155 dollars per patient, and 4,681 in female patients, while this cost was 6,875 dollars for patients admitting to the emergency department and 3,769 dollars for patients admitting to outpatient department.

III. METHOD

This descriptive and retrospective study was conducted in a Sivas Numune Hospital with 905 beds, which can be called a large-scale hospital, in the Central Anatolian city of Sivas. All cases that received inpatient treatment and developed nosocomial infections in 2018 were included in the study. Of the 197 case files, 48 files were excluded for reasons such as the lack of information about the parameters, and many clinical changes of the patient during hospitalization, thus 149 files were studied.

3.1. Data Collection

The detected cases are given in Table 2 according to their clinics and the number.

Table 2. The Distribution of Nosocomial Infections by Surgical, Internal and Intensive Care Clinics in 2018

Clinics	**The Number of Nosocomial Infection Cases**
Surgical Clinics (N=12);	
General Surgery	2
Orthopedics and traumatology	3
Gynecology and obstetrics surgery	5
Brain surgery	2
Internal Clinics (N=29);	
Neurology	4
Palliative care	21
Medical oncology	4
Intensive Care Clinics (N=108);	
Anesthesiology and reanimation	85
Internal	11
Neurology	12
Total Cases	**149**

Most of the 149 cases included in the study were from intensive care clinics. The subtitles and content of the "Infection Surveillance Follow-Up Form" prepared for each patient based on the nosocomial infections diagnosis criteria determined by the Centers for Disease Control and Prevention in order to collect cost information of the cases are as follows:

a) **Patient data collection form**: It is the form including the socio-demographic characteristics of the patients, file number, main diagnosis according to ICD-10, additional diagnosis and procedures.
b) **Medication data collection form**: It is the form in which information including IM/IV/SC applications and oral medications applied is recorded. This form includes the names of the medications, the number/quantity of medications used, and the price and the amounts invoiced to the Social Security Institution.

c) Laboratory tests data collection form: It is the form including information on laboratory tests. This form includes the name of the test, the number of transactions, and the price and the amounts invoiced to the Social Security Institution.

d) Radiology data collection form: It is the form including information about X-ray. This form includes the name of the examination, the number of transactions, and the price and the amounts invoiced to the Social Security Institution.

3.2. Economic Impact

For all patients with nosocomial infections, the service fee (dollars) invoiced by the hospital administration at the time of discharge was recorded as data. Among the total number of hospitalized days, the number of hospitalized days due to nosocomial infection was determined, and the invoiced cost of all resources used during the number of days of hospitalization was obtained. The services resulting in additional costs were calculated over the invoiced costs to the Social Security Institution.

Starting from the diagnosis of nosocomial infection, the patient file, discharge report, adult infection form, and hospital automation system were used for the cost determination of all resources used to the patient.

Within the scope of nosocomial infection costs:

- Hospitalization days,
- Medication,
- Laboratory,
- Radiology,
- Consultation,
- Other items,

were gathered and an "Infection Surveillance Follow-Up Form" was prepared for each case.

Hospitalization Cost: It is calculated by multiplying the bed and hospital attendant fees determined by the Social Security Institution for each clinic and the number of days of hospitalization between the onset and ending dates of the nosocomial infection. For example, the cost of anesthesiology and reanimation intensive care package bed is 117 dollars per day, internal and neurology intensive care is 58 dollars, palliative care clinic is 44 dollars, medical oncology is 6 dollars, orthopedics and traumatology is 4 dollars.

Medication Cost: It is the total cost of the medication prescribed by the infectious diseases specialist within the days between the onset and ending dates of nosocomial infection. Generally prescribed medication names are listed in Chart 1.

Chart 1: The List of Medication Names Prescribed in the Treatment of Nosocomial Infections

1	Amijeksin 1 gr	16	Cubicin 500 mg	31	İesetum 1gr	46	Merosid 1 gr
2	Avelox 400 mg	17	Desefin 1 gr	32	Invazn 1 gr	47	Meropenem 500 mg
3	Ambisome 350 mg	18	Devasid	33	Tazerecin 4.5 gr	48	Meronem 1 gr
4	Avitaz 4.5 gr	19	Ertapenem 1 gr	34	Tigeject 50 Mg	49	Mrsacin 50 mg
5	Amikasin 500 mg	20	Ekipim	35	Tekosıt 400 Mg	50	Mofelox
6	Bactrim 200 mg	21	Fungidas 50 mg	36	Targocid 400 Mg	51	Sulbaksit
7	Cancidas 70 mg	22	Flagyl 500 mg	37	Tienam 500 Mg	52	Seffur 750 mg
8	Cancidas 50 mg	23	Flukonazol 200 mg	38	Tazoject 4.5 Gr	53	Sulzon
9	Colymisin150 mg	24	Fulukopol 400 mg	39	Tygasil 50 mg	54	Silanem 500 mg
10	Cipro 400 mg	25	Genta 160 mg	40	Tazocin 4.5 gr	55	Seftazıdım
11	Ciproktan 200 mg	26	Linedor	41	Maxipen 500 mg	56	Seftriakson 1 gr
12	Ciflosin 500 mg	27	Linezolid 600 mg	42	Meroepnem	57	Vancotek 500 mg
13	Cravit 750 mg	28	Linezone 2 mg	43	Mopem	58	Vankomisin 1 gr
14	Colimysin 1/2 inhaler	29	Levofloksasin 500 mg	44	Metronidazol 500 mg	59	Voleflok 750 mg
15	Colistin 100 mg	30	Lefox 750 mg	45	Moxiflex	60	Zidim

Laboratory Cost: It is the total cost of the examinations requested by the infectious diseases specialist within the days between the onset and ending dates of the nosocomial infection. The names of the laboratory tests generally requested from the patients for the treatment are listed in Chart 2.

Chart 2. The List of Generally Requested Laboratory Tests in the Treatment of Nosocomial Infections

1	Catheter culture	12	Procalcitonin test
2	Catheter tip culture	13	Gram stain
3	Blood culture	14	WBC (White Blood Cell)
4	Wound culture	15	Stained direct microscopy
5	Tracheal aspirate culture	16	Antibiotic sensitivity test
6	Urine culture	17	Complete urinalysis
7	Sputum microscopy culture	18	Routine biochemistry test
8	Single blood culture	19	Bacteria identification and susceptibility test
9	Fungal culture	20	Urea
10	CRP (turbidimetric method)	21	Extended spectrum beta lactamase (ESBL)
11	Sedimentation rate	22	Creatinine blood test

Radiology Cost: It is the total cost of imaging services requested by the infectious diseases specialist within the days between the onset and ending dates of hospital infection. PA chest radiography, chest radiography (one-way projection), urinary USG, abdominal USG, and ECHO were generally requested by the physician.

Consultation Cost: It is the costs occurring as a result of the relevant clinical specialist physicians inviting the infectious diseases specialist physician for consultation within the days between the onset and ending dates of the nosocomial infection. One consultation costs 1 dollar.

Other Items Cost: These are the costs of the services provided by service providers to patients within the days between the onset and ending dates of the nosocomial infection and listed in Chart 3.

Chart 3. The List of Other Cost Items in Nosocomial Infection Service Supply

1	IV injection	**16**	Medication application with nebulizer
2	Catheter dressing and care	**17**	Establishing vascular access
3	Daily monitoring	**18**	Total parenteral nutrition (TPN) monitoring
4	IV drug infusion	**19**	Wound dressing
5	Emergency hemodialysis/intensive care and inpatient hemodialysis	**20**	Urinary catheter application
6	Cardiopulmonary resuscitation	**21**	Central vein catheterization, jugular or subclavian
7	Cardioversion	**22**	Intra-arterial cannulation + pressure measurement
8	Colostomy care	**23**	Endotracheal tube or tracheotomy cannula replacement
9	Enteral hyperalimentation follow-up	**24**	Training a patient with COPD
10	Subcutaneous injection	**25**	Inhaler device training
11	Daily inpatient pain monitoring	**26**	Oxygen therapy session
12	Steam inhalation	**27**	Transthoracic echocardiogram (TTE)
13	Wound debridement and dressing, large	**28**	Electrocardiogram (ECG)
14	Nasogastric catheter application	**29**	Decubitus wound dressing
15	Endotracheal intubation, non-operating room	**30**	Transfusion of blood or blood products

3.3. Statistical Evaluation of Data

Statistical Package for Social Sciences (SPSS) 22.0 package software was used for statistical analysis. First, the compliance of the variables with normal distribution was evaluated by Shapiro-Wilk test. As a result of the analysis, the variables were heterogeneous and they were not normal

distributed. Therefore, nonparametric tests were used. The study data were used along with descriptive statistical methods (mean, standard deviation) to evaluate how the cost and the number of days of hospitalization of the most common nosocomial infections vary according to the selected patient characteristics (gender, age, admission clinics, admission type, and nosocomial infection diagnosis groups); Mann-Whitney U test was used for two independent groups and Kruskal Wallis-H test was used for more than two groups, and $p < 0.05$ level was considered significant. Since more than two independent groups were not normal distributed in the research, Mann-Whitney U test was used to determine the statistical difference between groups instead of Post-Hoc test.

3.4. Research Ethics Statement

This research has obtained approval from the research ethics committee in İstanbul Okan University (Meeting dated 13.02.2019 and numbered 103).

IV. RESULTS

It was determined that 50.3% of the patients were male and 49.7% were female. The mean age was 72.04±17.5 (55 – 90 age range). 57.0% of the patients were 75 years and older, and 29.5% were between the ages of 55-74. It was found that 61.7% of the patients admitting to the hospital from the emergency service, 27.5% from another service, and 10.7% from the polyclinic; 91.9% of them did not undergo any surgery (Table 3).

Table 3. The Distribution of Patients According to Their Socio-Demographic Characteristics (n=149)

Characteristics	Number	%
Gender		
Male	74	49.7
Female	75	50.3
Age		
19-34	11	7.4
35-54	9	6.0
55-74	44	29.5
75 and ↑	85	57.0
Admission Type		
Polyclinic	16	10.7
Emergency Service	92	61.7
Another Service	41	27.5
The State of Undergoing a Surgery		
Yes	12	8.1
No	137	91.9

It was determined that 93.3% of the patients developed nosocomial during the hospitalization period, 32.9% were requested six or more consultations, 7.4% were diagnosed with the main diagnosis, and 52.4% died due to nosocomial infection. In the distribution of nosocomial infection-related deaths according to clinics, 8.3% were found to die in surgical clinics, 27.6% in internal clinics, and 63.9% in intensive care clinics. 2/3 of the deaths due to hospital infection were seen in intensive care clinics (Table 4).

Table 4. The Main Characteristics Distribution of Patients by Nosocomial Infection (n=149)

Characteristics	Number	%
Nosocomial infection development status		
Nosocomial infection developed during the hospitalization	139	93.3
Hospital infection developed after discharge	10	6.7
The number of nosocomial infection consultation requests		
No	4	2.7
1	13	8.7
2	34	22.8
3	19	12.8
4	16	10.7
5	14	9.4
6 and ↑	49	32.9
Nosocomial infection treatment results		
Discharge	33	22.1
Referral	27	18.1
Death due to the main diagnosis	11	7.4
Death due to nosocomial infection	78	52.4
Death due to nosocomial infection according to clinics (n=78)		
Surgery	1	8.3
Internal	8	27.6
Intensive care	69	63.9

Ventilator-associated events were frequently responsible for the deaths (38.3%). Other infections were determined as urinary tract infection (16.8%), pneumonia (16.1%) and bloodstream infections (15.4), respectively (Table 5).

Table 5. The Distrubution of Diagnosis Groups for Nosocomial Infection (n=149)

Diagnoses	Number	%
Ventilator-Associated Events	57	38.3
Urinary Tract Infections	25	16.8
Pneumonia	24	16.1
Bloodstream Infections	23	15.4
Surgical Site Infection	10	6.7
Skin and Soft Tissue Infections	4	2.7
Bone and Joint Infections	2	1.3
Lower Respiratory Tract Infection (Except for Pneumonia)	4	2.7

Among the most common concomitant diseases, it was found to be hypertension (27.3%), diabetes mellitus (17.1), cerebrovascular accident (10.2%), chronic obstructive pulmonary disease (COPD) (9.1%), heart failure (8.0%), and other neurological disorders (8.0%) (Table 6).

Table 6. The Distribution of Concomitant Diseases in Cases of Nosocomial Infections within the Scope of the Study

Concomitant Diseases*	**Number**	**%**
Hypertension	51	27.3
Diabetes mellitus	32	17.1
Cerebrovascular accident	19	10.2
COPD	17	9.1
Heart failure	15	8.0
Other neurological disorders	15	8.0
Coronary artery disease	12	6.4
Malignant solid tumor	9	4.8
Kidney failure	8	4.3
Psychiatric disorders	2	1.1
Pancreatic diseases	2	1.1
Cerebral palsy	1	0.5
Other endocrine disorders	1	0.5
Chronic liver disease	1	0.5
Benign solid tumor	1	0.5
Ashthmatic bronchiole	1	0.5
TOTAL CASES	**187**	**100.0**

*****The patient may have more than one concomitant disease.

Invasive catheter applications were the most important risk. The most common risk factors were found to be peripheral venous catheter (11.0%), urinary catheter (10.3%), H2 receptor antagonist (10.2%), central venous catheter (8.0%), unconsciousness (7.3%), nasogastric tube (7.3%), enteral nutrition (7.1%), mechanical ventilation (7.1) and endotracheal intubation (7.0%) (Table 7).

Table 7. The Distribution of Risk Factors Affecting the Development of Nosocomial Infection

Risk Factors*	**Number**	**%**
Peripheral Venous Catheter	133	11.0
Urinary Catheter	125	10.3
H2 receptor antagonist	123	10.2
Central venous catheter	97	8.0
Unconsciousness	88	7.3
Nasogastric tube	88	7.3
Enteral nutrition	86	7.1
Mechanical ventilation	86	7.1
Endotracheal intubation	85	7.0
Peripheral artery catheter	52	4.3
Decubitus	41	3.4
Total parenteral nutrition (with CVC)	40	3.3
Respiratory Failure	38	3.1
Percutaneous endoscopic gastrostomy (PEG)	36	3.0
Cardiopulmonary resuscitation	27	2.2
Transfusion	25	2.1
Hemodialysis	21	1.7
Tracheostomy	10	0.8
Chest tube	5	0.4
Colostomy	1	0.1
Umbilical catheter	1	0.1
Surgery drain	1	0.1
TOTAL	**1209**	**100.0**

*****The patient may have more than one risk factor.

4.1. Hospital Costs Related to Nosocomial Infections

In this section, expenditures related to treatment costs are given. The total amount invoiced to the Social Security Institution consists of the main diagnosis and treatment costs related to nosocomial infections. The total cost invoiced to the Social Security Institution for the main diagnosis and hospital infection is 2,079,925 dollars, and the average cost per patient is 13,959 dollars. Besides, the additional cost of nosocomial infection is given. The total cost of nosocomial infections was 652,838 dollars, and the average nosocomial infection cost per patient was determined to be 4,381 dollars. On average, nosocomial infections increased hospital costs by 45.7%, in other words, 1.5 times (Table 8).

Table 8. The Distributions of Descriptive Statistics for Costs (n=149)

Cost	Average	Ss	S_x	Min.	Max.	Total cost amount (Dollars)
Nosocomial infection cost (Dollars)	4.381	5.165	423	86	28.562	652.838
The total cost invoiced to the SSI (Dollars)*	13.959	11.684	957	207	74.369	2.079.925

*****The total cost invoiced to the Social Security Institution = The main diagnosis cost + Nosocomial infection cost

It was determined that the nosocomial infection *hospitalization day costs* of intensive care clinics ($\overline{X}$=3.368) were higher than internal clinics ($\overline{X}$=891) and surgical clinics ($\overline{X}$=103) ($p<0.001$). The nosocomial infection hospitalization day costs of internal clinics ($\overline{X}$=891) were higher than surgical clinics ($\overline{X}$=103) ($p<0.001$). The hospitalization day costs of intensive care clinics were 32.8 times higher than surgical clinics and 3.8 times more than internal clinics. The hospitalization day costs of internal clinics were 8.7 times higher than surgical clinics (Table 9).

It was determined that nosocomial infection *medication costs* of intensive care clinics ($\overline{X}$=1.093) were higher than surgery clinics ($\overline{X}$=427) and internal clinics ($\overline{X}$=357) ($p<0.05$). The medication costs of intensive care clinics were 3.1 times higher than internal clinics and 2.6 times higher than surgical clinics. The medication costs of surgical clinics were 1.2 times higher than internal clinics (Table 9).

It was determined that nosocomial infection *laboratory costs* of intensive care clinics ($\overline{X}$=210) were higher than internal clinics ($\overline{X}$=95) and surgical clinics ($\overline{X}$=33) ($p<0.001$). The laboratory costs of intensive care clinics were 6.3 times higher than surgical clinics and 2.2 times higher than internal clinics. The laboratory costs of internal clinics were 2.8 times higher than surgical clinics (Table 9).

It was determined that nosocomial infection *radiology costs* in intensive care clinics ($\overline{X}$=15) were higher than internal clinics ($\overline{X}$=10) and surgical clinics ($\overline{X}$=4) ($p<0.001$). The radiology costs of intensive care clinics were 3.7 times higher than surgical clinics and 1.6 times higher than internal clinics. The radiology costs of internal clinics were 2.3 times higher than surgical clinics (Table 9).

It was determined that nosocomial infection *consultation costs* of intensive care clinics ($\overline{X}$=9) were higher than surgical clinics ($\overline{X}$=5) and internal clinics ($\overline{X}$=4) ($p<0.001$). The consultation costs of intensive care clinics were 2.1 times higher than internal clinics and 1.9 times higher than surgical clinics. The consultation costs of surgical clinics were 1.1 times higher than internal clinics (Table 9).

It was determined that *other cost items* of nosocomial infection in intensive care clinics ($\overline{X}$=847) were higher than surgical clinics ($\overline{X}$=92) and internal clinics ($\overline{X}$=241) ($p<0.001$). Nosocomial infection other cost items of internal clinics ($\overline{X}$=241) were higher than surgical clinics ($\overline{X}$=92) ($p<0.001$). Other cost items of intensive care clinics were 9.2 times higher than surgical clinics and 3.5 times higher

than internal clinics. The other cost items of internal clinics were 2.6 times higher than surgical clinics (Table 9).

It was determined that *the total cost of nosocomial infections* in intensive care clinics ($\overline{X}$=5.542) was higher than surgical clinics ($\overline{X}$=664) and internal clinics ($\overline{X}$=1598) (p<0.001). The total cost of nosocomial infections in intensive care clinics is 8.3 times higher than surgical clinics and 3.5 times higher than internal clinics. The total cost of nosocomial infections in internal clinics was 2.4 times higher than in surgical clinics (Table 9).

Table 9. The Average Costs per Patient due to Nosocomial Infection by Surgical, Internal, and Intensive Care Clinics (n=149)

Costs (Dollars)	Clinics			X^2
	Surgical (n=12)	Internal (n=29)	Intensive (n=108)	
	Average	Average	Average	*p*
Hospitalization day	103	891	3.368	53.761 0.000*
Medication	427	357	1.093	11.000 0.004*
Laboratory	33	95	210	33.967 0.000*
Radiology	4	10	15	16.731 0.000*
Consultation	5	4	9	15.582 0.000*
Other cost items**	92	241	847	41.863 0.000*
Total cost of nosocomial infections	664	1.598	5.542	43.512 0.000*

*p<0.05
**Other cost items are explained in the Method section.

It was determined that nosocomial infection *laboratory costs* of neurosurgery clinics ($\overline{X}$=36) were higher than obstetrics and gynecology clinics ($\overline{X}$=10) (p<0.05). Nosocomial infection laboratory costs of orthopedics and traumatology clinics ($\overline{X}$=88) were higher than gynecology and obstetrics clinics ($\overline{X}$=10) (p<0.05). Laboratory costs in orthopedics and traumatology clinics were 17.8 times higher than the general surgery clinic, 8.7 times higher than gynecology and obstetrics clinic, and 2.4 times higher than neurosurgery clinic. Laboratory costs of the neurosurgery clinic were 7.4 times higher than the general surgery clinic and 3.6 times higher than the gynecology and obstetrics clinic. Laboratory costs of the gynecology and obstetrics clinic are 2.1 times higher than the general surgery clinic (Table 10).

Table 10. The Average Costs per Patient due to Nosocomial Infection by Surgery Clinics (n=12)

Costs (Dollars)	Surgical Clinics				X^2
	General Surgery (n=2)	Orthopedics and Traumatology (n=3)	Gynecology and Obstetrics (n=5)	Brain Surgery (n=2)	
	Average	Average	Average	Average	*p*
Hospitalization day	35	163	104	75	5.033 0.169
Medication	85	1266	145	212	5.362 0.147
Laboratory	5	88	10	36	8.738 0.033*
Radiology	0	6	0,9	13	4.401 0.221
Consultation	0,8	11	2	4	5.732 0.125
Other cost items	19	171	78	78	5.179 0.159
Total cost of nosocomial infections	144,8	1.705	339,9	418	5.362 0.147

*p<0.05

It was found that nosocomial infection *hospitalization day costs* of palliative care clinics ($\overline{X}$=1.189) were higher than medical oncology ($\overline{X}$=146) and neurology clinics ($\overline{X}$=72) (p<0.05). The cost of hospitalization in the palliative care clinic was 16.6 times higher than the neurology clinic and 8.1 times higher than the medical oncology clinic. The hospitalization day costs of the medical oncology clinic were 2 times higher than the neurology clinic (Table 11).

It was found that the costs of nosocomial infection *other cost items* of palliative care clinics ($\overline{X}$=277) were higher than neurology clinics ($\overline{X}$=67) (p<0.05). Other cost items in the palliative care clinic were 4.1 times higher than the neurology clinic and 1.2 times higher than the medical oncology clinic. Other cost items of the medical oncology clinic were 3.4 times higher than the neurology clinic (Table 11).

It was found that *the total nosocomial infection* costs of palliative care clinics ($\overline{X}$=1.999) were higher than medical oncology ($\overline{X}$=664) and neurology clinics ($\overline{X}$=420) (p<0.05). The total cost of nosocomial infections in the palliative care clinic was 4.6 times higher than the neurology clinic and 3 times higher than the medical oncology clinic. The total cost of nosocomial infections in the medical oncology clinic was 1.6 times higher than the neurology clinic (Table 11).

Table 11. The Average Costs per Patient due to Nosocomial Infection by Internal Clinics (n=29)

Costs (Dollars)	Internal Clinics			X^2
	Neurology (n=4)	Palliative Care (n=21)	Medical Oncology (n=4)	
	Average	Average	Average	*p*
Hospitalization day	72	1.189	146	7.245 0.003*
Medication	221	411	208	0.322 0.728
Laboratory	47	106	79	5.647 0.059
Radiology	10	11	4	1.017 0.601
Consultation	3	5	2	4.321 0.115
Other cost items	67	277	225	6.299 0.043*
Total cost of nosocomial infections	420	1.999	664	12.979 0.002*

*p<0.05

It was found that *the hospitalization day costs* of the anesthesiology and reanimation intensive care clinic ($\overline{X}$=3.811) were higher than the internal intensive care ($\overline{X}$=2.077) and neurology intensive care ($\overline{X}$=1.410) clinics (p<0.05). The hospitalization costs in the anesthesiology and reanimation intensive care clinic were 2.7 times higher than the neurology intensive care clinic and 1.8 times higher than the internal intensive care clinic. The hospitalization costs of the internal intensive care clinic were 1.5 times higher than the neurology intensive care clinic (Table 12).

It was found that nosocomial infection *laboratory costs* of the anesthesiology and reanimation intensive care clinic ($\overline{X}$=227) were higher than the neurology intensive care clinic ($\overline{X}$=93) (p<0.05). The laboratory costs in the anesthesiology and reanimation intensive care clinic were 2.4 times higher than the neurology intensive care clinic and 1.1 times higher than the internal intensive care clinic. The laboratory costs of the internal intensive care clinic were 2.2 times higher than the neurology intensive care clinic (Table 12).

It was found that the nosocomial infection *consultation costs* of the anesthesiology and reanimation intensive care clinic ($\overline{X}$=10) were higher than the neurology intensive care clinic ($\overline{X}$=4) (p<0.05). The consultation costs in the anesthesiology and reanimation intensive care clinic were 2.2 times higher than the neurology intensive care clinic and 1.6 times higher than the internal intensive care clinic. The consultation costs of the internal intensive care clinic were 1.4 times higher than the neurology intensive care clinic (Table 12).

Anesthesiology and reanimation intensive care clinic ($\overline{X}$=974) was found to be higher in *nosocomial infection other cost items* than neurology intensive care clinic ($\overline{X}$=156) (p<0.05). The costs of the internal intensive care clinic nosocomial infection other cost items ($\overline{X}$=620) were higher than the neurology intensive care clinic ($\overline{X}$=156) (p<0.05). Other cost items in the anesthesiology and reanimation intensive care clinic were 6.2 times higher than the neurology intensive care clinic and 1.6 times higher than the internal intensive care clinic. Other cost items of the internal intensive care clinic were 3.9 times higher than the neurology intensive care clinic (Table 12).

The total costs of nosocomial infections of the anesthesiology and reanimation intensive care clinic ($\overline{X}$=6.205) were higher than the neurology intensive care unit ($\overline{X}$=2.059) (p<0.05). The total cost of nosocomial infections in the anesthesia and reanimation intensive care clinic was 3 times higher than

the neurology intensive care clinic and 1.5 times higher than the internal intensive care clinic. The total cost of nosocomial infections in the internal intensive care clinic was 2 times higher than the neurology intensive care clinic (Table 12).

Table 12. The Average Costs per Patient due to Nosocomial Infection by Intensive Care Clinics (n=108)

Costs (Dollars)	Intensive Care Clinics			X^2
	Anesthesiology and Reanimation (n=85)	Internal (n=11)	Neurology (n=12)	
	Average	Average	Average	*p*
Hospitalization day	3.811	2.077	1.410	12.584 0.002*
Medication	1.167	1.287	388	4.737 0.094
Laboratory	227	205	93	8.500 0.014*
Radiology	16	15	8	4.216 0.121
Consultation	10	6	4	7.621 0.022*
Other cost items	974	620	156	23.023 0.000*
Total cost of nosocomial infections	6.205	4.210	2.059	10.810 0.004*

*p<0.05

The cost of male patients with nosocomial infections ($\overline{X}$=5.313) were higher than female patients with nosocomial infections ($\overline{X}$=3.437) (p<0,05) (Table 13).

When the costs of nosocomial infections evaluated according to *the clinics admitted*, it was found that palliative care clinic nosocomial infection costs ($\overline{X}$=1.999) were higher than neurology ($\overline{X}$=420), gynecology and obstetrics ($\overline{X}$=343), general surgery ($\overline{X}$=147), and brain surgery ($\overline{X}$=422) clinics (p<0.001). Nosocomial infection costs of the neurology intensive care clinic ($\overline{X}$=2.060) were higher than the general surgery clinic ($\overline{X}$=147) (p<0.001) (Table 13).

According to *the admission type*, it was determined that nosocomial infection costs of the patients admitting to the emergency department ($\overline{X}$=5.059) were higher than the patients admitting to the polyclinics ($\overline{X}$=1.096) (p<0.001). Nosocomial infection costs of the patients admitting to another service ($\overline{X}$=4.144) were higher than the patients admitting to the polyclinics ($\overline{X}$=1.096) (p<0.001) (Table 13).

According to *the diagnoses*, it was found that the costs of nosocomial urinary tract infection ($\overline{X}$=4.305) diagnosis were higher than surgical site infection ($\overline{X}$=367) diagnosis; the costs of nosocomial pneumonia infection ($\overline{X}$=3.514) diagnosis were higher than surgical site infection ($\overline{X}$=367) diagnosis; the costs of nosocomial ventilator-associated events ($\overline{X}$=5.431) diagnosis were higher than surgical site infection ($\overline{X}$=367) diagnosis (p<0.001) (Table 13).

Table 13. The Distribution of Nosocomial Infection Costs Developing during the Patient's Stay in the Hospital According to Basic Patient Characteristics

Patient Characteristics	n		Nosocomial infection cost (Dollars)	Difference	*p*
	Number	%	Average		
Sex					
Female	74	49.7	3.437	Z=-3.098	0.002*
Male	75	50.3	5.313		
Age					
19-34	11	7.4	2.054		
35-54	9	6.0	2.194	X^2=7.318	0.062
55-74	44	29.5	3.998		
75 and ↑	85	57.0	5.113		
Surgical Clinics					
General surgery	2	1.3	147		
Orthopedics and traumatology	3	2.0	1.708		
Gynecology and obstetrics	5	3.4	343		
Brain surgery	2	1.3	422		
Internal Clinics					
Neurology	4	2.7	420	X^2=58.601	0.000*
Palliative care	21	14.1	1.999		
Medical oncology	4	2.7	665		
Intensive Care Clinics					
Anesthesiology and reanimation	85	57.0	6.206		
Internal IC	11	7.4	4.209		
Neurology IC	12	8.1	2.060		
Admission Type					
Polyclinic	16	10.7	1.096	X^2=18.833	0.000*
Emergency service	92	61.7	5.059		
Another service	41	27.5	4.144		
Nosocomial Infection Diagnosis Groups					
BSI	23	15.4	4.211		
UTI	25	16.8	4.305		
Pneumonia	24	16.1	3.514	X^2=35.179	0.000*
Skin and soft tissue infections	4	2.7	1.790		
Bone and joint infections	2	1.3	2.152		
SSI	10	6.7	367		
VAE	57	38.3	5.431		
LRTI	4	2.7	9.827		

* $p<0.05$

** BSI – Bloodstream Infection, UTI – Urinary Tract Infection, SSI – Surgical Site Infection, VAE – Ventilator-Associated Events, LRTI – Lower Respiratory Tract Infection (except for pneumonia)

Treatment costs in the gynecology and obstetrics clinic increased by 91.9% due to nosocomial infections. In internal clinics, it increased by 23.9% in neurology service, and 23.6% in palliative care. It increased by 92.2% in the internal intensive care clinic and 49.0% in emergency service admissions. Among the types of nosocomial infections, the highest increase in the costs is caused by bone and joint infection (95.2%) (Table 14).

Table 14. The Distribution of Nosocomial Infection and the Main Diagnosis Cost According to Basic Patient Characteristics

Patient Characteristics	n		Nosocomial infection cost (Dollars)	Main diagnosis cost (Dollars)	Hospital cost increased by%
	Number	%	Average	Average	
Surgical Clinics					
General surgery	2	1.3	147	205	71.8
Orthopedics and traumatology	3	2.0	1.708	2.041	83.7
Gynecology and obstetrics	5	3.4	343	373	91.9
Brain surgery	2	1.3	422	4.768	8.9
Internal Clinics					
Neurology	4	2.7	420	1.762	23.9
Palliative care	21	14.1	1.999	8.453	23.6
Medical oncology	4	2.7	665	5.357	12.4
Intensive Care Clinics					
Anesthesiology and reanimation	85	57.0	6.206	12.329	50.3
Internal IC	11	7.4	4.209	4.564	92.2
Neurology IC	12	8.1	2.060	8.751	23.5
Admission Type					
Polyclinic	16	10.7	1.096	2.392	45.8
Emergency service	92	61.7	5.059	10.328	49.0
Another service	41	27.5	4.144	10.699	38.7
Nosocomial Infection Diagnosis Groups					
BSI	23	15.4	4.211	12.089	34.8
UTI	25	16.8	4.305	9.261	46.5
Pneumonia	24	16.1	3.514	6.554	53.6
Skin and soft tissue infections	4	2.7	1.790	10.439	17.2
Bone and joint infections	2	1.3	2.152	2.260	95.2
SSI	10	6.7	367	1.341	27.4
VAE	57	38.3	5.431	11.325	48.0
LRTI	4	2.7	9.827	13.747	71.5

* BSI – Bloodstream Infection, UTI – Urinary Tract Infection, SSI – Surgical Site Infection, VAE – Ventilator-Associated Events, LRTI – Lower Respiratory Tract Infection (except for pneumonia)

V. DISCUSSION, RESULT AND SUGGESTIONS

This study was conducted to determine the costs of nosocomial infections occurring in adult patients in surgical, internal, and intensive care clinics and the additional cost of them to the Social Security Institution.

The socio-demographic characteristics of the patients included in the study are presented in results chapter. The average age of the patients is 72.04±17.5 (55 – 90 age range). It was determined that 57.0% of the patients were 75 years and older and 29.5% were between the ages of 55-74. 50.3% of the patients were male and 49.7% were female. In the study conducted by Yıldırım (2007) regarding the frequency of nosocomial infection in hospitalized patients and the factors related to the development of nosocomial infection, it was determined that 54.7% of the patients were male and 45.3% of them were female. Meriç (2008) determined in the study conducted on the mortality rate due to the risk factors of nosocomial infections and the cost that 45,7% of the patients were female, 54,3% of them were male, the average age of the patients was 57.3±21.3 (36-78 age range), and 59,4% of those having nosocomial infection were at the age of 65 and above. In the study condacted by Erbay (2003) male patients were identified as a risk factor for developing nosocomial infections. This result is similar to our study's. In the study conducted by Plowman (2003) on the frequency of nosocomial infections in surgical clinics and their economic burden, it was determined that 65.4% of the patients were female and 34.6% of them were male. It was stated that 36.5% of the patients were at the age range of 18-34, 31.6% of them 55-74, 23.6% of them 35-54, and 8.4% of them at the age of 75 and above. The results are different from those of our study. While it was determined in the study

conducted by Plowman that female patients and those at the age range of 18-34 were high in number, it was found in this study that male patients and those at the age of 75 and above were more. The reason of this difference can be stated as that the study population of Plowman was only those in surgical clinics whereas the population of this study was those in intensive care clinics and palliative care clinics that include the patients mostly at advanced ages in addition to surgical clinics.

According to the findings of this study, it was determined that 61.7% of the patients admitted to the hospital from the emergency service, 27.5% from another service, and 10.7% from the polyclinic. In the study of Plowman (2003) in England, it was shown that 90.1% of the patients admitted to polyclinics and 9.9% to the emergency service. It is because that while Plowman's (2003) study includes only surgical clinics, this study also includes intensive care and palliative clinics, where emergency admissions are higher. Another reason is that the admission rate to hospitals from emergency services is higher in Turkey.

The mortality rate is very high in nosocomial infections. In a study conducted in Turkey, Yıldırım (2007) determined that nosocomial infections increase the mortality rate ninefold. In its report in 2000, CDC explains that an average of 2 million people develop nosocomial infections annually and approximately 90,000 (4.4%) patients die per year. According to CDC, 32% of patients who died from nosocomial infections were due to urinary tract infection, 22% to surgical site infection, 15% to ventilator-associated pneumonia, and 14% to bloodstream infection (APIC, 2020). Rosenthal (2009) revealed that the mortality rate due to septicemia from nosocomial infections can increase by up to 75%. In our study, it was determined that 7.4% of the patients died due to the diagnosis at hospitalization and 52.4% died due to nosocomial infection.

The leading types of nosocomial infections are regarded as bloodstream infections, ventilator-associated events, urinary tract infections, and pneumonia. In our study, the highest rate was ventilator-associated events (38.3%) and the others were urinary tract infection (16.8%), pneumonia (16.1%), bloodstream infections (15.4%), respectively. In the studies conducted by Kayış (2018) and Vançelik et al. (2006) in Turkey, the types of diagnosis order show similarities. Rosenthal et al. (2003) found bloodstream infection as 32%, ventilator-associated event as 25%, and urinary tract infection as 23%. Richards et al. (2000) found pneumonia as 31%, urinary tract infection as 23%, and bloodstream infection as 14%. Vincent et al. (1995), on the other hand, found pneumonia as 46.9% and urinary tract infection as 17.6%, among the diagnoses of nosocomial infection. The dominance of the ventilator-related event in this study suggests that it is necessary to evaluate the processes and interventions in the use of the ventilator with the statement that they can be prevented in terms of infection control. These results suggest that it is necessary to re-evaluate the treatment modalities and interventions in the use of ventilators and the infection control measures. It should be kept within the scope of a field open to improvement. The high rate of occurance of ventilator-related events, the increase in multiple resistant microorganisms, and subsequently, increases in deaths, hospitalization days and costs constitute the primary danger for the clinics. In this regard, nosocomial infection assessment programs should be taken on the agenda as the most important step. Awareness can be created among clinicians in terms of ventilator usage standards and processes as a serious factor in nosocomial infections. Plowman (2003) determined that 48.1% of the nosocomial infection diagnoses were urinary tract infections, 19.2% were surgical site infections, 11.1% were lower respiratory tract infections, 7.7% were skin infections, 1.9% were bloodstream infections and 12.1% were the infections in other areas. The valid comparison of the incidence rate observed in this study with those observed in other studies can be difficult since there might be important differences between this study and other studies in terms of the definitions and surveillance methods used in this study, the case mix studied on and treatment modalities carried on in different clinical environments. For instance, in a research conducted by Glenister et al (1992) in England in a similar NHS hospital and using the same definitions and surveillance methods that were used in Plowman's study, a higher incidence rate was observed than the one observed in Plowman's study. It can be difficult to interpret these findings without more detailed information about case mix and treatment modalities. Different infection rates can reflect the differences in practice, and the study hospital can reveal a better performance about infection control. Although the incidence rates observed in various studies cannot be compared

precisely, the most frequent nosocomial infection types can be stated as ventilator-associated pneumonia, urinary system, surgical site, bloodstream and lower respiratory tract infections in other incidence studies as it is in this study. Another risk factor affecting the development of nosocomial infections is the use of invasive catheters. Peripheral venous catheter (11.0%), urinary catheter (10.3%), central venous catheter (8.0%), nasogastric tube (7.3%) were determined as leading risk factors in the study. In another study conducted in Turkey, it was determined that the risk factors affecting the development of nosocomial infections are long hospitalization, urinary catheters, hemodialysis, and intubation (Meriç, 2008).

In his study conducted in Sweden, Appelgren et al. (2001) found that 10% of chronic kidney failure; Pittet et al. (1999) determined that 26% of cardiovascular system disease and 13% of respiratory system disease accompanied nosocomial infection. Generally, this kind of studies associate concomitant diseases with aging. Old age appears to be an important factor in the development of nosocomial infections (Hanson et al., 1992; Tekeli and Palabıyıkoğlu, 2003). In our study, it was found that the most common concomitant diseases were hypertension, diabetes mellitus, and cerebrovascular events, and the average age of the patients was 72.04±17.5 (55 – 90 age range) and approximately 60% of them were 75 years and above.

In this study, the total cost invoiced to the Social Security Institution due to the main diagnosis and nosocomial infection in 2018 was 2,079,925 dollars, and the average cost per patient was 13,959 dollars. The total cost of nosocomial infections was 652,838 dollars, and the average nosocomial infection cost per patient was 4,381 dollars. According to the result of this study, nosocomial infections increased hospital costs by over 45%, in other words, it increased 1.5 times. Plowman (2003) found that nosocomial infections increased the cost of hospital 2.3 times and there was an additional cost of 2,807 dollars per case. In another study conducted by Yıldırım (2007) in Turkey, it was found that the additional cost per case was 3,854 dollars. In her study conducted in the intensive care clinic in Spain, Sanchez-Velazquez and Ponce de la Leon Rosales (2006) found that the cost per case was 3,715 dollars, increasing the main diagnosis cost 1.9 times. In the study of Meriç (2008) in 2008, it was found that nosocomial infection doubled the total cost. In the study of Chen et al. (2005) conducted in China, it was determined that nosocomial infection brought an additional cost of 3,306 dollars per case.

In the study conducted in surgical wards by Eksik et al. (1995) between 1992 and 1994, it was found that the cost of nosocomial infection per patient was 6,643 dollars. When projected to the number of all patients in surgical services, it was found that the annual cost was 362 million and 400 thousand dollars.

It was determined that nosocomial infection hospitalization day, medication and total cost were higher in intensive care clinics than internal and surgical clinics ($p<0.001$). The hospitalization day costs of intensive care clinics were 32.8 times higher than surgical clinics and 3.8 times higher than internal clinics. Intensive care drug costs were found to be 3.1 times higher than internal clinics and 2.6 times higher than surgical clinics. The total costs of intensive care nosocomial infections were 8.3 times higher than surgical clinics and 3.5 times higher than internal clinics. In the study conducted by Rosenthal (2005), the average cost of nosocomial infection in patients having recurrent pneumonia in the intensive care unit was determined as $2.255. In the study conducted by Özbek (2008), nosocomial infections cost in the intensive care clinics was found as $6.995, and in other clinics as $2.387. While nosocomial infections increased the average costs in intensive care clinics by 4 times, it increased 1.3 times in other clinics. Since intensive care clinics are the units where medical interventions are widely applied, it is an expected result that the economic burden of nosocomial infections developing in these patients is high.

The costs of nosocomial infection are higher for men. Nosocomial infections of male patients increased hospital costs by 50.6%, in other words, it increased 1.5 times. In the study carried out by Plowman (2003) on the frequency of nosocomial infections in surgical clinics and their economic burden, it was found that the cost of hospital infections for male patients was £ 4,889 and that of

female patients was £ 3,742. Similar results were found in our study. It can be stated that the fact that men have heavier work life than women has a negative effect on the recovering process of their health problems they experience in life. The patients admitting to the hospital from the emergency service have the highest costs according to the admission type. Similarly, the costs of emergency service admissions are higher in Plowman's study. According to the type of nosocomial infection, the cost of LRTI is followed by ventilator-related nosocomial infection and urinary tract infection, respectively. In the studies of Plowman (2003), Jarvis (1996) and Graves (2001), the highest cost belongs to septicemia and LRTI.

Although not all nosocomial infections can be prevented, it was stated that bloodstream (65-70%), ventilator-associated pneumonia (55%), and surgical site (55%) infections can be prevented or controlled with evidence-based strategies (Umscheid et al., 2011). Aboelela et al. (2007) explained that precautions and interventions played an important role in reducing the frequency of nosocomial infections. With these measures, it can be said that by achieving a significant improvement in the knowledge, attitude, and behavior of healthcare workers, the frequency of nosocomial infections, mortality, and economic burden can be reduced.

Forming a data entry system at a national level as the basis for the studies and putting forward preventive measures with the information and analysis that are obtained from this data system better, sharing of the result with the healthcare personnel or the hospitals should be ensured. Due to the fact that the most important risk factor is the use of invasive devices and attempts, acting more meticulously can be achieved in adding indications and terms of use.

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