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Major Article

Prospective surveillance of device-associated health care–associated infection in an intensive care unit of a tertiary care hospital in New Delhi, India

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Key Words:
Device-associated health care–associated infections
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Background: Surveillance of health care–associated infections (HAIs) plays a key role in the hospital infection control program and reduction of HAIs. In India, most of the surveillance of HAIs is reported from private sector hospitals that do not depict the situation of government sector hospitals. Other studies do not confirm with the Centers for Disease Control and Prevention's (CDC) National Healthcare Safety Network (NHSN) surveillance criterion, or deal with ventilator-associated pneumonia (VAP) instead of ventilator-associated event (VAE). The aim of this study was to identify the incidences of 3 device-associated HAIs (DA-HAIs) (VAE, central line–associated bloodstream infection [CLABSI], and catheter-associated urinary tract infection [CAUTI]) by active surveillance using CDC's NHSN surveillance criteria and to identify the pathogens associated with these DA-HAIs.

Methods: This was a prospective surveillance study (January 2015-December 2016) conducted in an intensive care unit (ICU) of a large, tertiary care, government hospital situated in Delhi, India. Targeted surveillance was done as per the CDC's NHSN 2016 surveillance criteria.

Results: There were 343 patients admitted to the ICU that were included in the study. The surveillance data was reported over 3,755 patient days. A DA-HAIs attack rate of 20.1 per 100 admissions and incidence of 18.3 per 1,000 patient days was observed. The duration of use for each device for patients with DA-HAIs was significantly longer than for patients without DA-HAIs. The device utilization ratios of central line, ventilator, and urinary catheters were 0.57, 0.85, and 0.72, respectively. The crude excess length of stay for patients with DA-HAI was 13 days, and crude excess mortality rate was 11.8%. VAE, CLABSI, and CAUTI rates were 11.8, 7.4, and 9.7 per 1,000 device days, respectively. Among 69 DA-HAIs reported, pathogens could be identified for 49 DA-HAI cases. *Klebsiella* spp was the most common organism isolated, accounting 28.5% for all DA-HAI cases, followed by *Enterococcus* spp (24.4%). The most common organisms causing VAE, CAUTI, and CLABSI were *Acinetobacter* (6/15, 40%), *Enterococcus* spp (11/31, 35.4%), and *Candida* spp (5/19, 26.3%), respectively. Most of the gram-negative organisms were carbapenem resistant; however, none of the isolates were colistin resistant.

Conclusions: To reduce the risk of infection in hospitalized patients, DA-HAI surveillance is of primary importance because it effectively describes and addresses the importance and characteristics of the threatening situation created by DA-HAIs. The present surveillance shows high rates of ICU-onset DA-HAIs and high resistance patterns of organisms causing HAIs, representing a major risk to patient safety.

Health care–associated infections (HAIs) are the most frequent adverse event threatening the safety of patients.[1] They are responsible for significant morbidity and mortality.[2] Patients with invasive devices who are admitted to the intensive care unit (ICU) are at an even higher risk of developing HAI.[3]

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Surveillance of HAIs plays a key role in the hospital infection control program and reduction of HAIs.[4] The Centers for Disease Control and Prevention's (CDC) National Healthcare Safety Network (NHSN) has developed standardized criteria for device-associated HAI (DA-HAI) surveillance.[5] This standardized surveillance method determines the DA-HAI rates per 1,000 device days. The rate can be used to compare the incident of DA-HAIs in different health care centers. It can also be used to assess the effectiveness of interventions in infection control practices.

In India, the incidence of HAI varies from 6-40 per 1,000 patient days,[6] and most common pathogens associated with HAIs reported are multidrug-resistant gram-negative bacteria.[7-9] However, most of these studies are reported from private sector hospitals that do not depict the situation of government sector hospitals. The government sector hospitals are often resource-limited, provide health care to a much larger population, and predominantly cater to people of lower socioeconomic status. Other studies do not confirm with the CDC's NHSN surveillance criterion or deal with ventilator-associated pneumonia (VAP) instead of ventilator-associated event (VAE). The VAE surveillance definition is based on more objective, streamlined, and potentially automatable criteria that identifies a broad range of conditions and complications occurring in mechanically ventilated adult patients.[10] The earlier VAP surveillance criteria were based on clinical signs, chest radiography, and microbiologic data. Most of these criteria were not objective, leading to subjectivity in the diagnosis of VAP.[10] The present study addresses the aforementioned shortcomings.

The aim of this study was to identify the incidence of 3 DA-HAIs (VAE, central line–associated bloodstream infection [CLABSI], and catheter-associated urinary tract infection [CAUTI]) by active surveillance using the CDC's NHSN surveillance criteria and to identify the pathogens associated with these DA-HAIs.

METHODS

Study design

This was a prospective surveillance study.

Site of study

Safdarjung Hospital is a 1,531-bed, tertiary care, government hospital situated in Delhi, India. Active surveillance of DA-HAIs has been an ongoing program in the ICU since January 2015. Its catchment area includes Delhi and neighboring states, with daily average outpatient department visits of 9,538 and inpatient admission of 434. The ICU (medical and surgical) is 8 beds and admits patients of medical or surgical complications and hence caters to a mixed population.

The hospital provides diagnostic laboratory support for multiple disciplines, such as hematology, pathology, histopathology, and biochemistry. The hospital also has a clinical microbiology laboratory that perform microscopy, serology, culture, identification, and sensitivity of various microorganisms by conventional or molecular techniques as per standard microbiologic protocol.[11] In vitro antimicrobial susceptibility testing of first- and second-line antimicrobials was done according to Clinical and Laboratory Standards Institute guidelines.[12] Multidrug-resistant *Acinetobacter* spp was defined as nonsusceptibility to at least 1 agent in ≥3 antimicrobial categories.[13] The laboratory participates in an internal and external quality assurance program.

Study period

The study took place over 21 months from January 2015-December 2016. The ICU was under renovation from December 2015 to February 2016 and was closed for patient care. The surveillance of DA-HAIs was not performed during this period and is excluded for data analysis.

Inclusion criteria

Inclusion criterion included consecutive adult patients admitted to the ICU.

Exclusion criteria

Exclusion criterion included patients admitted for <48 hours to the ICU.

Follow-up periods

The surveillance period ends with a patient's discharge or transfer out of the ICU, or death of the patient.

Active surveillance

Daily ICU rounds were taken by designated members of the infection control team, and targeted surveillance was done for 3 DA-HAIs: CAUTI, CLABSI, and VAE. The surveillance definitions for these DA-HAIs were adapted from the CDC's NHSN 2016 surveillance criteria.[3] To calculate the number of device days, the date of insertion and date of removal of the specific device were recorded. The surveillance form recorded patients' demographic details, reason for admission, key investigation results, and outcome of patients.

Data collection

The data collected in active surveillance were analyzed. The data collected included the following: (1) patient days: total number of days that all patients were in the ICU during the selected time period; (2) device days: total number of days of exposure to each device for all the patients during the selected time period; (3) device utilization ratio (DUR): ratio of device days to patient days; (4) HAI: defined as the presence of site-specific infection criterion together on or after the third hospital day; (5) crude excess length of stay (LOS) of DA-HAI: difference between the crude LOS of patients in the ICU with and without DA-HAI; (6) crude mortality rate: total number of deaths to total number of patients; (7) crude excess mortality rate: difference between the crude overall case mortality rate of patients with and without DA-HAI; (8) DA-HAI incidence: number of DA-HAI cases per 1,000 patient days; (9) attack rate: number of DA-HAI cases per 100 admissions; (10) DA-HAI rate: number of specific device-associated infections per 1,000 device days; (11) VAE: identified using a combination of objective criteria, that is deterioration in respiratory status after a period of stability or improvement on the ventilator (increase in daily minimum fraction of inspired oxygen ≥20 points or positive end-expiratory pressure ≥3 cm of water over values during baseline period), evidence of infection or inflammation (temperature >38°C or <36°C; white blood count ≥14,000 or ≤4,000 cells/mm^3; a new antimicrobial agent that was continued for ≥4 calendar days), and laboratory evidence of respiratory infection (purulent respiratory secretion identified by microscopy or positive culture of respiratory specimens); VAE algorithm was applied only on those patients who were mechanically ventilated and ≥18 years of age[3]; (12) CLABSI: identified as laboratory-confirmed bloodstream infection (≥1 blood culture positive for recognized pathogen; ≥2 blood cultures positive for common commensal and at least 1 of the following signs: fever, hypotension, or bradycardia) that was not secondary to an infection at any other body site and where central line was in place for ≥2 calendar days[3];