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Abstract

Purpose: Over the past decade, the media, politicians, practitioners, and researchers paid increasing attention to the risks involved in hospital admission at weekends. This study examined the impact of weekend admission on in-hospital mortality among U.S. adults and by sex, age, race/ethnicity, and disease category and tracked changes from 2003 to 2013.

Methods: Over 50 million hospital discharge data came from 2003 to 2013 National Inpatient Sample. Cox regressions were performed to estimate the hazard ratios of in-hospital mortality associated with weekend admission, adjusting for individual and hospital characteristics and National Inpatient Sample sampling design.

Results: Compared to weekday admissions, weekend admissions were associated with increased in-hospital mortality risk by 5% among all inpatients. Young adults (2.7%) had lower incremental mortality risk than middle aged (5.3%) and older adults (5.2%). Among the 10 leading causes of death, patients hospitalized at weekends due to malignant neoplasms (12.1%), diabetes mellitus (11.7%), and heart diseases (8.2%) had the highest incremental mortality risk. The estimated weekend effects tended to be more prominent among inpatients with higher assessed mortality risk. Incremental mortality attributable to weekend hospitalization decreased from 6.9% in 2003 to 2.5% in 2013.

Conclusions: Weekend admissions were associated higher in-hospital mortality, but the impact declined during 2003–2013.
and Quality (AHRQ). NIS is a nation's largest database of hospital inpatients derived from billing data submitted annually by hospitals to statewide data organizations across the United States. These inpatient data contain clinical and resource use information typically available from discharge abstracts, including patient demographic characteristics, primary and secondary diagnoses and procedures, length of stay, severity and comorbidity measures, payment source, total charges, discharge status, and hospital characteristics. NIS sampling frame covers 97% of the U.S. population and nearly the entire universe of discharges. Detailed information on NIS can be found on its website (https://www.hcup-us.ahrq.gov/nisoverview.jsp).

NIS tracks hospital discharges rather than unique patients, so that the same patient with multiple hospitalizations in a year is potentially sampled more than once. Therefore, the unit of analysis in this study was discharge. Over the period of 2003–2013, a total of 71,004,360 discharges were recorded in NIS pertaining to adult inpatients aged 18 years and above. Among these discharges, over a quarter (27.1%) were elective, that is, a doctor requested a bed be reserved for a patient on a specific day. Removing those elective discharges resulted in 51,762,178 nonelective discharges, which served as the study sample. The study sample contained 18.7% of missing values resulted from nonreporting of patients’ race/ethnicity by some hospitals and states. We constructed a dummy variable for unreported race/ethnicity so that the regressions could be performed over the entire sample. In a sensitivity analysis, we excluded the proportion of data with missing values for race/ethnicity. The estimated impact of weekend admission on in-hospital mortality remains fairly comparable as the one based on the entire sample incorporating the missing values. Therefore, we reported the modeling results based on the entire sample.

We chose to include data from NIS 2003 and onward because inpatient severity and comorbidity measures were only available from NIS 2002 and onward, and multiple inpatient characteristics such as residential ZIP Code’s median household income and urbanicity were unavailable or inconsistent in NIS 2002.

Weekend versus weekday admissions

NIS defined weekend admissions as those occurring between 12:01 AM Saturday through 11:59 PM on Sunday and considered all other admissions as weekday admissions (including national holidays that occurred at weekends). We constructed a dichotomous variable for weekend admissions (with weekday admissions in the reference group).

Inpatient characteristics

The following inpatient characteristics were controlled for in the regression analysis: a dichotomous variable for sex (men, with women in the reference group); two continuous variables for age in years and age squared (to account for potential nonlinear relationship between age and in-hospital mortality); five categorical variables for race/ethnicity (whites, blacks, Hispanics, and Asians or Pacific Islanders); assessed mortality risk (minor, moderate, major, and extreme likelihood of dying); and disease category. The disease categories comprise 10 leading causes of death according to the National Vital Statistics Reports [16], including diseases of heart (ICD-9 codes: 390–398, 402, 404, 410–429); malignant neoplasms (ICD-9 codes: 140–208); chronic lower respiratory diseases (ICD-9 codes: 490–494, 496); accidents (unintentional injuries) (ICD-9 codes: E800–E869, E880–E892); cerebrovascular diseases (ICD-9 codes: 430–434, 436–438); Alzheimer’s disease (ICD-9 code: 331.0); diabetes mellitus (ICD-9 code: 250); influenza and pneumonia (ICD-9 codes: 480–487); nephritis, nephrotic syndrome and nephrosis (ICD-9 codes: 580–589); and intentional self-harm (suicide) (ICD-9 codes: E950–E959). Disease categories were classified based on the ICD-9 codes of a patient’s primary diagnosis.

Hospital characteristics

The following hospital characteristics were controlled for in regression analysis: two continuous variables for annual total discharges and discharges squared (to account for potential nonlinear relationship between number of hospital discharges and in-hospital mortality); two categorical variables for bed size (medium and large bed size classified by NIS, with small bed size in the reference group); two categorical variables for teaching status (urban nonteaching and urban teaching hospitals, with rural hospitals in the reference group); and three categorical variables for location (Midwest, South, and West, with Northeast in the reference group).

Statistical analysis

Weekend admission rate, length of stay, in-hospital mortality, and inpatient and hospital characteristics were summarized in descriptive statistics. Kaplan–Meier estimator was used to estimate the unadjusted survival function stratified by weekend/weekday admission. Cox proportional hazards regressions were performed to estimate the hazard ratios of in-hospital mortality associated with weekend admission, adjusting for individual and hospital characteristics and accounting for the NIS sampling design.

In subgroup analysis, Kaplan–Meier estimator and regression analysis were performed on subsamples stratified by sex (men and women); age group (young adults 18–44 years of age, middle-aged adults 45–64 years of age and above, and older adults 65 years of age and above); race/ethnicity (whites, blacks, Hispanics, and Asians or Pacific Islanders); assessed mortality risk (minor, moderate, major, and extreme likelihood of dying); and disease category. The disease categories comprise 10 leading causes of death according to the 2013 National Vital Statistics Reports [16], including diseases of heart (ICD-9 codes: 390–398, 402, 404, 410–429); malignant neoplasms (ICD-9 codes: 140–208); chronic lower respiratory diseases (ICD-9 codes: 490–494, 496); accidents (unintentional injuries) (ICD-9 codes: E800–E869, E880–E892); cerebrovascular diseases (ICD-9 codes: 430–434, 436–438); Alzheimer’s disease (ICD-9 code: 331.0); diabetes mellitus (ICD-9 code: 250); influenza and pneumonia (ICD-9 codes: 480–487); nephritis, nephrotic syndrome and nephrosis (ICD-9 codes: 580–589); and intentional self-harm (suicide) (ICD-9 codes: E950–E959). Disease categories were classified based on the ICD-9 codes of a patient’s primary diagnosis.
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