Journal of Critical Care 35 (2016) 69–74

Contents lists available at ScienceDirect

Journal of Critical Care

journal homepage: www.jccjournal.org

Sepsis/Infection

Clinical and economic burden of bloodstream infections in critical care patients with central venous catheters

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ARTICLE INFO

Keywords:
Central venous catheter
Bloodstream infection
Intensive care unit
Cost
Readmission
Mortality

ABSTRACT

Purpose: Bloodstream infections (BSIs) complicate the management of intensive care unit (ICU) patients. We assessed the clinical and economic impact of BSI among patients of a managed care provider group who had a central venous catheter (CVC) placed in the ICU.
Methods: We considered hospitalizations occurring between January 1, 2011, and September 30, 2014, that involved an ICU stay during which a CVC was placed. Comparisons were made between episodes where the patient did vs did not develop BSI after CVC insertion. Length of stay, costs of index hospitalization, and total costs over the 180 days after discharge were compared using linear mixed models. Inhospital mortality and 30-day readmission rates were compared using negative binomial regression models.
Results: Development of BSI was associated with longer hospital stay (+7 days), more than 3-fold increase in risk of inhospital death, and an additional $129 000 in costs for the index hospitalization. No statistically significant differences in 30-day readmission rates or costs of care over the 180-day period after discharge from the index admission were observed.
Conclusion: Bloodstream infections after CVC placement in ICU patients are associated with significant increases in costs of care and risk of death during the index hospitalization but no differences in readmissions or costs after discharge.

1. Introduction

Central venous catheters (CVCs) are often required during the course of treatment of patients in the intensive care unit (ICU). Annually, in the United States, catheter usage constitutes approximately 15 million CVC days per year among ICU patients [1,2]. However, use of CVCs in the hospital setting is associated with risk of complications, including those arising from bloodstream infections (BSIs), which may ultimately result in death or poorer patient outcomes. Estimates suggest that more than 250 000 episodes of CVC-related BSIs occur annually in the United States [3].

Development of BSI may result in extended ICU or hospital stay and iatrogenic complications and may potentially have additional downstream consequences, including the need for rehospitalization, emergency department visits, or follow-up outpatient visits to health care professionals [4]. Collectively, the burden of BSIs may increase health care costs both in the short and long terms.

Several previous studies have estimated the effects of catheter-related BSI on hospitalization costs, length of hospital stay, and mortality rates [3,5–9]. However, many of these studies used data from a single hospital/care setting or were not restricted to ICU patients, and most considered only the direct effects of BSI on index hospitalization costs.

To provide a more comprehensive assessment of total health care costs attributable to BSIs after CVC placement among ICU patients, we performed a retrospective observational analysis using contemporary data from patients of a managed care provider group. In this managed care setting, claims data are available for all health care interactions for subscribers: inside and outside of the hospital and within and outside of network. This allows for consideration not only of costs associated with the index hospitalization itself but also of the cost of care across all health care settings over the following months.

2. Methods

2.1. Study design and data source

The study was a retrospective observational analysis of data on patients of a managed care provider group administering health care services in the United States (HealthCare Partners, Inc, Los Angeles, CA).

Conflicts of interest: SMB, WT, SS, and AH are employees of DaVita Clinical Research. AP is an employee of CorMedix, Inc. SMB's spouse is employed by AstraZeneca. SS owns stock in DaVita HealthCare Partners, Inc. AP owns stock in CorMedix, Inc.

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http://dx.doi.org/10.1016/j.jcrc.2016.04.035
0883-9441/

The group covers approximately 750 000 enrolled members at any time across a variety of care settings in Southern California and Nevada.

The study was determined to be exempt following review of the study protocol by the institutional review board (Quorum IRB, Seattle, WA).

2.2. Study patients and exposure

We considered eligible patient episodes in which patient was admitted to hospital between January 1, 2011, and September 30, 2014; patient was 18 years or older at admission; hospitalization included an ICU stay (medical, surgical, coronary care, mixed or intermediate care units); a CVC was placed during the ICU stay (Fig. 1). Patients were eligible to contribute multiple qualifying episodes. A total of 1963 qualifying episodes were included representing 1853 unique patients (1760, 80, 10, 2, and 1 patients contributed 1, 2, 3, 4, and 5 qualifying episodes, respectively).

Exposed (case) episodes were those with an *International Classification of Diseases, Ninth Revision* (*ICD-9*), diagnostic code for infection due to catheter, bacteremia, or septicemia (999.31, 999.32, 999.33, 996.62, 995.91, 790.7, and 038.x) that occurred during the index hospitalization, on or after the date of catheter placement. Control episodes were those with a qualifying ICU admission and CVC placement but no subsequent *ICD-9* diagnostic code for infection during the index hospitalization. Events used to identify eligible index admission and to ascribe case/control status were abstracted from claims history files.

Characteristics of case and control episodes were taken from claims data that preceded index hospitalization. Specifically, we considered age; race; sex; ethnicity; type of qualifying ICU admission (medical vs surgical vs oncologic ICU); and the presence or absence of diabetes, malignancy, and end-stage renal disease (ESRD). Clinical data for inpatient admissions (eg, vital signs, medication administration records) were not available for analysis.

2.3. Outcomes

Length of stay for the index hospital admission was considered as the span of days between admission and discharge. Costs for the index hospitalization were based on charged amounts and included charges for inpatient admission and any professional or other services rendered during the hospitalization (ie, with date of service between hospital admission and discharge dates, inclusive). Deaths during the index hospitalization were determined from patient electronic health records: deaths that occurred within 1 day of the discharge date were designated as occurring during the hospitalization (to account for discrepancy between date of death and date of discharge that may occur if the patient

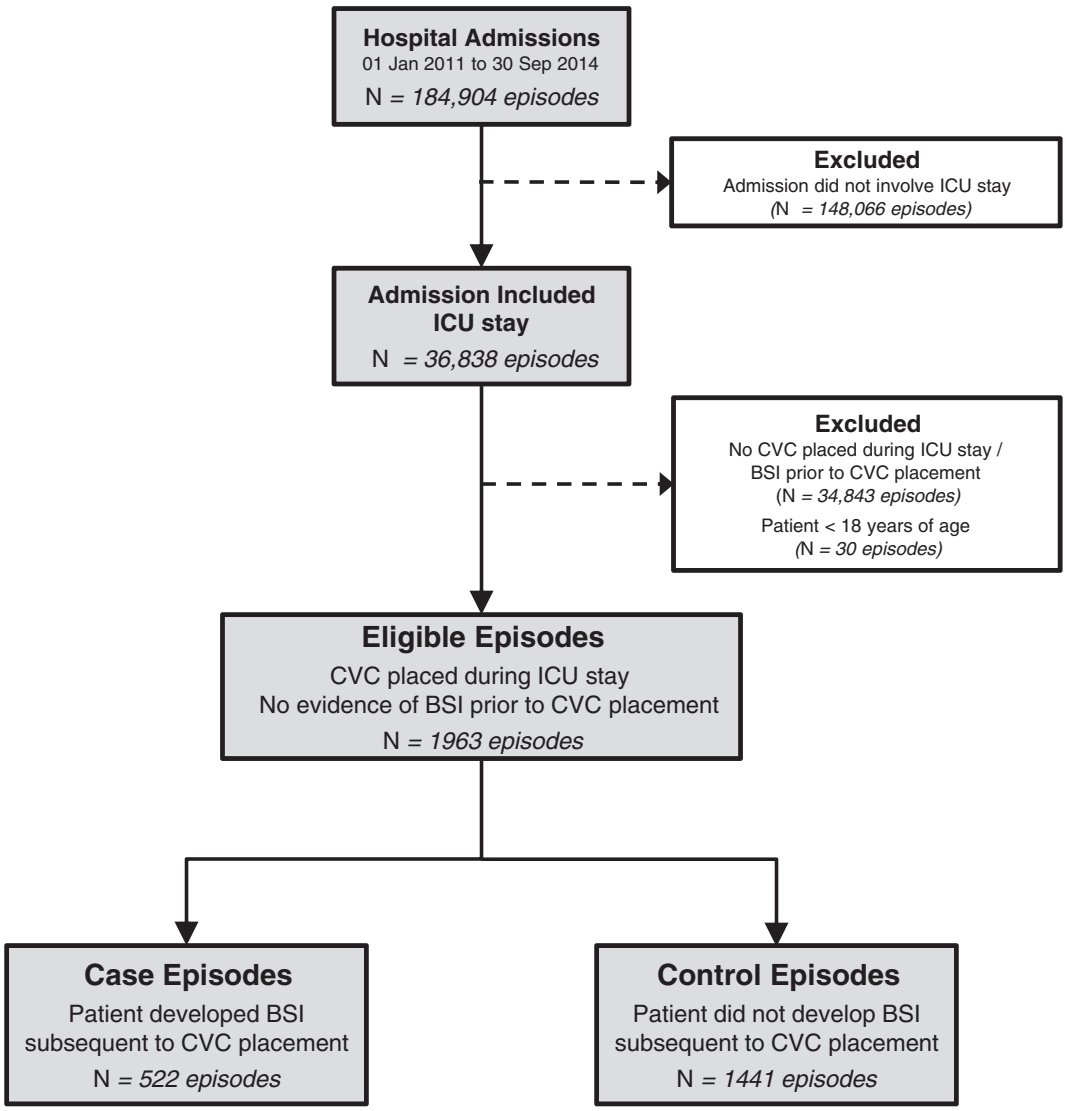

Fig. 1. Study design.