better to incorporate both cancer characteristics and patient LE into decision making.

![Figure](image-url)

**Figure.** Percentage of patients with moderate-risk (A) and low-risk (B) tumor characteristics receiving curative therapy over time, stratified by life expectancy (LE).

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**Author Contributions:** All authors had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.

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**Online-Only Material:** The eAppendix is available at http://www.archinternmed.com.


**Increasing US Rates of Endocarditis With Staphylococcus aureus: 1999-2008**

Estimates of the incidence and impact of bacterial infective endocarditis (IE) have been limited by the infrequency of the disease. Administrative data analyses can provide important information across a broad range of hospitals and regions. We used a recent nationally representative sample\(^1\) to estimate the incidence of hospitalizations for bacterial IE in the United States.

**Methods.** We conducted a retrospective cohort study using the 1999 through 2008 Nationwide Inpatient Sample (NIS), which is produced by the Agency for Healthcare...
Research and Quality. The NIS is the largest all-payer inpatient database in the United States (approximately 8 million records per year). Admissions related to bacterial IE were identified by the presence of International Classification of Diseases, Ninth Revision (ICD-9) codes 421.0, 421.1, 421.9, or 996.61, combining 2 previous strategies. The etiologic agent of IE was determined by the presence of organism-specific infection (eg, 041.x) and bacteremia codes (038.x). Incidence was estimated using the rate of IE-related discharges per 100 000 US population-years. Rates were calculated quarterly based on discharge date; the denominator was adjusted annually based on the US population.

Trends in admission rate were evaluated using jointpoint methods, allowing the trend to change over time. We measured the effect of organism on in-hospital mortality using logistic regression, adjusting for age, sex, payer, and comorbidities. The data set was constructed in SAS software, version 9.22 (SAS Institute Inc); analyses were performed in Stata/IC, version 11.2 (StataCorp LP) and the Joinpoint Regression Program, version 3.4.3 (National Cancer Institute), using the stratification and weighting the data provided in the NIS to create nationally representative estimates. Additional detail on study methods is available in the eAppendix (http://www.archinternmed.com).

Results. Of the 78.2 million records in the 1999 through 2008 NIS database, 93 511 met our inclusion criteria. Using weights, we determined that these records corresponded to 457 690 discharges nationwide. After exclusion of 9538 admissions that ended in inpatient transfer and 273 (0.3%) with unknown disposition, the main study sample consisted of 83 700 discharges (409 665 weighted). Most episodes involved patients who were male (59.3%), white (71.4%), and insured by Medicare (57.2%). Of those discharges for which an organism was identified, staphylococci were the most common (57.5%), followed by streptococci and/or enterococci (33.3%).

Between the first quarter of 1999 and the first quarter of 2006, the rate of bacterial IE–related hospitalizations increased from 11.4 per 100 000 population-years to 16.6 per 100 000 population-years (test of trend, P < .001). This trend corresponds to an average percentage change (APC) of 1.1% per quarter (95% CI, 0.9%-1.3%). After the first quarter of 2006, the rate stabilized, with an APC of 0.1% (95% CI, −0.6% to 0.8%). Substantial differences were evident in the rate of IE-related admissions caused by different organisms over the study period (Figure, A). Admissions associated with staphylococcal IE grew at a rate of 1.1% per quarter (95% CI, 0.9%-1.3%), rising from 3.3 to 5.4 cases per 100 000 population-years from first quarter of 1999 to the fourth quarter of 2008 (test of linear trend, P < .001). Most of the increase in staphylococcal IE admissions was due to IE caused by *Staphylococcus aureus*, which increased at a rate of 1.7% per quarter between the first quarter of 1999 and the first quarter of 2006 (95% CI, 1.3%-2.0%). Interestingly, rates of *S aureus*–associated IE stabilized between 2006 and 2008 (APC, 0.1%; 95% CI, −1.1% to 1.2%).

We limited the cohort to 33 956 admissions (165 563 weighted) that occurred in 2002 or later for which an etiologic organism was identified (excluding unknown organisms and unspeciated staphylococci) and that had complete covariate data. Admissions for *S aureus*–related IE were associated with a higher probability of in-hospital mortality than streptococcal and/or enterococcal IE (17.5% vs 8.9%) (P < .001). After adjustment, IE caused by *S aureus* was associated with a 57.1% greater risk of in-hospital mortality (risk difference, 5.9%) (P < .001) compared with streptococcal and/or enterococcal IE (Figure, B).

Comment. This report estimates the current incidence and trends in hospitalizations for bacterial IE in the United States at the beginning of the 21st century. We found that the rate of IE-related hospitalizations grew markedly and that this growth was driven primarily by increases in *S aureus* IE. Patients with *S aureus* IE were also more likely to die during the hospitalization. Since these findings were drawn from a representative sample of over 78 million hospitalizations, they are generalizable to contemporary medical practice.

Our finding that *S aureus* is the predominant cause of IE in the 21st century is consistent with results from the International Collaboration on Endocarditis. Our results contrast with those of Tleyjeh and colleagues, who found no significant change in IE rates or cause during the 1970-2000 period in Olmstead County, Minnesota.
The generalizability of that important study was limited by its small size (107 IE cases during the 30-year period), small geographic scope, and lack of racial and ethnic diversity. By contrast, the current investigation involved a nationally representative sample of contemporary US admissions.

This investigation has important strengths. Our study used a large, contemporary, and nationally representative data set. Such a data set avoids referral bias, ensuring that our results are broadly generalizable, and allows for sufficient sample size for statistical inference. The study is limited by its use of ICD-9 diagnosis codes, which have been associated with both false-positive and false-negative findings. However, others have reported good agreement between IE diagnosis codes and clinical criteria obtained from medical records. Our inability to access laboratory results resulted in a relatively high proportion of IE cases without organism identification (43.8%). However, the number of unidentified cases grew at a rate similar to that of identified cases (APC, 1.1% vs 1.2%), suggesting that our findings are not owing to improvements in coding.

Despite these limitations, our study is uniquely able to make a number of observations. We estimate the incidence of bacterial IE in the United States and document its increasing prevalence in the early 21st century. This growth is primarily attributable to increased rates of IE related to S. aureus, which was associated with worse outcomes and higher costs than IE caused by other organisms.

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