ORIGINAL ARTICLE

Prevalence and associated factors of healthcare associated infections in Habib Bourguiba university hospital, Sfax, Tunisia, 2024

Prévalence des infections associées aux soins et leurs facteurs associés dans le Centre Hospitalier-Universitaire Habib Bourguiba Sfax Tunisie, 2024

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Abstract

Introduction-Aim: Healthcare-associated infections (HCAIs) are a major public health issue due to significant related morbidity, mortality and increased costs. This study aimed to determine the prevalence of HCAI in a Tunisian university hospital in 2024 and to determine its associated factors.

Methods: A point-prevalence study was conducted from 10th to 22nd of June 2024 in Habib-Bourguiba hospital in Sfax-Tunisia. It included all patients hospitalised for a minimum of 48 hours.

Results: Of 227 patients, 40 patients had at least one HCAIs, giving a HCAIs prevalence of 17.6% (95%CI 12.8-22.5). The HCAIs prevalence was 46.7% (95%CI 29.2-65.4) in ICU (Intensive care units) versus 13.9% (95%CI 8.9-19.6) in non-ICU.

Urinary tract infections (40.6%) were the most common, followed by respiratory tract infections and surgical site infections (both 17.4%). The main identified microorganisms among HCAIs were Pseudomonas Aeruginosa (19.3%), Klebsiella Pneumoniae and Proteus Mirabilis (both 14.8%).

Factors independently associated with having at least one HCAI were admission in ICU (aOR=5.7, 95%CI: 2.4-13.3), obesity (aOR = 4.2, 95%CI: 1.5-12.1), age 60 years and older (aOR=2.7, 95%CI: 1.1-7.4), antibiotic use in the past six months (aOR = 2.5, 95%CI: 1.1-5.7), and the number of days of peripheral venous catheter (aOR = 1.6, 95%CI: 1.1-2.5).

Conclusion: Our study fills a critical gap in the literature on the national and regional levels. It revealed a high prevalence of HCAI in Habib-Bourguiba Hospital compared to similar studies in other regions. We, therefore, recommend setting up operational hospital hygiene programmes for healthcare professionals in order to create a culture of patient safety.

Key words: Healthcare associated infections, Surveillance, Infection Prevention

Résumé

Introduction-Objectif: Les infections associées aux soins (IAS) constituent un problème majeur de santé publique en raison de l'importance de la morbidité et de la mortalité associées et de l'augmentation des coûts. En Tunisie, les dernières études de prévalence des IAS publiées au niveau national et régional (à Sfax-Tunisie) datent respectivement de 2005, 2012, 2017 et 2019. Cette étude visait à déterminer la prévalence des IAS dans un hôpital universitaire tunisien en 2024 et à déterminer les facteurs associés.

Méthodes: Une étude de prévalence ponctuelle a été réalisée du 10 au 22 juin 2024 à l'hôpital Habib-Bourguiba de Sfax-Tunisie. Elle a inclus tous les patients hospitalisés pour une durée minimale de 48 heures.

Résultats: Nous avons colligé 227 patients, 40 ont eu au moins une IAS, ce qui donne une prévalence d'IAS de 17,6 % (IC 95 % 12,8-22,5). La prévalence des IAS était de 46,7% (95%CI 29,2-65,4) dans les unités de soins intensifs contre 13,9% (95%CI 8,9-19,6) dans les autres unités.

Les infections urinaires (40,6 %) étaient les plus fréquentes, suivies des infections des voies respiratoires et des infections du site opératoire (17,4 % dans les deux cas). Sur l'ensemble des 69 IAS, 66 infections (95,7 %) ont été documentées microbiologiquement. Les principaux micro-organismes identifiés parmi les IAS étaient Pseudomonas Aeruginosa (19,3 %), Klebsiella Pneumoniae et Proteus Mirabilis (14,8 % chacun) et 20,5 % étaient toto-résistants.

Les facteurs indépendamment associés aux IAS étaient l'admission en unités de soins intensifs (aOR=5,7, 95%CI : 2,4-13,3), l'obésité (aOR = 4,2, 95%CI : 1,5-12,1), l'âge de 60 ans ou plus (aOR=2. 7, 95%CI : 1.1-7.4), l'utilisation d'antibiotiques au cours des six derniers mois (aOR = 2.5, 95%CI : 1.1-5.7), et le nombre de jours de cathéter veineux périphérique (aOR = 1.6, 95%CI : 1.1-2.5).

Conclusion: Notre étude comble une lacune critique dans la littérature au niveau national et régional. Elle a révélé une prévalence élevée des IAS à l'hôpital Habib-Bourguiba par rapport à des études similaires dans d'autres régions. Nous recommandons donc la mise en place de programmes opérationnels d'hygiène hospitalière pour les professionnels de la santé afin de créer une culture de la sécurité des patients.

Mots clés: Infections associées aux soins, Surveillance, Prévention

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Introduction

Healthcare-associated infections (HCAIs), previously known as nosocomial or hospital-acquired infections, remain a significant concern for patient safety, representing a persistent challenge for healthcare systems worldwide (1).

In fact, according to the French Technical Committee on Nosocomial Infections and Healthcare-Related Infections (CTINILS 2007), an infection is classified as healthcare-associated if it occurs in the context or after medical care of a patient (diagnostic, therapeutic, palliative, preventive or educational care) and if it was neither present nor incubating at the start of the care (2).

They represent a threat not only to patient safety but also include infections contracted by healthcare workers, and visitors in various healthcare settings, including hospitals, clinics, and long-term care facilities (3). The burden of HCAIs is a critical issue given their increasing morbidity, mortality, and costs globally and particularly among developing countries (1,3,4).

According to the World Health Organization (WHO), HCAIs lead to Anti-Microbial Resistance (AMR), which has substantial financial costs in addition to their direct effects on population health, such as longer hospital stays (5).

To lower the rate of HCAIs, many hospitals have implemented strong preventive policies, as well as infection tracking and surveillance systems (3,6–8). In Tunisia, HCAIs are not a mandatory notifiable disease on national level. Yet, descriptive and analytical epidemiology of HCAIs in Tunisia were quantified via prevalence surveys limited in number. In fact, two national surveys on the prevalence of nosocomial infections have been carried out, NosoTun2005 and NosoTun2012 (9,10). On regional level, some point-prevalence surveys (PPSs) were carried out in university hospitals, adopting the protocol of the national survey of 2005 in order to ensure comparability with other university hospitals (11–13). In the Habib Bourguiba University Hospital (HBUH), the latest PPS indicated a prevalence of 9.9% in 2019 during the pre-COVID-19 era (14).

The HBUH, a mainly surgical vocation hospital in the governorate of Sfax in Tunisia, was put into service in 1985. Yet, the creation of the Hospital Hygiene department (HHD) in this university hospital was in 2021, 38 years later. HCAIs surveillance system was quite challenging to implement in this hospital. Prevalence studies have been done in HBUH since 2017, showing HCAIs prevalence trends and analysing its associated factors (13,14). In fact, effective surveillance is a cornerstone against HCAIs, as it provides critical data that informs infection control practices, monitors trends, and measures the effectiveness of interventions such as training (3,7,8).

As a continuation of the HCAIs prevalence studies, the HHD conducted a PPS in HBUH in June 2024. The objectives of this study were to determine HCAIs prevalence in HBUH in 2024 and to identify factors associated with HCAIs occurrence.

Methods

It was a PPS conducted by the HHD from 10 to 22 June 2024 in the HBUH in Sfax, Tunisia. The investigators were medical doctors affected at the HHD of the HBUH.

The HBUH compromises 16 inpatient hospital departments with a capacity of 562 beds. We included all patients “present on the day of the survey” in the above-mentioned participating departments and hospitalized for at least 48 hours at the HBUH. The term ‘present on the day of the survey’ corresponds to the actual presence of the patient in the department when the investigator visited, including any patient absent from their bed on the day of the survey for further examinations, surgery, or specialist consultation. Any patient who met the above inclusion criteria and was discharged on the day of the study was also included in the survey as long as the patient was still in the department during the investigator’s visit. We did not include patients with a hospital stay of less than 48 hours and patients admitted to outpatient departments.

To determine the sample size for PPS, level of confidence, precision, variability of the data, and anticipated loss (four parameters) are required. In the 2019 PPS conducted in HBUH, the prevalence of HCAI was 9.9% (13,14). These calculations underscored the importance of using a minimum sample size greater than 139 (and 155 if 10% anticipated loss is added) when conducting PPS among hospitalized patients in HBUH for a precision of 0.05.

HCAIs are defined as infections that become clinically or microbiologically apparent 48 hours or more after hospital admission in inpatient care. Surgical site infections (SSIs) are considered HCAIs if they occur within 30 days of surgery or within 1 year of surgery if an implant, prosthesis, or prosthetic device is placed (2,15). However, the Hospital Hygiene Operational Team discussed the plausibility of the association between the operation and the infection in each case, taking into account all variables involved.

The general director of the hospital and all heads of departments were informed about the HCAIs PPS two weeks in advance. The survey was conducted from the 10th to 22nd of June 2024. Each ward included was surveyed only once on a single day (one-day pass per department). Every filled investigation form was validated daily to ensure data completeness and to discuss infections one by one if they were HCAIs.

Data entry and analysis were performed using SPSS version 25 software. We described the study population and its distribution according to the measured variables. Quantitative variables were presented as mean ± standard deviation if normally distributed or as median with interquartile ranges if else. The normality of the quantitative variable distribution was done using the Kolmogorov-Smirnov test. Qualitative variables were presented as numbers and percentages. The prevalence of HCAIs was presented with their 95% confidence intervals (95%CI).

To determine factors associated with HCAI occurrence, we performed a univariate comparative statistical analysis. Statistical significance for frequencies was determined using the Chi-square test or Fisher's exact test in cases where the conditions for applying the chi-square test were not met. We calculated the crude Odds Ratio (OR) and their 95%CI to quantify the association between the variable of interest "HCAI" and the various different factors. For the quantitative variable, we used the Student's T-test. We then performed a multivariate analysis to seek factors independently associated with HCAIs. This analysis was performed using binary logistic regression. We used stepwise regression to select the variables to include in the model that were associated with the dependent variable "Having at least one HCAI" in the univariate analyses with significance levels <0.20. the strength of association between the factors studied and the dependent variable was estimated by calculating adjusted Odds Ratios (aOR) and their 95%CI. We adopted a conservative threshold of 5%.

This study followed the principles of the declaration of Helsinki and was approved by the Institutional Review Board of the Habib Bourguiba university hospital.

All included patients gave consent to use their information for the study (we got parent's consent for patients aged less than 18 years old). Anonymity was ensured from data entry to the publication of the results. During analysis, patient identities (including their hospital ID) were eliminated. Each patient's file was assigned a distinct survey number.

Results

In total 227 patients hospitalized in 16 departments were included in this PPS. The mean age of the included patients was 52.71±21.61 years. We noted that 42.3% (n=96) were aged 60 years old or above and 9.7% (n=22) were aged less than 18 years old. The study population included 124 males (54.6%) with a sex ratio (M/F) of 1.2. Among our study population, 13.2% (n=30) were hospitalised in ICUs departments. In total, 24.2% patients (n=55) had diabetes, 18.1% (n=41) had immune depression and 7.0% (n=16) were obese. Besides, and 17.2% patients (n=39) were active tobacco users.

The median hospital length of stay (LOS) was six days (IQR= [3 - 15]). Of all included patients, 43.6% (n=99) had a history of hospitalisation in the last three months, 21.1% (n=48) were transferred before being admitted to the concerned ward and 19.4% patients (n=44) used antibiotics in the last six months

A total of 84 patients (37.0%) had undergone surgery in the 30 days prior to the survey, and 37 (38.5%) patients benefited from prosthetic equipment in the last year prior to the survey.

Table 1 summarises the distribution of patients by invasive medical devices. The median number of days of having an invasive medical device was five days for the urinary catheterisation (IQR= [3-9.5]), six days for peripheral venous catheters (IQR= [3 -12]), 9.5 days for central venous catheters (IQR= [4-15]) and the median number of days for mechanic ventilation was nine days (IQR= [3-27]).

Table 1. Distribution of patients having invasive medical devices by wards

Invasive medical device	Total (N=227)		Unit				p
			ICU (n=30)		Non-ICU (n=197)		
	n	%	n	%	n	%	
Actual urinary catheterisation	78	34.4	28	93.3	50	25.4	***<10⁻³***
Urinary catheterisation within 7 days before onset	49	21.6	16	53.3	33	16.8	***<10⁻³***
Peripheral venous catheter	167	73.6	30	100.0	137	69.5	***<10⁻³***
Central venous or arterial catheter	26	11.5	21	70.0	5	2.5	***<10⁻³***
Mechanical ventilation	32	14.1	23	76.7	9	4.6	***<10⁻³***
Tracheotomy	18	7.9	11	36.7	7	3.6	***<10⁻³***
Nasogastric tube	27	11.9	19	63.3	8	4.1	***<10⁻³***
Haemodialysis	6	2.6	3	10.0	3	1.5	***0.007***
Drainage	28	12.3	6	20.0	22	11.2	0.171

ICU= Intensive care unit, **n**= number

Global healthcare-associated infection prevalence: Among the 227 patients meeting the inclusion criteria, 40 had at least one HCAI with a global HCAIs prevalence of 17.6% (95%CI = [12.8% - 22.5%]).

Of the 40 infected patients, 13 (32.5%) had more than one HCAI. The total number of HCAIs in all infected patients was 69, as 30.4 HCAI per 100 patients (95%CI= [24.2 - 36.6]).

The HCAI prevalence was 46.7% (95%CI [29.2% -65.4%]) in ICU and 13.2% (95% CI [8.6% -17.9%] in non-ICU (hospitalisation units) with a significant difference (p≤10-3).

The mean age of patients with HCAIs was 57.38± 16.75 years old. Among them, 21 (52.5%) were males.

HCAIs Prevalence was 16.9% (95%CI= [10.5-24.0]) among males and 18.4% (95%CI= [11.2-26.3]) among females (p=0.766).

Characteristics of the healthcare-associated infections recorded: HCAI distribution by anatomic site revealed that healthcare-associated urinary tract infections (UTI) were the most common (n=28, 40.6%), followed by respiratory tract infections and SSIs (both n=12, 17.4%), bloodstream infections (n=8, 11.6%) and catheter-associated infections (n=4, 5.8%).

Micro-organisms associated with documented healthcare-associated infections: Of all 69 HCAIs, 66 infections (95.7%) were microbiologically documented. The total number of microorganisms documented in HCAIs was 88 microorganisms. The main identified microorganisms among HCAI were Pseudomonas Aeruginosa (19.3%), Klebsiella Pneumoniae and Proteus Mirabilis (both 14.8%), and Escherichia coli (10.2%).

As for the antimicrobial resistance patterns of the micro-organisms found, 20.5% were Pan-Drug-resistant (PDR), 13.6% were Extremely-drug-resistant (XDR), 19.3% were Multi-Drug-resistant organisms (MDRO) and 46.6% were sensitive.

Factors Associated with healthcare associated infections: After multivariate analysis, as illustrated in Table 2, factors independently associated with having at least one HCAI were being admitted in an ICU (aOR = 5.682, 95%CI [2.404 -13.333], p ≤10-3), obesity (aOR = 4.195, 95%CI [1.460 -12.052], p=0.008), paediatric and geriatric age (aOR = 2.747, 95%CI [1.027-7.353], p=0.044), antibiotic use in the past six months (aOR = 2.475, 95%CI [1.063 – 5.747], p=0.036), and the number of days of peripheral venous catheter (aOR = 1.617, 95%CI [1.041 -2.511], p=0.032)

Table 2. Factors associated with having at least one Health-care associated infection : Univariate and multivariable analysis

Factors	**Healthcare associated infection**		**OR**	**p**	**aOR**	**p**
	Yes n (%)	***No n (%)***	**[95% CI]**		**[95% CI]**	
Social demographic characteristics						
Age by classes						
<18 or ≥60 years old	23 (57.5)	86 (46.0)	**1.590 [0.797-3.16]**	**0.186**	**2.747 [1.027-7.353]**	**0.044**
18-60 years old*	17 (42.5)	101 (54.0)				
Gender						
Male	21 (52.5)	1.3 (55.1)	1.109 [0.560 – 2.199]	0.766		
Female*	19 (47.5)	84 (44.9)				
Hospitalisation :						
History of hospitalisation in the last 3 months	24 (60.0)	75 (40.1)	**2.240 [1.116 – 4.497]**	***0.021***		
Hospitalisation in ICU	14 (35.0)	16 (8.6)	**5.755 [2.516 -13.164]**	***<10⁻³***	**5.682 [2.404-13.333]**	***<10⁻³***
History of inter-hospital or intra-hospital transfer	15 (37.5)	33 (17.6)	2.800 [1.333- 5.883]	***0.005***		
Hospital length of stay (N=227) (median [IQR])	19 [9 – 38.5]	5 [2 -12]	1.044 [1.024-1.064]	***<10⁻³***		
History of antibiotic use in the past 6 months	12 (30.0)	32 (17.1)	2.076 [0.955 – 4.510]	0.061	**2.475 [1.063 – 5.747]**	**0.036**
Habits and comorbidities:						
Diabetes	13 (32.5)	42 (22.5)	1.662 [0.789 – 3.503]	0.179		
Immune-depression	5 (12.5)	36 (19.33)	0.599 [0.219 – 1.637]	0.314		
Obesity	7 (17.5)	9 (4.8)	**4.195 [1.460 – 12.052]**	**0.004**	**4.195 [1.460 – 12.052]**	**0.004**
Active Tobacco use	9 (22.5)	30 (16.0)	1.519 [0.657 – 3.514]	0.326		
Invasive medical devise use during the actual hospital stay:						
Actual urinary catheterisation	31 (77.5)	47 (25.1)	10.260 [4.554 – 23.118]	***<10⁻³***		
Urinary catheterization in days (M ± SD)	9 [5.75 -15]	3 [2 -5]	1.370 [1.163-1.615]	***<10⁻³***		
Urinary catheterisation within 7days before onset	27 (67.5)	22 (11.8)	15.577 [7.018 -34.573]	***<10⁻³***		
Peripheral venous catheter	39 (97.5)	128 (68.4)	17.977 [2.412 – 133.997]	***<10⁻³***		
Days of **Peripheral venous catheter** (M ± SD)	11 [7-15]	4 [2-8.75]	**1.106 [1.042 – 1.175]**	***<10⁻³***	**1.106 [1.041 – 2.511]**	**0.032**
Central venous or arterial catheter	16 (40.0)	10 (5.3)	11.800 [4.808- 28.959]	***<10⁻³***		
Days of **central venous or arterial catheter** (n= (M ± SD)	14 [9.25-17.25]	4 [2.25 -8.25]	1.445 [1.058 – 1.974]	***0.003***		
Mechanic ventilation	16 (40.0)	16 (8.6)	**7.125 [3.157 – 16.082]**	***<10⁻³***		
Days of **mechanic ventilation** (M ± SD)	26 [10.75-35]	3 [2-7]	**1.374 [1.046 – 1.806]**	***0.001***		
Haemodialysis	3 (7.5)	3 (1.6)	4.973 [1.966 – 25.606]	***0.035***		
Drainage	8 (20.0)	20 (10.7)	2.008 [0.846- 5.150]	0.115		

n= number, **OR**= Odds Ratio; **CI**= Confidence interval, **M**=Mean, **SD**= Standard deviation, **IQR**= Interquartile range

Discussion

HCAIs have received extensive coverage in the literature and are currently a significant public health problem (1). In addition to causing a great amount of morbidity, these infections also have a sizable fatality rate(16,17). To take and assess the most effective control actions, a thorough understanding of the epidemiology of HCAIs is necessary (15).

This current PPS study was a continuity to other HCAI PPS studies made in HBUH. Through this continuity and regularity in studies, we could track trends over time, helping identify changes in infection rates and emerging risks (7,8,15).

This was a cost-effective PPS. It showed the post-pandemic (COVID-19) changes in HCAI trends. Through the HHD, This PPS study had an influence on current healthcare policies on infection control. The analytical part of this PPS, strengthened the study by uncovering factors associated with acquiring a HCAI, which can inform targeted prevention strategies (7,8). In fact, our findings had an immediately applied responses to reduce HCAIs rates or improve infection control practices in HBUH and this through training healthcare workers about factors associated with HCAIs occurrence. This PPS enhanced understanding of the dynamics of HCAIs and helped drive actionable interventions (7).

The prevalence of healthcare associated infections in Habib Bourguiba University hospital had a notifiable evolution in time. This HCAIs PPS took place in the HBUH in June 2024. In this same hospital, during the last decade, four HCAI PPS took place (13,14). Prevalence from 2023 was not published yet during our study period (data collection, analysis, and writing the manuscript). Table 3 summarises the evolution of HCAI prevalence in HBUH from 2017 to 2024.

As elaborated in Table 3, there was a high increase in the HCAI prevalence in HBUH compared to previous years. In fact, the COVID-19 pandemic had widespread effects on global healthcare systems, including a marked increase in the prevalence of HCAIs (11,18,19). Our study showed an increase in HCAI prevalence from 2019 (pre-COVID-19 era) to 2024. This might be explained by the release of the use of personal protective equipment (PPE), the workforce shortage, the medical staff fatigue and the use of broad-spectrum antibiotics (18). In Tunisia, as elsewhere, the overuse of antibiotics during the pandemic increased the incidence of MDROs, which are a significant cause of HCAIs (11,12).

Table 3. Prevalence of healthcare-associated infections, Habib Bourguiba University Hospital, 2017-2024

Year	Number of eligible patients	Number of eligible patients with healthcare-associated infections	Healthcare-associated infections prevalence
2017	251	35	13.9%
2019	312	31	9.9%
2024*	227	40	17.6%

*Current study

The global HCAI prevalence in HBUH was 17.6%. The HCAI prevalence in HBUH was higher than the majority of low and lower-middle income countries, such as Morocco (10.1%), Libya (13.7%) and Nigeria (14.3%) (16,20,21). Our HCAIs prevalence was also higher than pooled prevalence from Africa (12.76%) and the Middle-East (11.2%) (22,23).

Our prevalence was very comparable to other Tunisian mainly surgical hospitals such as Sahloul de Sousse (HCAI prevalence 15.5 in 2020) (11). Tunisian hospitals that share both medical and surgical departments had a lower HCAI prevalence (Charles Nicolle Hospital de Tunis2018: 13%, Hedi Chaker de Sfax2017: 9.4%) (12,13).

The HCAIs prevalence in 2024 in HBUH was higher than in other studies led in time and in space. In fact, HBUH is a mainly surgical hospital compared to other polyvalent medical and surgical hospitals. In fact, HCAI prevalence tends to be higher in surgical departments (11,24). Other factors could explain the high HCAI prevalence in HBUH, such as the ICU and oncology departments catering to vulnerable patients and requiring more invasive methods, which would be at the origin of the high infection rates.

In our study, HCAI prevalence was significantly higher in ICU departments (46.7%) than non-ICUs (13.2%). Other Tunisian surgical hospitals such as Sahloul de Sousse showed a higher prevalence in ICU departments (44.3%) (11) and many other studies showed a similar result (4,12–14,21–23). This might be explained by the severity of the illness, invasive procedures used, frequent contact, the complexity of the environment, longer LOS and the frequent use of antibiotics.

As for the characteristics of patients with healthcare associated infections, in this present study, there was no significant difference between gender in HCAIs prevalence. It was comparable to other Tunisian national and regional studies (10,12–14). Our study showed that the three most frequent HCAI sites, were UTI, respiratory infections, and SSI. Our results were consistent with those in the literature, although the importance of infection sites in terms of frequency and order sometimes differed between countries (12–14,16,21,22). Although our study was done in a mainly surgical hospital, the most frequently reported HCAI was not SSI but UTI.

As about the resistance patterns of micro-organisms involved in healthcare associated infections, with the emergence of MDRO, XDR and even PDR (which is a source of therapeutic impasse), mortality and considerable additional costs increased as well, especially for a low-income country (25,26).

The factors associated with the occurrence of healthcare associated infections showed a significant correlation with patient's age, comorbidities, antibiotic use and ICU admission. First of all, patients in ICU often require life-supporting treatments such as mechanical ventilation, central venous catheters, and urinary catheters. Additionally, the high-touch environment, combined with prolonged hospital stays and invasive procedures, creates a setting where pathogens spread easily (22,27). Added to the resistance patterns of these microorganisms due to the frequent antibiotic use in ICUs. Similar to our findings, an African meta-analysis demonstrated that the presence of a peripheral vascular catheter doubled the risk of having HCAI (22).

Also, obesity multiplied the occurrence of HCAI by four times in this present study. Indeed, Obese patients are at higher than normal risk for HCAIs such as pneumonia and surgical site infections (28). It is, in fact, associated with an inflammatory condition that leads to an immune-deficient state (28,29). Other recent studies shared this same result about obesity and HCAI occurrence (22,28).

Likewise, advanced age can increase the risk of HCAI. This is because age can influence immune system function, physiological resilience, and antibiotic use (4). Both the very young and the elderly are particularly vulnerable to HCAI due to these age-related changes and healthcare exposures (17,20).

Antibiotic use, particularly broad-spectrum antibiotics, can contribute to HCAI occurrence in hospitalised patients. While antibiotics are essential for treating bacterial infections, their overuse or misuse can disrupt the balance of normal flora in the body, leading to overgrowth of resistant or opportunistic pathogens (26,30). In addition to AMR, prolonged or inappropriate antibiotic use also increases the risk of infections that are difficult to manage, making infection control in healthcare settings more challenging (10,12,31).

In this present study, antibiotic use in the last six months increased the risk of HCAI by two folds. Similar to our findings, a study in Tunisia showed the evolution of AMR from 2010 to 2016 (26). ECDC reports also showed that antibiotic use is related to HCAIs (4).

Conclusion

HCAIs remain a serious and frequent complication in healthcare facilities, hampered by the growing threat of microbial resistance to antibiotics, the resulting additional costs and the medico-legal aspects involved. The experience of developed countries in setting up and developing HCAI surveillance systems witnesses the effectiveness of surveillance as a means of prevention, making it possible to reduce HCAIs on the one hand and their possible consequences on the other. The objectives of this survey were to measure the global and specific prevalence of HCAI in the HBUH in the Sfax region, to study their characteristics and to identify the factors associated with HCAIs occurrence. Our findings made it possible to estimate the weight of HCAI in the HBUH on a given day. This problem affected almost two in ten hospitalised patients (17.6%). This survey was extremely instructive, particularly useful for raising awareness among healthcare professionals in all disciplines, as well as their patients, about the prevention of HCAIs, and of great to evaluate and guide the actions of current national programmes. The survey also demonstrated the importance of setting up a surveillance system to measure the incidence of HCAIs, targeting primarily the most frequent infections, such as those in ICU, urinary and respiratory tract infections, as well as SSIs. At the end of this study, we proposed certain recommendations, particularly for healthcare professionals. These recommendations were no more than actions incorporating measures that would enable the effective implementation of the HCAIs surveillance system, a policy that unfortunately faces cultural, financial, regulatory and organisational challenges. The strategic axes of this system were: awareness-raising, education and training for healthcare professionals, monitoring HCAIs in laboratories and reporting in case of outbreaks or in case of particular resistance profiles, limiting the transmission of infections through hygiene and sanitation measures and rationalising the use of antibiotics by drawing up and implementing standardised protocols.

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