ARTICLE ORIGINAL

Burden of Healthcare-associated infections in a Tunisian University Hospital in 2019

Ampleur des infections associées aux soins dans un centre hospitalo-universitaire tunisien en 2019

Olfa Ezzi, Mohamed Majoub, Asma Ammar, Nawel Dhaouadi, Yosr Ayedi, Radhia Helali, Wadiaa Bannour, Mansour Njah

CHU Farhat Hached de Sousse, Faculté de Médecine de Sousse, Tunsie.

ABSTRACT

Background: Healthcare-associated infections (HAI) represent a real threat to patient safety and their prevention should be a priority for any Health system. Prevalence surveys constitute one of the most common methods of HAI epidemiological surveillance to determine the burden of this problem.

Aim : The aim of this study is to determine the prevalence of HAI and its associated risk factors.

Methods: It is a cross-sectional survey, carried out at Farhat Hached University Hospital in 2019, over a period of nine days including all patients who had been hospitalized for at least 48 hours, in 21 clinical departments of our hospital. A single passage has been carried out by department.

Results: Of 373 patients included, a total of 66 patients experienced HAI, with a mean prevalence of 17.7%. In addition, four patients suffered from two types of HAIs. The overall prevalence of HAI in Farhat Hached University Hospital was 19%. Peripheral venous catheter associated infection (41.5%) was the most common type of infections recorded in this survey.

Patients admitted to a surgical ward were 4.6 times more likely to acquire HAIs. Patients admitted for more than 7 days were 4.57 times more at risk of developing HAIs. Exposure to peripheral venous catheter, to central venous catheter and to mechanical ventilation were among significant risk factors responsible for HAI with adjusted OR of 4.90, 10.65 and11.99, respectively.

Conclusion: Prevalence of HAI is high at our center. National strategy to address HAI should be implemented for better control **of HAIs.**

Key words: Healthcare associated infections, Prevalence, Risk factors, Tunisia.

RÉSUMÉ

Introduction: Les infections associés aux soins (IAS) représentent une menace réelle pour la sécurité des patients et leur prévention devrait être une priorité pour tout système de santé. Les enquêtes de prévalence constituent l'une des méthodes les plus courantes de surveillance épidémiologique des IAS dans le but de déterminer le fardeau de ce problème.

Objectif : Déterminer la prévalence de l'IAS et ses facteurs de risque associés.

Méthodes : Il s'agit d'une étude transversale descriptive, réalisée au CHU Farhat Hached en 2019, sur une période de 9 jours incluant tous les patients hospitalisés depuis au moins 48 heures, dans 21 services cliniques de notre hôpital. Un seul passage a été effectué par service.

Résultats : Sur 373 patients inclus, un total de 66 patients ont présenté une IAS, avec une prévalence moyenne de 17,7 %, quatre patients ont présenté plus qu'une IAS. La prévalence moyenne des IAS au CHU Farhat Hached était de 19 %. Les infections associées aux cathéters veineux périphériques (41,5%) représentaient l'IAS la plus fréquente. Les patients admis dans un service chirurgical étaient 4,6 fois plus susceptibles de contracter une IAS. Les patients hospitalisés pour plus de 7 jours étaient 4,57 fois plus à risque de développer une IAS. L'exposition au cathéter veineux périohérique, au cathéter veineux central et à la ventilation mécanique étaient parmi les facteurs de risque indépendants de l'IAS avec un OR ajusté, respectivement de 4,90; 10,65 et 11,99.

Conclusion : La prévalence de l'IAS est élevée dans notre CHU. Une stratégie nationale pour la prévention des IAS doit être instaurée pour un meilleur contrôle de ce problème de santé.

Mots clés: Infections associées aux soins, Prévalence, Facteurs de risque, Tunisie

Correspondance

Olfa Ezzi

CHU Farhat Hached de Sousse / Faculté de Médecine de Sousse

E-mail : olfa.ezzi@hotmail.com

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INTRODUCTION

Hospital-acquired infections (HAIs) are growing global public health problems(1,2) resulting in relatively larger incidence of patient mortality and disability and additional healthcare costs (3). They represent the most frequent adverse event to occur during hospitalization causing a real threat to patient safety(4). Continued improvements in patient safety depend on a comprehensive understanding of the local epidemiology of HAIs. The frequency of HAIs is substantially higher in Low and Middle Income Countries (LMICs), with an average prevalence of 15.5%, compared to prevalence of 7.1% and 4.5% in Europe and USA, respectively (1).

The principal goal of an infection prevention and control (IPC) program is to reduce the risk of HAIs among patients, health care workers, and environment, leading to a reduction in HAI-related morbidity, mortality, and avoidable costs (5). Because of limited resources, LMIC face significant and often insurmountable challenges to accomplish this goal. PC strategies provide cost-effective solutions as 20–30% of HAI are avoidable (6). However, as mentioned, the risks of HAIs appear considerably higher in LMICs, and the impact on patients, and health-care systems is considerable and typically greatly under estimated (7,8).

Timely data on the occurrence of HAI in hospitals are essential in response to an evolving epidemiologic situation. Internationally, prevalence surveys are widely used to estimate the burden of this type of infections (9). A prevalence survey is a surveillance tool that takes inventory of all active (existing and new) infections at a single point in time. Data from each patient are collected only once, on a single day or over the course of a set number of days (10). Prevalence is useful for measuring the burden of disease in a population, which may in turn inform decision-making regarding issues such as the allocation of resources and funding of research initiatives(11).Nevertheless, prospective active surveillance is the gold standard for controlling HAIs but incidence surveys are time-consuming and costly and require significant resources which hospitals can no longer afford. Prevalence surveys of HAI are valuable and low cost alternatives to incidence surveys (12).

Repeated point-prevalence surveys are a feasible method for the measurement of all HAIs in a hospital, and it is also crucial to estimate the burden of HAIs in teaching hospitals in a resource-limited country like Tunisia. It is important to prioritize areas that require interventions (13).

In Tunisia, up to now, only two nationwide point-prevalence surveys have been conducted. The first one was in 2005 and the second in 2012. The prevalence rate of HAIs was 6.9% and 7.7% respectively (14,15).

In our hospital, surveillance program based on regular point-prevalence surveys was established in 2000. The last study was undertaken in 2017.

The aim of this study is to determine the prevalence of HAI and its associated risk factors in Farhat Hached Teaching Hospital.

METHODS

This point-prevalence study was based at Farhat Hached university hospital in Sousse, a city located in East-central Tunisia, during ten days from the 11th to the 20th of November 2019.This survey was part of a HAI epidemiological surveillance program based, among others, on HAI regular prevalence surveys. Farhat Hached University is composed of 26 medical wards, 4 surgical wards and 9 laboratories. Our facility comprises 704 beds in 2019 and approximately 38216 admissions per year. In 2019, total staff practicing at this hospital is 1979, among them 1411 health professionals of whom1141 were paramedics and 231 were doctors. The study was conducted in 21 specialty departments including Neonatology, Cardiology, Pneumology, Pediatrics, Oncology, Psychiatry, General Surgery, Ear-Nose-Throat (ENT), Endocrinology, Gynecology (with high-risk and post-operative pregnancies), Ophthalmology, Dermatology, Hematology, Internal medicine, Rheumatology, Medical Intensive Care, Infectious Diseases, Anesthesia-Reanimation and Emergency. The criteria of the Centers for Disease Control and Prevention (CDC) Atlanta, USA (16)were used to define HAIs: surgical site infections (SSIs), pneumonia, bloodstream infections, urinary tract infections, gastrointestinal system infections, skin and soft tissue infections, bone and joint infections,...

The Clinical sepsis was only used to report primary bloodstream infection (BSI) in neonates and infants. It is not used to report BSI in adults and children: Patient <one year of age has at least one of the following clinical signs or symptoms with no other recognized cause: Fever (>38°C rectal), hypothermia (<37°C rectal), apnea, or bradycardia and blood culture not done or no organisms detected in blood and no apparent infection at another site and physician institutes treatment for sepsis HAI were defined using Centers for Disease Control (CDC) Atlanta USA criteria (16) and adapted to our local context.

Because of the difficulty in obtaining a microbiological documentation to all suspected infections, we considered as an infection the presence of clinical symptoms or antimicrobial treatment started after a clinical diagnosis of infection site, when other CDC criteria were satisfied. All consecutive patients admitted in these departments for at least 48 hours were included. A single passage has been carried out by department. The survey of each ward was completed within one day and data were collected from all sources available on the ward at the time of the survey, such as nursing notes, medical notes, temperature charts, drug charts, surgical notes and laboratory reports, in addition to patients interview. A pretested standardized questionnaire was used to collect data for determining the prevalence of HAI. Laboratory samples of urine, sputum, wound swabs, fecal specimens, throat swabs, nasal swabs, and blood samples were collected (17). Medical records and consultation with the person in charge of the patient were the gold standard for the identification of the infection. Data were collected based on the signs and symptoms and the specific site criteria, as recommended by CDC.

Collected data included patient's general characteristics : sex, age, underlying diseases, immunosuppression, obesity, neutropenia, coma, progressive cancer, prior hospitalization in the last 12 months, prior use of antibiotics in last 6 months, use of invasive devices such as gastric tube (GT), non-invasive ventilation(VNI), mechanical ventilation (MV), tracheotomy, central venous catheter (CVC), peripheral venous catheter (PVC) and urinary catheter (UC) in the last 7 days and in the same date of the study, prior endoscopy (last 7 days) and prothesis (last 12 months), laparoscopy and prior surgical intervention in the last 30 days and in the last 12 months.

All the data were analyzed using version 20.0 of the SPSS software. Categorical variables in univariate analysis were compared using Chi-squared and Fisher's exact tests. Student test was used to compare continuous variables.

Variables with p-value ≤20% in the univariate analysis were further analyzed in a multivariate analysis using a multiple logistic regression model. Maximum likelihood estimates of Odds ratios with their 95% confidence intervals were calculated. A p-value of <5% was regarded as a statistically significant difference.

RESULTS

A total of 373 patients were included in this point-prevalence survey. The sex ratio in our population was 0.85 and patients' age ranged from two days to 98 years with a median age of 39 (interquartile range: 12–59 years). Nearly 77.7% of patients were hospitalized in medical departments, among them 11% were hospitalized in intensive care unit. The main intrinsic risk factors were diabetes (22.8%), immunosuppression (18.2%) and obesity (9.9%). Moreover, the history of hospitalization during the last 12 months preceding the survey and the use of antibiotics during the last 6 months was observed, respectively in 33% and 31.9%.

Among extrinsic factors, PVC was the most frequent encountered medical device (55.5%) followed by surgical intervention (12.6%) and urinary probe (8%).

Concerning health status of patients undergoing surgery, 50% had an American Society of Anesthesiologists (ASA) grade 1 or 2 and only 37.5% of interventions were scheduled. The demographic and clinical characteristics of the patients included in the survey are summarized in Table 1.

Table 1. Demographic and clinical characteristics of patients (N=373)

Characteristics	Number of patients n (%)
Intrinsic Risk Factors	
Sex	
Male	172 (46.1)
Female	201 (53.9)
Age (years)	
<1	67 (18)
1-16	35 (9.4)
17-45	115 (30.8)
≥45	154 (41.3)
Ward type	
Medicine	171 (45.8)
Surgical ward	61(16.4)
Obstetrics and Gynecology	47 (12.6)
Neonates and Pediatrics	82 (22.0)
Intensive Care Units	12 (3.2)
Received antimicrobials in the last 6 months	**119 (31.9)**
Diabetes	85 (22.8)
Undernutrition	8 (2.1)
Neutropenia	20 (5.4)
History of hospitalization in the last 12 months	123 (33.0)
Hospital lengh of stay (days)	
2-7	190 (50.9)
>7	183 (49.1)
Extrinsic Risk Factors	
Peripheral venous catheter	207 (55.5)
Surgical intervention	47(12.6)
Central venous catheter	29 (7.8)
Urinary catheter	22 (5.9)
Mechanical Ventilation	17 (4.6)
Gastric Tube	30 (8.0)

A total of 66 patients experienced HAI, with a prevalence of 17.7% (95% CI [13.9 ; 21.5]). In addition, four patients suffered from two types of HAIs. The overall prevalence of HAI in Farhat Hached University Hospital was 19% (95% CI [15% ; 23%]). PVC infections (41.5%) were the most common type of infections recorded in this survey, followed by clinical sepsis (17.1%) and surgical site infections (12.8%) (Table 2).

Table 2. Proportion of specific site infections among Hospital Acquired Infections in Farhat Hached Teaching Hospital of Sousse, Tunisia (n=70)

Characteristics		Number	Percentage (%)	95% CI
PVC infections		29	41.5	[39.7;43.3]
Clinical sepsis		12	17.1	[8.3;25.9]
Surgical site infections		9	12.8	[5.6;20]
Pneumonia	with MV	5	11.4	[4.1;18.7]
	without MV	3		
Gastrointestinal system		3	4.2	[1.9;7.5]
Urinary tract infections (catheter associated)		2	2.9	[0;6.8]
Blood stream infections		2	2.9	[0;6.8]
Others infections (Skin and soft tissue infections, Bone and joint infections)		5	7.2	[1.6;12.8]
Total		70	100	-

VM : Mechanical ventilation; PVC : Peripheral venous catheter

Among 70 HAI detected, 27 (38.6%) microbiological samples have been carried out. Microorganisms were identified for only eight HAI: Staphylococcus aureus (2/8), Pseudomonas aeruginosa (1/8), Acinetobacter baumanii (1/8), Enterobacter cloacae (1/8) and Candida albicans (3/8).

Antibiotics were given to 45 infected patients (68.2%) on the day of the survey.

The multiple logistic regression model for HAIs showed that, compared with women,males were more likely to acquire HAIs (AOR: 2.92, 95% CI [1.43 ; 5.98]).

Patients admitted to a surgical ward were 4.6 times more likely to acquire HAIs compared to those admitted to a medical ward (AOR: 4.58, 95% CI [1.98 ; 10.61]).

Patients admitted for more than 7 days were 4.57 times more at risk of developing HAIs (AOR: 4.57, 95% CI [2.22–9.40]).

Exposure to CVP (adjusted OR of 4.90, 95% CI [2.24 ; 10.70]), exposure to CVC (adjusted OR of 10.65, 95% CI [2.76 ; 41.03]) and exposure to mechanical ventilation adjusted (OR of 11.99, 95% CI [1.23 ; 117.09]) were among significant risk factors responsible for HAI in our hospital (Table 3).

Table 3. Predictive factors for the occurrence of HAI in Farhat Hached Teaching Hospital of Sousse, Tunisia (n=373)

	HAI		Univariate analysis		Multivariate analysis	
	No	**Yes**	**Crude OR [95% CI]**	**p-value**	**Adjusted OR [95% CI]**	**p-value**
Sex						
Male	127	45	3.03 [1.72 ; 5.3]	10^{-3}	2.92 [1.43 ; 5.98]	10^{-3}
Female	180	21	1		1	
Age (years)					-	-
<1	47	20	3.65 [1.65 ; 8.08]	10^{-3}		
1-16	26	9	2.97 [1.1 ; 7.8]	0.02		
17-45	103	12	1	-		
≥45	129	25	1.66 [0.7 ; 3.4]	0.17		
Ward type						
Medicine	153	18	1	-	1	
Surgical	42	19	3.84 [1.85 ; 7.97] 1.01	10^{-3}	4.58 [1.98 ; 10.61]	10^{-3}
Obstetrics and gynecology	42	5	[0.35 ; 2.88]	0.98	3.49 [1.01 ; 12.00]	0.05
Neonates and Pediatrics Intensive Care	59	23	3.31 [1.67 ; 6.58]	10^{-3}	1.40 [0.60 ; 3.30]	0.44
Units	11	1	0.77 [0.09 ; 6.33]	0.8	0.02 [0.001 ; 0.58]	0.02
Received antimicrobials in the last 6 months	90	29	1.9 [1.09 ; 3.25]	0.02	-	-
Undernutrition_	5	3	2.87 [0.67 ; 12.34]	0.15	-	-
Hospital length of stay (days)						
2-7	171	19	1			
>7	136	47	3.11 [1.62 ; 6.23]	10^{-3}	4.57 [2.22 ; 9.40]	10^{-3}
CVP	158	49	2.71 [1.5 ; 4.9]	10^{-3}	4.90 [2.24 ; 10.70]	10^{-3}
CVC_	16	13	4.46 [2.02 ; 9.81]	10^{-3}	10.65 [2.76 ; 41.03]	10^{-3}
Mechanical Ventilation	7	10	7.65 [2.8 ; 20.9]	10^{-3}	11.99 [1.23 ; 117.09]	0.03
Surgical intervention in the last month	32	15	2.52 [0.51 ; 8.1]	0.06	-	-

DISCUSSION

In this survey, the prevalence of HAIs among patients was 17.7 %, and the overall prevalence of HAIs in Farhat Hached University Hospital was 19%.

This finding was higher than that observed in almost all other point-prevalence studies conducted in developed (18–21) and developing countries (22–25). However, this rate appears to be of the same magnitude as that reported from some developing countries: 19.1% found in Albania (26) and Benin (27),18.6% in Turkey (28), 17.8% in Morocco (29) and 17.9% in Habib Bourguiba University Hospital, Tunisia in 2005 (30).

This high prevalence can be explained on the one hand by the lack of structured and mandatory infection control programs in Tunisian hospitals, and on the other hand by the high occupancy rate and the academic structure of our hospital whereby patients undergo advanced medical and surgical procedures. In addition, even though the prevalence surveys are a rapid, inexpensive, and easy way to estimate the HAI burden, they are less acceptable and less reliable than prospective surveillance studies. Moreover, the duration and conditions under point-prevalence studies, seasonal variations, and possible epidemic peaks can influence prevalence rates to an unknown extent (29). However, we conducted a multi-step validation of HAIs which increased the detection of infected patients. First, our investigators not only collected information about HAIs from medical records but also visited and interviewed these patients. Afterwards, the team of validators also visited all patients with suspected infection. A specialist in infection control then performed the final step of validation after reviewing microbiological, biochemical and radiological examinations.

Our findings indicated that PVC associated infection were the most common HAIs, followed by clinical sepsis (17.1%), surgical site infections (12.8%) and pneumonia (11.4%).

PVC associated infections were the leading HAIs with a proportion of 41.5%. This finding is consistent with a previous prevalence survey conducted in 2012in Farhat Hached University Hospital wherePVC was the most prevalent identified HAI (42.2%) (31). Our findings are different from those reported in literature : Lower respiratory tract infections (32–35),urinary tract infections (12,29,19,30,36) and surgical site infections(13,26,37,38)were the most prevalent HAI in most published studies worldwide.

Given the high prevalence of intravascular catheter related infections in our teaching hospital, education programs and training have to be carried out regarding the indications for intravascular catheter use, proper procedures for the insertion and maintenance of intravascular catheters, and appropriate infection control measures to prevent intravascular catheter-related infections(39,40). These measures should be associated with periodically assessment of knowledge and adherence to guidelines for all professionals involved in the insertion and maintenance of intravascular catheters (41,42).

On another level, microbiological documentation was available only for 11.4% of infected patients. This rate is lower than that reported in the literature (41-86%)(33)and may lead to overestimation of the infection rate, overuse of broad-spectrum antibiotics, and increased mortality when the prescribed antibiotics are inadequate(29,30). Several factors may explain the low number of performing cultures in our study. Firstly, because of limited health care resources in Tunisian hospitals, specimen cultures are often taken in our hospital when empiric antibiotic therapy fails. It is then uncommon practice to obtain cultures when an infection is clinically suspected especially PVC associated infection, the most common type of infection in our study. Secondly, the study design did not allow us to analyze the actual number of specimens cultured; therefore, it is difficult to determine whether this low rate was due to insufficient laboratory capacity or to insufficient practice. Furthermore, other prevalence studies from developing countries conducted in University Hospitals reported a similarly low availability of microbiology reports (30,37).

Statistical analysis showed that hospital stay for more than 7 days, admission in surgery ward and invasive devices are associated with an increased risk of HAI, which is in agreement with earlier publications (29,30,36). Thus, potential interventions to reduce the risk of PVC associated infection have already been conducted in our hospital, including continuing healthcare professional education regarding indications for intravascular catheter use, proper procedures for the insertion and maintenance of intravascular catheters, and appropriate infection control measures to prevent intravascular catheter-related infections.

The survey focused on a relatively small number of risk factors for HAIs. In addition, few data on antibiotic usage were available. We suggested that future surveys should collect more data on antibiotic usage.

The major limitation of this study was its design; cross sectional study are susceptible to many biases and associations identified may be difficult to interpret.

Furthermore, one-day point prevalence studies tend to overestimate persistent infections and underestimate infections with shorter durations.

Prospective, continuous monitoring of HAIs can help clinicians to better identify areas that need improvement and to demonstrate effectiveness of interventions (43).

Despite these limitations, findings from this point-prevalence survey can provide clues for the development of future interventions, help practitioners to prioritize interventions, and target future incidence surveillance to reduce the risk of infection in our healthcare facility.

CONCLUSION

HAI prevalence in Farhat Hached University Hospital was rather higher than described in similar studies. This might be at least partially affected by methodological differences and differences in patient populations. However, the fact that the proportion of device-associated infections in our study was relatively high does point to a larger proportion of HAI being preventable and confirm the need for more efficient programs to decrease HAI prevalence. Our study emphasizes the urgent need for a nationwide for HAI surveillance to provide the proper tools to prevent and manage HAIs in hospitalized patients.

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