The Prevalence of Health Care-Associated Infections and Risk Factors in a University Hospital

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Key Words: *health care-associated infections; risk factors; prevalence; antibiotics.*

Summary. *The aim of the study was to evaluate the prevalence of health care-associated infections, risk factors, and antimicrobial use.*

Material and Methods. The study was carried out as a point-prevalence study in acute care wards, i.e., intensive care, surgical, and medical wards, at Vilnius University Hospital Santariškių Klinikos in April 2010. The study variables included the patient's general data, indwelling devices, surgery, infection and its microbiological investigation, and antimicrobial use. All the variables that were logically related or had a P value of <0.25 in the univariate analysis were included in the stepwise logistic regression in order to study the factors potentially associated with health care-associated infections.

Results. A total of 731 patients were surveyed. The overall prevalence rate of health care-associated infections was 3.8%. The prevalence of health care-associated infections differed by hospital wards (range 0.0%–19.2%). The lower respiratory tract (32.2%), urinary tract (28.5%), and surgical site infections (32.1%) were the most common health care-associated infections. Moreover, 89.3% of the cases of health care-associated infections were microbiologically investigated. Staphylococcus aureus (28.6%) and Escherichia coli (19.1%) were the most frequently isolated microorganisms. The use of one or more invasive devices was recorded in 332 patients (45.4%). Of the surveyed patients, 20.2% received antimicrobial agents. The most commonly prescribed antimicrobial agents were fluoroquinolones (21.1%), broad-spectrum penicillins (19.1%), and first- or second-generation cephalosporins (18.6%).

Conclusions. The prevalence of health care-associated infections was found to be similar to the reported overall prevalence rate of health care-associated infections in acute care hospitals in Lithuania.

Introduction

Health care-associated infections (HCAIs) (also referred to as hospital-acquired infections or nosocomial infections) are infections occurring after exposure to health care, often, but not always, as a consequence of this exposure (1). HCAIs refer to a special group of infectious diseases characterized by their epidemiological patterns and complexity of prevention. The prevention and control of HCAIs is closely related to the quality of health care, and therefore, these infections are an important public health threat in Europe and globally (1). Prevalence surveys performed in Europe have shown an overall prevalence of HCAIs of 3.5%–10.5% (2–6). The surveillance of HCAIs is an important component of an effective infection control program and can reduce up to one-third of HCAIs (7). Prevalence studies can be a useful part of a surveillance system as an easy and inexpensive way to evaluate the situation, estimate the main risk factors, evaluate interventions, and identify the areas for further investigation (1, 7). National point-prevalence studies of HCAIs based on confidentiality of health care institutions have been periodically carried out in Lithuania since 1996. The studies have shown an overall prevalence of HCAIs of 3.4%–4.3%; inter-hospital variations were between 0.0% and 12.3% (8). Medical staff and the general public have a wrong understanding of HCAIs, mostly considering them as exogenous infections caused by medical activities. The emergence of HCAIs is determined by exogenous and endogenous factors depending on medical interventions, staff, patient's condition, and other reasons. The published data on HCAIs will enable researchers to introduce the risk factors, compare the data (rate, type of infections, antimicrobial use, etc.) between different types of hospitals (e.g., university or regional), and discuss about the performed investigations and planned or applied prevention methods. The aim of this study was to evaluate the prevalence of HCAIs (sites and microorganisms), risk factors, and antimicrobial

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use (compounds and indications) in a university hospital.

Material and Methods

The study was designed as a point-prevalence study and carried out in Vilnius University Hospital Santariškių Klinikos (914 beds) in April 2010. The data were collected by the hospital specialists on infection control. All the patients in the acute care wards, i.e., intensive care, surgical, and medical wards, admitted before 8:00 AM on the day of the survey were included. The patients in the long-term (e.g., rehabilitation) wards and the patients undergoing day surgery and dialysis were excluded. HCAI was defined as an infection that was neither present nor incubating at the time of the hospital admission or within 48 hours after it. Readmission with an infection resulting from previous hospitalization was recorded as an HCAI. HCAIs were identified using the case definitions of the US Centers for Disease Control and Prevention (CDC) (9). The data were collected using the protocol of prevalence surveys of nosocomial infections prepared by the Hospital in Europe Link for Infection Control through Surveillance (HELICS) project (10). Those definitions and the protocol have been approved by the Order of the Minister of Health of the Republic of Lithuania and have been used for the epidemiological surveillance of HCAIs in health care institutions since 2008 (11). The specialists on infection control collected the data at the patient's bedside from medical documentation and through consultations with an attending physician and a nurse. The study protocol included the collection of the following data: patient's general data, date of admission, presence of indwelling devices on the day of the survey, surgery within 30 days, infection and its microbiological investigation, and current antimicrobial use. The data were checked at the end of each day by the specialists on infection control.

The statistical analysis was conducted using EPInfo (CDC, Atlanta, USA) and Statistical Package for Social Sciences for Windows Version 20.0 (SPSS Inc., Chicago, Ill, USA). The overall HCAI prevalence rates and specific rates in different units and other patients' groups (by age and sex) were computed and compared. Differences were considered statistically significant when $P<0.05$. All the P values were two-tailed and calculated with χ^2 tests for categorical data. The univariate analysis of each variable was performed. All the variables that were logically related or had a P value of <0.25 in the univariate analysis were included in the stepwise logistic regression in order to study the factors potentially associated with HCAIs (age, medical service, length of stay, and presence of a central venous catheter, urinary catheter, mechanical ventilation, or operation). Odds ratios (OR) and 95% confidence intervals (CI) were calculated.

Results

In total, 731 patients were included; 50.1% (n=366) of the patients were women; men accounted for 49.9% (n=365). The mean age was 58.7 years (median, 62). The average length of stay in hospital from admission to the day of the study was 9.9 days (median, 5; range, 1–419 days) (Table 1). At the

Table 1. Patients' Characteristics and Intrinsic Risk Factors for Health Care-Associated Infections (Multivariate Analysis)

Risk Factor	Health Care-Associated Infections		OR (95% CI), P	χ^2	P
	n/N	%			
Age, years					
0–18	1/16	6.3	1	2.86	0.413
19–44	2/132	1.5	0.23 (0.20–2.69), 0.24		
45–64	13/271	4.8	0.76 (0.09–6.17), 0.79		
>64	12/312	3.8	0.60 (0.07–4.92), 0.63		
Length of stay before survey, days					
0–2	3/287	1.0	1	28.21	0.01
3–7	10/283	3.5	3.47 (0.94–12.74), 0.06		
8–14	3/71	4.2	4.18 (0.83–21.15), 0.08		
>14	12/90	13.3	14.56 (4.01–52.89), 0.01		
Medical service					
Medicine	8/443	1.8	1	11.46	0.003
ICU	3/43	6.98	0.26 (0.11–0.62), 0.002		
Surgery	17/245	6.7	1.05 (0.29–3.73), 0.95		
Risk factor					
Intravascular catheter	40/231	16.7	3.60 (2.18–5.95)	27.67	<0.01
Urinary catheter	14/66	21.2	3.22 (1.68–6.17)	13.58	<0.01
Mechanical ventilation	3/14	21.4	2.83 (0.77–10.41)	2.68	0.101
Operation	38/193	19.7	4.23 (2.56–6.99)	35.73	<0.01

ICU, intensive care unit; OR, odds ratio; CI, confidence interval.

Table 2. Microbiological Investigation and Antimicrobial Use on the Day of Survey

	n (%)
Microbiologically investigated HCAIs	25 (89.3)
Isolated pathogens	
Staphylococcus aureus	6 (21.4)
Escherichia coli	4 (14.3)
Klebsiella spp.	4 (14.3)
Acinetobacter spp.	3 (10.7)
Enterococcus spp.	2 (7.1)
Other	9 (32.1)
Patients receiving antimicrobials	148 (20.2)
Prophylaxis	64 (43.2)
Treatment	84 (56.4)
Prescribed antimicrobials	
Penicillins	9 (4.5)
Broad-spectrum penicillins	29 (14.6)
First- or second-generation cephalosporins	37 (18.6)
Third- or fourth-generation cephalosporins	6 (3.0)
Other β-lactams	17 (8.5)
Vancomycin	12 (6.0)
Aminoglycosides	5 (2.5)
Fluoroquinolones	42 (21.1)
Macrolides	2 (1.0)
Metronidazoles	8 (4.0)
Sulfonamides	13 (6.5)
Antifungal agents	9 (4.5)
Other	10 (5.0)

HCAIs, health care-associated infections.

time of the survey, the use of 349 invasive devices was recorded in 332 patients (45.4%): 231 intravascular catheters (31.6%), 66 urinary catheters (9.0%), 38 surgical drains (5.2%), and 14 mechanical ventilators (1.9%). A total of 193 patients (26.4%) underwent surgery. Moreover, 20.2% of all the patients surveyed received antimicrobial agents: 131 patients (88.5%) received monotherapy, and 17 (11.5%) were given 2 to 4 antimicrobial agents. The most commonly prescribed antimicrobial agents were fluoroquinolones, broad-spectrum penicillins, and first- or second-generation cephalosporins (Table 2).

The overall prevalence rate of HCAIs was 3.8% (n=28). The prevalence of HCAIs in different hospital wards ranged from 0.0% to 19.2%. The lower respiratory tract, urinary tract, and surgical site infections were the most common HCAIs (32.2%, 28.5%, and 32.1%, respectively) (Table 3). The surgical site infections were mostly detected in surgical wards; and the lower respiratory tract and urinary tract infections, in different units. A multivariate logistic regression model showed that hospital stay longer than 14 days, intravascular catheters, urinary catheters, mechanical ventilation, and an operation were associated with a higher risk of HCAIs (Table 1).

As many as 89.3% of the 28 HCAI cases were investigated microbiologically. Pathogens were isolated from 17 patients (67.9%). *Staphylococcus aureus* and *Escherichia coli* were the most common microorganisms identified (Table 2).

Discussion

The importance of reducing HCAIs has been recognized by health care facilities worldwide. HCAI control is an integral part of patient safety and quality of care.

The prevalence of HCAIs on the day of the survey was relatively low (3.8%) in comparison with the published surveys in other European countries (3.5%–10.5%) (2–6). However, the prevalence of HCAIs was similar to the overall prevalence of HCAIs in acute care hospitals in Lithuania in 2007 (3.4%) (8). The prevalence of HCAIs in ICUs in our study was significantly lower as compared with the conducted point-prevalence surveys in European countries (15.7%–44.4%) and Lithuania (10.0% in 2007) (3–5, 8, 12–14).

The distribution of HCAIs according to the site of infection showed that the most frequent HCAIs in the present study were lower respiratory tract infections followed by surgical site infections. This corresponds with the most common HCAIs detected in Lithuanian surveys (8). Point-prevalence studies carried out in acute care hospitals in Europe have shown urinary tract infections to be most common followed by surgical site infections (12, 14–17). A higher rate of urinary tract infections was detected in our study as compared with the average rate in Lithuania. A relatively higher prevalence of urinary tract infections in our study could be the result of a more common use of urinary catheters (9.0%) than that shown by the data of national Lithuanian surveys (4.2%–5.2%) (8). The prevalence of other risk factors (intravascular catheters, mechanical ventilation, and an operation) was similar to the overall prevalence in Lithuania (8). A lower use of intravascular catheters in comparison with other European

Table 3. Prevalence of Health Care-Associated Infections According to Site and Medical Service

Medical Service	Site of Health Care-Associated Infections				
	Lower Respiratory Tract	Urinary Tract	Surgical Site	Bloodstream	Other
ICU	1 (3.6)	2 (7.1)	0 (0)	0 (0)	0 (0)
Surgery	3 (10.7)	4 (14.3)	9 (32.1)	1 (3.6)	0 (0)
Medicine	5 (17.9)	2 (7.1)	0 (0)	0 (0)	1 (3.6)
Total	9 (32.2)	8 (28.5)	9 (32.1)	1 (3.6)	1 (3.6)

Values are number (percentage).

studies may explain a relatively low prevalence of bloodstream infections in our study (12, 14, 18).

HCAIs were confirmed microbiologically in approximately 90.0% of the cases, and pathogens were determined in more than two-thirds of the cases. The national HCAI surveys in Europe and Lithuania have reported lower proportions of microbiological investigations of HCAIs (3, 5, 8, 15, 18). As in other European studies, HCAIs were often caused by *Staphylococcus aureus* and *Escherichia coli* microorganisms (4, 18, 19).

The overall percentage of the patients receiving antimicrobials was relatively low (20.2%), and the same data were found in Norwegian (16.6%–19.2%) and UK (18.2%) studies (20, 21). A higher antibiotic use was detected in the Lithuanian surveys (30.0%); the studies carried out in Europe showed a markedly higher use of antibiotics in Albania (46.9%), Greece (51.4%), and Italy (58.4%) (3, 8, 12, 13, 17, 18). Penicillins and aminoglycosides were prescribed less frequently, whereas fluoroquinolones were prescribed much more often in the present study as compared with the national Lithuanian surveys (8).

Periodic prevalence surveys are recommended to be conducted to monitor the effectiveness of infection control measures (22). The annual point-prevalence surveys of HCAIs have been introduced in our hospital since 2003. Regular feedback of the results is presented for the units and the administration of the hospital. This initiated interventions focused on the prevention of HCAIs in ICUs, epidemiological surveillance of surgical site infections, and development of a general infection control program. These implementations have resulted in low HCAIs rates in 2010. A relatively lower prevalence of HCAIs in the present study than that in the reported European surveys could be explained by numerous methodological differences, e.g., the eligibility criteria for hospitals, patients, case definitions, sensitivity and specificity of the approaches to the identification of HCAIs, etc. Despite that, continuous surveillance of surgical site infections, lower respiratory tract infections, and use of urinary catheters should be the priorities of infection control initiatives.

Conclusions

This prevalence study enabled us to estimate the magnitude of health care-associated infections, compare it with the overall prevalence rate of Lithuania, and identify the priorities for future surveillance and prevention activities. The prevalence of health care-associated infections was found to be similar to the reported overall prevalence rate of health care-associated infections in acute care hospitals in Lithuania.

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Statement of Conflict of Interest

The authors state no conflict of interest.

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