JOURNAL OF THE AMERICAN COLLEGE OF CARDIOLOGY
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PUBLISHED BY ELSEVIER INC.
VOL. 65, NO. 19, 2015
ISSN 0735-1097/$36.00
http://dx.doi.org/10.1016/j.jacc.2015.03.518

Trends in Infective Endocarditis Incidence, Microbiology, and Valve Replacement in the United States From 2000 to 2011

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ABSTRACT

BACKGROUND In accordance with the 2007 American College of Cardiology and American Heart Association infective endocarditis (IE) guideline update, antibiotic prophylaxis is now being restricted to a smaller number of cardiac conditions with very high risk for adverse outcomes from IE. However, there is scant data on IE trends since this major practice change in the United States.

OBJECTIVES The aim of this study was to compare temporal trends in IE incidence, microbiology, and outcomes before and after the change in the 2007 IE prophylaxis guideline in the United States.

METHODS The NIS (Nationwide Inpatient Sample) database was used to investigate IE hospitalization rates in the United States from 2000 through 2011. The mean annual rates of IE before and after the 2007 guideline change were compared using segmented regression analysis.

RESULTS There were 457,052 IE-related hospitalizations in the United States from 2000 to 2011, with a steady increase in incidence ($p < 0.001$). The trend in IE hospitalization rates from 2000 to 2007 and from 2008 to 2011 was not significantly different ($p = 0.74$). The increases in the number of *Staphylococcus* IE cases per million population during the study periods 2000 to 2007 and 2008 to 2011 were similar ($p = 0.13$), but *Streptococcus* IE hospitalization rates were significantly higher after the release of new guidelines ($p = 0.002$). Finally, valve replacement rates for IE steadily increased from 2000 to 2007 ($p = 0.03$) but showed a plateau from 2007 to 2011. Overall, there was no significant difference in the rates of valve replacement for IE before and after the release of new guideline ($p = 0.23$).

CONCLUSIONS These results show that IE incidence has increased in the United States over the past decade. With regard to the microbiology of IE, there has been a significant rise in the incidence of *Streptococcus* IE since the 2007 guideline revisions. However, the rates of hospitalization and valve surgery for IE have not increased since the change in IE prophylaxis guideline in 2007. (J Am Coll Cardiol 2015;65:2070–6) © 2015 by the American College of Cardiology Foundation.

The epidemiology of infective endocarditis (IE) has changed over the years because of changes in the prevalence of risk factors, as well as improved diagnostic tools and management. Although there has been a reduction in rheumatic heart disease in United States (1), there has been an increase in invasive procedures as well as an increase in high-risk groups, such as intravenous drug users and those with human immunodeficiency virus and diabetes mellitus (2–5). Furthermore, the increase in the survival of IE risk-prone populations, such as adults with congenital heart disease and prosthetic

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Manuscript received December 23, 2014; revised manuscript received March 3, 2015, accepted March 9, 2015.

device implants, also contributes to increasing IE incidence. Finally, global trends in infectious disease epidemiology also may affect trends in IE. A revised guideline for antibiotic prophylaxis for the prevention of IE was released in 2007 by the American Heart Association (AHA) and the American College of Cardiology (ACC) (6). According to the new guidelines, antibiotic prophylaxis is restricted to only a small number of cardiac conditions with high risk for adverse outcomes from IE. However, there is a paucity of data on IE trends since this major change in practice guidelines in the United States.

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Through our study, we sought to: 1) identify trends in the incidence of IE before and after the publication of the new guideline for antibiotic prophylaxis for IE in 2007; 2) assess trends in the microbiology of IE over the past decade; and 3) assess the trend in valve replacement before and after the change in the guideline.

METHODS

DESIGN. We performed a retrospective observational cohort study, using the Healthcare Cost and Utilization Project NIS (Nationwide Inpatient Sample) database, sponsored by the Agency for Healthcare Research and Quality (7). We used the International Classification of Diseases, Ninth Revision, Clinical Modification code to identify patients discharged with acute and subacute bacterial endocarditis between 2000 and 2011 (Online Appendix). Similarly, the microbiology, as well as valve replacement, were identified using appropriate procedure codes. With regard to microbiology, 4 groups were included: *Staphylococcus*, *Streptococcus*, Gram negative (GN), and fungi. We excluded endocarditis due to syphilis, rheumatic heart disease (without infection), gonococcal endocarditis, and lupus or other noninfectious causes. We used weights provided with the NIS to generate national estimates.

ABBREVIATIONS AND ACRONYMS

ACC = American College of Cardiology

AHA = American Heart Association

GN = Gram negative

IE = infective endocarditis

STUDY POPULATION. The NIS database is the largest all-payer database (Medicare, Medicaid, private insurance, and uninsured) of hospital inpatient stays available in United States (excluding the federal, institutional, and short-term rehabilitation hospitals). Each year, the NIS data are updated to approximately represent a 20% stratified sample of U.S. hospitals. Each individual hospitalization is deidentified and maintained in the NIS as a unique entry with 1 primary discharge diagnosis and ≤24 secondary diagnoses during that hospitalization. Each entry also contains information on demographic details, including age, sex, race, insurance status, primary and secondary procedures (up to 14), hospitalization outcome, total charges, and length of stay. Data from the NIS have been previously used to identify, track, and analyze national trends in health care utilization, patterns of major procedures, trends in hospitalizations, charges, quality, and outcomes (8–10). They also have been used to study the epidemiology of IE in the United States in the past (11,12).

STATISTICAL ANALYSIS. We used Stata IC version 11.0 (StataCorp LP, College Station, Texas) and SAS version 9.2 (SAS Institute Inc., Cary, North Carolina)

TABLE 1 Incidence of IE, Microbiology, and Valve Replacement From 2000 to 2011

Year	Total No. of IE Cases	Incidence of IE per 100,000 Population	Valve Replacement per 1,000 IE Cases	Staphylococcal IE per 1 Million Population	Streptococcal IE per 1 Million Population	Gram-Negative IE per 1 Million Population	Fungal IE per 10 Million Population
2000	29,820	11	14	35	26	6	6
2001	31,526	11	16	38	28	5	11
2002	32,229	11	19	38	29	6	11
2003	35,190	12	18	42	29	7	12
2004	36,660	13	19	46	29	7	11
2005	37,508	13	23	46	31	8	15
2006	40,573	14	23	50	32	8	14
2007	38,207	12	30	46	32	8	17
2008	41,143	14	19	51	35	8	17
2009	43,502	14	27	57	38	12	16
2010	43,560	14	27	55	38	12	17
2011	47,134	15	26	61	42	12	20

IE = infective endocarditis.