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Major Article

Risk factors for health care–associated infections: From better knowledge to better prevention

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Background: Health care–associated infections (HCAIs) are preventable with adoption of recognized preventive measures. The first step is to identify patients at higher risk of HCAI. This study aimed to identify patient risk factors (RFs) present on admission and acquired during inpatient stay which could be associated with higher risk of acquiring HCAI.
Methods: A case-control study was conducted in adult patients admitted during 2011 who were hospitalized for >48 hours. Cases were patients with HCAIs. Controls were selected in a ratio of 3:1, case matched by the admission date. The likelihood of increased HCAI was determined through binary logistic regression.
Results: RFs identified as being the more relevant for HCAI were being a man (odds ratio [OR], 2.4; 95% confidence interval [CI], 1.2-4.7), being aged >50 years (OR, 2.9; 95% CI, 1.3-6.9), and having an insertion of a central venous line during hospital stay (OR, 12.4; 95% CI, 5.0-30.5).
Conclusions: RFs that showed statistical significance on admission were the patient's intrinsic factors, and RFs acquired during hospitalization were extrinsic RFs. When a set of RFs were present, the presence of a central venous line proved to be the more relevant one.

BACKGROUND

Health care–associated infections (HCAIs) are a major patient safety problem with significant morbidity, mortality, prolonged hospitalization, and increased costs.[1,2]

There are general HCAI predisposing factors. These factors are associated with characteristics of the patient, such as age, underlying disease, comorbidities, and reduced host defenses.[3] Since the publication of the SENIC (Study on the Efficacy of Nosocomial Infection Control) study,[4] it is known that at least a third of these infections could be prevented by the adoption of recognized preventive measures. More recent studies have increasingly established that a much higher number of HCAIs could be preventable,[5] namely infections related to certain medical devices, such as central venous lines, for which a zero rate is even possible.[6]

Despite significant scientific advances and sophistication of medical equipment and devices, patient care still contributes to acquisition of HCAIs. Numerous studies have shown the need for multimodal interventions[7,8] to obtain significant reductions of HCAI, more specifically bundled care in which a small number of elements of care considered to be essential for prevention are adopted in an all or none approach.[9]

To make the best use of resources, the first and essential step for prevention of HCAIs is to determine which patients are at higher risk of acquiring infection to direct resources to adopt the required preventive care.

Various attempts have been already made to identify the major patient risk factors involved, including definition of risk checklists or scales. However, most of these are directed to specific infections or specific microorganisms.[10-12]

In 1978, Freeman and McGowan attempted to devise a predictive model for HCAI risk.[13] They concluded that comorbidities, invasive procedures, individual characteristics (age, sex, and race), and emergency admission were statistically significant for acquiring an infection. Webster and Bowell developed a risk assessment tool addressing global and local factors, invasive devices, medications, and underlying diseases.[14] More recently, Chang et al[15] proposed a scoring system based on a small number of aspects. They grouped risk factors into 4 categories: demographics, health status, procedures, and medications.

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This study aimed to investigate the patient factors present on admission and acquired during inpatient stay which could be associated with a higher risk of acquiring HCAI, in a private hospital in Lisbon, Portugal.

MATERIALS AND METHODS

Setting

The study hospital is a 124-bed private hospital. The hospital has 7 operating theaters, accident and emergency departments (adult, pediatric, obstetrics, and gynecology), an oncology day care, and nuclear medicine, assisted medical procreation, radiology, physiotherapy, and rehabilitation departments. The hospital core business is surgical patients.

Study population

Inclusion criteria

Inclusion criteria included patients aged ≥18 years, admitted to the hospital during the year of 2011, and hospitalized for >48 hours (medical, surgical, and intensive care unit). Excluded patients included those from obstetrics, psychiatry, and pediatrics and those with a diagnosis of osteomyelitis at admission.

Case definition

The definition of a case was patients with infections acquired in the study hospital because of the health care delivered, during the year 2011, and who met the defined inclusion criteria. All cases of infection had been previously confirmed by the hospital infection prevention team medical consultant lead (infectious disease consultant) in accordance with the Centers for Disease Control and Prevention criteria.[16]

Control definition

The definition of a control was patients who meet inclusion criteria and who did not acquire an HCAI related to care delivered in the study hospital. They were selected by simple random sampling in a ratio of 3:1 cases from hospitalized patients. The matching of cases to controls was made based on the time reference of the day of admission (within 1 week of the date of admission).

Sources of information

The sources of information included clinical records, patient care pathways (medical and nursing records, specialty consultations, outpatient clinic, emergency visits, laboratory results and imaging, and all relevant clinical information for the study), data from the HCAI hospital surveillance system, and the 2011 hospital data (hospital activity) provided by the business office department.

Data collection

All variables were defined prior to data collection. A structured form was used for data collection (intrinsic and extrinsic risk factors, on admission, and during hospital stay). Routinely collected data (demographic and clinical data and laboratory and radiologic findings) were transferred directly from the HCAI hospital surveillance system.

The preoperative American Society of Anesthesiologists (ASA) score was used by the anesthetist to assess the patient's preoperative physical condition according to the ASA classification of physical status.

If a patient required a reoperation within 72 hours of the first operation because of an early complication, such as bleeding, the ASA score was reassessed in case it had changed.

The definition of immunosuppression used was in accordance with the Portuguese National Protocol for bloodstream infections surveillance: an absolute neutrophil count <500/mm^3, or primary or secondary immunologic disease, bone or organ transplant, or immunosuppression therapy (chemotherapy, radiotherapy, and steroid therapy in the 15 days prior to the HCAI).

Skin and soft tissue lesions included acute wounds, such as surgical wounds dehiscence, burns, abrasions, and wounds from open fractures. Chronic wounds included lesions such as pressure ulcers, leg ulcers, and diabetic foot ulcers.

Respiratory problems included cough, sneezing, presence of sputum, and bleeding. Gastric problems referred to vomiting, diarrhea, and bleeding.

Data were systematized in a spreadsheet using Excel for Windows (Microsoft 2007, Redmond, WA). Data from admissions that led to infection were recorded. Information related to HCAI acquired in a previous admission to the study hospital was collected from the inpatient stay that gave rise to the infection.

The data collection form (information at admission time and during the period of hospitalization) for cases and controls was completed by the researchers, including data related to intrinsic and extrinsic risk factors, admission diagnosis, and procedures performed during inpatient stay.

All the HCAIs identified in the hospital surveillance program were included in the study. The surgical patients were followed through readmission to the wards and through the outpatient department in the follow-up appointment with the consultants. Our surveillance program is based on following all patients with an antibiotic prescription, microbiology study request, or invasive device. Infections are reported by link nurses and validated by the infection control doctor. Additionally, link nurses report suspected infections which they identify in the wards.

Statistical analysis

Statistical analysis was performed using SPSS version PASW Statistics 19.

The likelihood of increased HCAI (odds ratio [OR]) was estimated based on the admission and inpatient stay risk factors through binary logistic regression, using the forward likelihood ratio method. A level of significance of 5% was set for all statistical tests.

The association between each risk factor individually with HCAI was quantified, and the joint effects of the most significant risk factors were obtained through multivariate analysis. Additionally, the joint effects of variables identified by Chang et al[15] were also estimated, because they were relevant to validate our results (given our small sample size) and allow a better comparison between both studies.

RESULTS

The study population included a total of 66 cases and 198 controls. The predominant medical specialties in the case group were internal medicine (31.8%), general surgery (25.7%), and orthopedics (18.1%). In the control group, the predominant clinical specialties were also general surgery (16.1%), orthopedics (31.1%), and gynecology (14.6%).

HCAI was detected after discharge in 16% of patients, requiring readmission to treat the infection. Among the patients, 4.5% (n = 3) developed a secondary bloodstream infection (one after an intra-abdominal infection and 2 after urinary tract infections).

In 9% of cases (n = 6), the patient acquired a second infection (2 urinary tract infections, 2 respiratory infections, and 2 bloodstream infections). Two of these patients (3%) acquired a third HCAI (1 infection of the urinary tract and 1 bloodstream infection).

Table 1 presents all the intrinsic and the extrinsic risk factors presented at admission and acquired during the hospital stay.

In the case group, 15.1% of the patients died during the hospital stay, and in the control group the death rate was 0.5%.