

# Epidemiologic profile of nosocomial infections among paediatric patients in a referral hospital in Hamadan, west of Iran

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## Abstract

Healthcare-associated infections (HC-AI) are major health problem with high financial impact. HC-AIs are one of the main causes of morbidity and mortality in paediatric hospitals. This study was performed to determine the epidemiology of HC-AIs in children admitted to medical wards of Besat Hospital in Hamadan, west of Iran. Data on cases of HC-AIs in paediatrics were collected from March 2017 to February 2018 in Besat Hospital. The medical records of eligible cases were extracted from Iranian Nosocomial Infections Surveillance Software. During the study period, a total of 355 HC-AIs in children were detected, 213 (60%) in boys and 214 (60.3%) in the 0–4-year age group. Of these, bloodstream infection was the most frequent infection in both age groups (37.38% in 0–4 years and 34.75% in 5–14 years). *Escherichia coli* was the common detected microorganism in girls (25.84% in those aged 0–4 years and 24.53% in 5–14 years), whereas *Staphylococcus* was more prevalent in boys (33.6% in those aged 0–4 years and 29.55% in 5–14 years). HC-AIs were more prevalent in burn, haematology and intensive care unit wards. In Besat Hospital, bloodstream infection and urinary tract infection were the most frequent infections among paediatric patients, and *E. coli* and *Staphylococcus* were the commonest detected microorganism in girls and boys respectively. Preventive activities should be targeted to reduce the rate of HC-AIs in wards associated with more contamination.

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## Introduction

Healthcare-associated infections (HC-AI) are one of the most important causes of mortality and morbidity in hospitals, which imposes a heavy financial burden on the health sector [15]. HC-AIs are associated with an increase in hospital costs as well as an increased use of antibiotics and longer hospitalization, which consequently leads to higher morbidity and mortality [11].

Globally, a huge number of patients experience HC-AIs, with incidence rates ranging from 3.5% to 12% in developed countries and 5.7% to 19.1% in middle- and low-income countries [16]. In developing countries, the rates of HC-AIs in intensive care units (ICUs) are over eight times higher than in the United States [18].

Children, especially those with underlying conditions and frequent visits and stay in the hospital, are more vulnerable to these infections [9]. Children hospitalized in the paediatric ICU (PICU) because of impaired host defenses, administration of drugs and the use of invasive devices are more susceptible to such infections [7]. Evidence showed that 4% to 56% of all causes of death in neonates are attributable to HC-AIs [12]. In the study of [1] in Turkey, prolonged hospitalization, neutropenia and use of central venous catheters were the risk factors of HC-AIs in paediatric patients.

Knowledge regarding the epidemiology of HC-AIs is crucial in establishing preventive strategies and implementing effective and reliable plans. In Iran, like other developing countries, there are few data that specifically focuses on paediatric HC-AIs, with most concentrated on such infections in the PICU.

We sought to describe the epidemiologic profile and microbiologic characteristics of HC-AIs in the PICU and other general wards of a main tertiary teaching referral hospital in Hamadan, west Iran.

## Methods

This registry-based descriptive study was conducted from March 2017 to February 2018 in Besat Hospital. Besat Hospital is located in Hamadan city, which is the capital of Hamadan province. The Besat educational and remedial center, from a geographical standpoint, is located in the north-eastern part of Hamadan province. This center officially initiated its activities on 9 October 2006. This study was approved by the ethics committee of Hamadan University of Medical Sciences (IR.UMSHA.REC.1397.590, Research ID 9709065242).

Hamadan province, with an area of 19 493 km<sup>2</sup>, is located in the west of Iran and has a population of 1 738 234 people according to the 2016 national census conducted by the Statistical Center of Iran (<http://irandataportal.syr.edu/census/census-2016>).

Patients younger than 15 with clinical signs of HC-AIs 48 hours after the hospitalization due to infectious or noninfectious reasons were enrolled onto the study. We used the World Health Organization definition for HC-AI.

The medical records of all patients who had been admitted to the hospital in the mentioned time period were extracted from Iranian Nosocomial Infections Surveillance Software (INIS 4.0.0). This software was designed in 2016 and has been updated several times. From 2016 onwards, registration of nosocomial infections in this software is mandatory. Major data collected in the programme include demographic characteristics, infections and related risk factors, pathogens and patient outcome. Data regarding HC-AI were entered into this software online by trained nurses.

We abstracted data from the software. Required information, including demographic characteristics of patients (e.g. age and gender), year of occurrence, type of infection (urinary tract infection (UTI), pneumonia, bloodstream infection (BSI), surgical site infection and other) and ward of admission, were

gathered. Patient data gathered by physical examination of patient's signs and symptoms were imported daily into the software, and assessment of medical records was performed by hospital infection control staff members.

Infections were defined as follows according to our National Directory of Nosocomial Infections Surveillance System. For UTI, the patient had at least one of the symptoms of fever, dysuria, frequency, flank pain, suprapubic pain, nausea and vomiting plus positive urine culture; or presence of at least two symptoms such as fever, dysuria, frequency, flank pain, suprapubic pain, nausea and vomiting plus pyuria. For surgical site infection, patients had at least one of the following characteristics: purulent wound discharge, organisms isolated from fluid or superficial surgical tissue that should be aseptic, at least one of symptoms such as pain, swelling, redness or warmth or diagnosis of a wound infection by a doctor. Pneumonia was defined as crackles on lung examination or radiographic findings plus at least one of the following: purulent sputum or positive blood culture, or positive culture of the tracheal aspirate sample. BSI was defined as blood culture growing a pathogenic organism, having a condition unrelated to location of localized infection or having fever, chills or decreasing blood pressure plus existing infection related to the skin in at least two blood culture samples.

Descriptive analyses including frequency tables, charts and percentages were used for presenting and summarizing the data. All analyses were performed by Stata 11.2 software (StataCorp, College Station, TX, USA). The significance level was considered less than 0.05.

## Results

During March 2017 to February 2018, a total of 355 HC-AIs in children were diagnosed at Besat Hospital. A total of 213 children (60%) were boys, and 214 (60.3%) were in the 0–4-year age group.

The relative frequency of detected HC-AIs during the study period according to hospital ward is shown in Fig. 1. Burn wards (30.42%) had the most HC-AIs, followed by haematology wards (21.41%). The lowest was in the ear, nose and throat ward (1.69%).

Frequency of different types of HC-AIs by age group is presented in Table 1. BSI was the most frequent infection in both age groups (37.38% in children aged 0–4 years and 34.75% in 5–14 years), followed by UTI (16.36% in 0–4 years and 20.57% in 5–14 years).

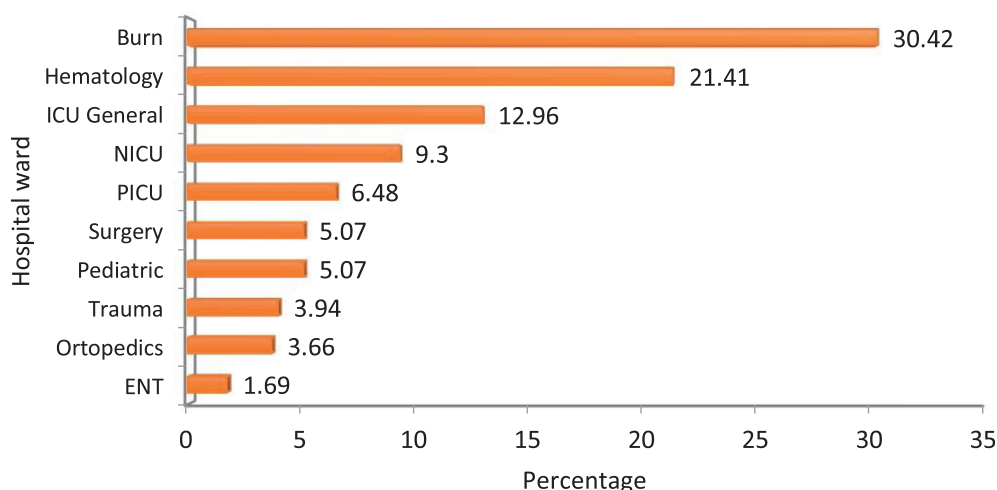


FIG. 1. Relative frequencies of healthcare-associated infections (HC-AIs) according to hospital ward.

*Escherichia coli* was the commonest detected microorganism in girls (25.84% in children aged 0–4 years and 24.53% in 5–14 years), whereas *Staphylococcus* was more prevalent in boys (33.6% in 0–4 years and 29.55% in 5–14 years) (Table 2).

### Discussion

This study presents data from the most recent nosocomial infection in paediatric patients in Besat Hospital, Hamadan. In this study the burn, haematology and ICU wards had the most HC-AIs in children. BSI and UTIs were the most frequent infections in both age groups studied, and *E. coli* was the most commonly detected microorganism in girls, whereas *Staphylococcus* was more prevalent in boys.

In the study conducted by [21] on 95 hospitals with over 200 beds in Iran in 2007–2008, most reported cases were from the

ICU. In two other studies performed in Shiraz, most cases were reported from ICUs and burn wards [13,2]. In our study, HC-AIs were most prevalent in burn wards. Susceptibility of patients to infection due to suppression of immune systems along with longer duration of hospitalizations in these units explain these findings. In addition, Besat Hospital is the main center for treatment of burns in Hamadan province, so all patients with severe burns are referred to this hospital. In these wards, the use of wide-spectrum antibiotics and cross-infection due to frequent contact between patients and personnel are common. In these wards, choosing invasive interventions is routine, and therefore these units have unavoidable risks of infection [4]. In a study performed in the neonatal ICU ward of a hospital in Turkey, device-associated HC-AIs were a particularly important problem, and therefore close monitoring regarding use of these devices is necessary [20].

In our study, BSIs and UTIs were the more frequent infections. The results of [21] were in line with our results. However [17], reported higher rates of respiratory and gastrointestinal tract infections. In the [3] study in Turkey, the most frequent HC-AIs were lower respiratory system infections, BSI and UTIs. [8]; in their study conducted in Turkey, found that fifth-minute Apgar test score, receipt of erythrocyte transfusion and surgery in neonates were associated with an increased risk of BSI. One reason for this contradiction may be the result of the climate and season in which the study was conducted.

Evidence showed that UTIs account for 6–18% of HC-AIs in paediatric wards in small and large teaching hospitals [5]. The rate of UTIs in our hospital was 18.03%, which lies within this range. In a study conducted in Canada, BSIs were the most frequent infection in neonates, infants and children [19]. In addition to the presence of an invasive device for BSIs and UTIs,

TABLE 1. Frequency of different types of healthcare-associated infections in different age groups

Type of nosocomial infection	Age group		
	0–4 years	5–14 years	Total
BSI	80 (37.38)	49 (34.75)	129 (36.34)
VASC	6 (2.80)	4 (2.84)	10 (2.82)
Pneumonia	2 (0.93)	6 (4.26)	8 (2.25)
SSI–SIP	15 (7.01)	8 (5.67)	23 (6.48)
SSI–SIS	32 (14.95)	26 (18.44)	58 (16.34)
SSI–VASC	4 (1.87)	2 (1.42)	6 (1.69)
SST–BURN	28 (13.08)	3 (2.13)	31 (8.73)
UTI	35 (16.36)	29 (20.57)	64 (18.03)
VAE	12 (5.61)	14 (9.93)	26 (7.32)
Total	214	141	355

Data are presented as n (%). BSI, bloodstream infection; SSI–SIP, surgical site infection – superficial incisional primary; SSI–SIS, surgical site infection – superficial incisional secondary; SSI–VASC, vascular surgical site infection; SST–BURN, skin and soft tissue burn; UTI, urinary tract infection; VAE, ventilator-associated event; VASC, arterial or venous infection.

**TABLE 2.** Frequency of different detected microorganism by gender and age group

Microorganism	Age 0–4 years			Age 5–14 years		
	Boy	Girl	Total	Boy	Girl	Total
<i>Acinetobacter</i>	2 (1.60)	3 (3.37)	5 (2.34)	4 (4.55)	0	4 (2.84)
<i>Escherichia coli</i>	16 (12.8)	23 (25.84)	39 (18.22)	14 (15.91)	13 (24.53)	27 (19.15)
<i>Enterobacter</i>	5 (4.00)	4 (4.49)	9 (4.21)	4 (4.55)	1 (1.89)	5 (3.55)
<i>Klebsiella</i>	11 (8.80)	11 (12.36)	22 (10.28)	10 (11.36)	13 (24.53)	23 (16.31)
Other	15 (12.00)	12 (13.48)	27 (12.62)	8 (9.09)	1 (1.89)	9 (6.38)
<i>Pseudomonas aeruginosa</i>	5 (4.00)	0	5 (2.34)	1 (1.14)	1 (1.89)	2 (1.42)
<i>Staphylococcus</i>	42 (33.60)	17 (19.10)	59 (27.57)	26 (29.55)	9 (16.98)	35 (24.82)
<i>Streptococcus</i>	6 (4.80)	6 (6.74)	12 (5.61)	5 (5.68)	2 (3.77)	7 (4.96)
<i>Candida</i>	4 (3.20)	2 (2.25)	6 (2.80)	2 (2.27)	3 (5.66)	5 (3.55)
<i>Serratia</i>	3 (2.40)	4 (4.49)	7 (3.27)	2 (2.27)	5 (9.43)	7 (4.96)
Unknown	16 (12.80)	7 (7.87)	23 (10.75)	12 (13.64)	5 (9.43)	17 (12.06)
Total	125	89	214	88	53	141

Data are presented as n (%).

low gestational age, low birth weight, vaginal birth type, presence and severity of the underlying disease, antibiotic consumption and longer hospitalization time can be considered to be major risk factors for the acquisition of HC-AIs in paediatric patients [6,14,8]. It should be noted that differences in characteristics of participating hospitals in the studies and the type of hospital (i.e. public, academic or private) can distort comparisons between hospitals. For example, paediatric ICUs have a higher rate of patients with HC-AIs compared to general paediatric medical wards.

The present study had some limitations. Firstly, the sensitivity of nosocomial infection surveillance system in Iran is relatively low and does not cover all patients [21,10]. Secondly, we did not have access to denominator information to calculate the incidence rate of HC-AIs by age group and gender.

## Conclusion

We found that hospitalized children in burn, haematology and ICU wards are the most susceptible to HC-AIs. In Besat Hospital, BSI and UTIs were the most frequent infections, and *E. coli* and *Staphylococcus* were the most commonly detected microorganism in girls and boys respectively. This information can help decision makers establish preventive strategies and implement effective and reliable plans.

## Conflict of interest

None declared.

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