

Letters to the Editor

Identifying Patients With Severe Hospital-Acquired Infections Due to *Staphylococcus aureus* by Using the Healthcare Cost and Utilization Project (HCUP): Problems and Pitfalls

To the Editor:

A vaccine against *Staphylococcus aureus* infection has been developed and proposed to have potential use for patients receiving dialysis.¹ A second target population that might benefit from such a vaccine are patients scheduled for elective surgery. We sought to identify patients with severe nosocomial infections due to *S. aureus* using a nationwide U.S. hospital-based database and then to examine the feasibility of identification of patient profiles at risk for these infections.

This study was based on a 10% random subsample (S1, n = 714,842) of data from the 1997 Nationwide Inpatient Sample provided by the Healthcare Cost and Utilization Project (HCUP) from the Agency for Healthcare Research and Quality.² This database was designed to represent a statistical sampling of U.S. hospitals sampled from 22 selected states. This database had been previously used to analyze outcomes and to prepare cost estimates of various medical treatments or hospitalization.^{3,6}

For each individual discharge (using the sequential [SEQ] variable), principal and secondary diagnoses and procedures were coded according to the International Classification of Diseases, ninth revision, Clinical Modification (ICD-9-CM). SEQ variables cannot be used as a unique identifier to track patients across time and hospitals and to create patient encounters using the Nationwide Inpatient Sample of the HCUP. For each selected patient

TABLE 1

DIAGNOSES REPORTED FROM THE 1997 NATIONWIDE INPATIENT SAMPLE OF THE HEALTHCARE COST AND UTILIZATION PROJECT AND MORE FREQUENTLY RETRIEVED FROM PATIENTS WITH SEVERE NOSOCOMIAL INFECTIONS ACCORDING TO THE INTERNATIONAL CLASSIFICATION OF DISEASES, NINTH REVISION, CLINICAL MODIFICATION DURING HOSPITALIZATION (N = 1,147)

Primary and Secondary Diagnosis	DX1	DX-DX1	DX
Postoperative infection (998.59)	357 (69.7%)	155	512
Infection, inflammatory reaction, and complications due to internal prosthetic device, implant, and graft (996.62, 996.69)	186 (52.1%)	171	357
<i>Staphylococcus aureus</i> and staphylococcal septicemia (038.11, 041.11)	24 (2.1%)	1,126	1,150
Infection with microorganisms resistant to penicillin (V09.0)	0 (0%)	160	160

DX1 = principal diagnosis in Healthcare Cost and Utilization Project (often the reason for admission to the hospital); DX-DX1 = secondary diagnosis; DX = principal and secondary diagnoses (merged together into this denomination).

(SEQ variable), information was combined using an SAS structured query language procedure within 5 data sets from the HCUP database. SAS software (version 8.2; SAS Institute, Inc., Cary, NC) was used for the extraction process and data analysis.

We restricted the analysis to patients hospitalized for more than 48 hours (n = 412,745). The population of patients receiving dialysis (n = 10,527) was directly identified using corresponding ICD-9-CM codes (38.95, 39.27, 39.42, 39.43, 39.93, and 39.95). An initial difficulty was that ICD-9-CM did not directly identify nosocomial infections for data capture; we thus combined the ICD-9 codes 996.6 and others, 997.3, and 999.3 for each group to identify 1,132 infectious complications among the patients receiving dialysis (10.8 complications per patient-year). A second difficulty was identifying patients with or without elective surgery directly from ICD-9-CM codes. We decided to identify the postoperative patients with infection using a combination of ICD-9-CM codes (998.5 and others with 996.6 and others, 997.3, and 999.3); 4,256 patients were identified. This approach underestimated the reality. We then restricted the analysis

to severe nosocomial infections (septicemia, pneumonia, or profound surgical-site infections) due to *S. aureus* (codes 038.11, 041.11, and 482.41). Finally, 869 severe nosocomial infections were identified in the postoperative patient group; of these, 537 (61.8%) were due to *S. aureus*. Two hundred twenty-three cases of severe nosocomial infections were identified in the group of patients undergoing dialysis, including 133 (59.6%) due to *S. aureus*.

White patients accounted for 84.5% of the *S. aureus* infections in the postoperative patient group as compared with 58.1% in the group of patients receiving dialysis; conversely, black patients accounted for 8.8% of the *S. aureus* infections in the postoperative patient group as compared with 35.2% in the group receiving dialysis. Mean ages were similar in the two groups (approximately 57 years). According to the database, three-fourths of postoperative patients had been admitted in emergency. Only the remaining one-fourth had been initially admitted for elective surgery. Nine of 10 patients receiving dialysis were admitted in emergency. Approximately half of the postoperative patients infected by *S. aureus* had

planned admissions to the hospital. Emergency was the first reason for admission for more than half (52.3%) of the patients receiving dialysis infected by *S. aureus*.

The median time between admission and the principal procedure was 1 day and the interquartile range (IQR) was 0 to 4 days. The median length of stay was 7 days (IQR, 4 to 14 days) in both groups. HCUP has many gaps in the data for variables concerning the hospitals; bed size categories were based on the number of hospital beds and were specific to the hospital location and teaching status. Nearly half of the healthcare payers were insured by Medicare, as was the case in 81.2% of the patients receiving dialysis reported to be infected by *S. aureus*. This is most likely because Medicare provides health insurance to individuals 65 years and older and to those who have permanent kidney failure or certain disabilities. Nearly half of the patients (postoperative patients, 48.6%; patients receiving dialysis, 54.7%) infected by *S. aureus* had routine discharge status. The discharge statuses in decreasing order were home healthcare, skilled nursing facility, and another type of facility. Among postoperative patients and those receiving dialysis who were infected by *S. aureus*, 1.1% and 9.8% of patients died, respectively. Finally, Tables 1 and 2 list the diagnoses and procedures, respectively, more frequently retrieved from patients identified with severe nosocomial infections due to *S. aureus* (n = 1,147) when we combined the selected ICD-9-CM codes for severe nosocomial infections due to *S. aureus*. All of these procedures could be the source of severe nosocomial infections, but the 1997 HCUP Nationwide Inpatient Sample did not provide the exact dates of the procedures and diagnoses. We were therefore unable to clearly determine which pathologies were responsible for the severity and the necessity of using medical devices before onset of the nosocomial infection.

This database did not permit clear description of patient profiles for those at risk of acquiring severe nosocomial infections and, ultimately, did not identify new groups of patients who could potentially benefit from a preventive vaccine against nosocomial infections due to *S. aureus*. However, for the patients receiving dialysis, the results of our analysis are

TABLE 2

PROCEDURES REPORTED FROM THE 1997 NATIONWIDE INPATIENT SAMPLE OF THE HEALTHCARE COST AND UTILIZATION PROJECT AND MORE FREQUENTLY RETRIEVED FROM PATIENTS WITH SEVERE NOSOCOMIAL INFECTIONS ACCORDING TO THE INTERNATIONAL CLASSIFICATION OF DISEASES, NINTH REVISION, CLINICAL MODIFICATION DURING HOSPITALIZATION (N = 1,147)

Primary and Secondary Procedure	PR1	PR-PR1	PR
Excisional debridement of wound, infection, or burn (86.22)	142 (69.6%)	62	204
Incision of skin or subcutaneous tissue with removal of foreign body or drainage (86.04, 86.05, 86.09)	69 (41.8%)	96	165
Venous catheterization, not classified elsewhere (38.93)	46 (21.8%)	165	211
Hemodialysis and venous catheterization for renal dialysis (39.95, 38.95)	42 (33.1%)	85	127
Injection of antibiotic and transfusion of packed cells (99.0, 99.21)	24 (14.9%)	137	161
Insertion of totally implantable vascular access device (86.07)	10 (18.9%)	43	53

PR1 = principal procedure in Healthcare Cost and Utilization Project (often the reason for admission to the hospital); PR-PR1 = secondary procedure; PR = principal and secondary procedures (merged together into this denomination).

in line with the data from the literature (approximately 10 complications per 100 patient-years).^{7,8} The identification of patient profiles at risk of nosocomial infection to assist in the development of a preventive vaccine recommendation against *S. aureus* remains a challenge.

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C. Souvignet, PharmD
G. Frebourg, MSc
 Aventis Pasteur
 Lyon, France
L. Baril, MD
 Aventis Pasteur
 Lyon, France
 and
 Institut Pasteur
 Paris, France

Evaluation of Surgical-Site Infections Following Cardiovascular Surgery

To the Editor:

Infections after cardiovascular surgery are an important cause of morbidity and mortality. During the past decade, prevention of surgical-site infections (SSIs) after cardiovascular surgery has become an important component of quality assurance