

Absence of a Weekend Effect on In-Hospital Mortality in Upper Gastrointestinal Bleeding: A Multisite Study from an Integrated Health System

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Abstract

Objectives

The “weekend effect” - worse outcomes among patients admitted on Saturdays or Sundays - has been reported in upper gastrointestinal bleeding (UGIB) and attributed to delayed endoscopy and reduced after-hours resources. We examined whether weekend admission is associated with worse outcomes within a contemporary integrated health system with continuous endoscopy availability.

Methods

We performed a retrospective cohort study of adults (18–89 years) admitted to Northwell Health hospitals with a primary or secondary diagnosis of UGIB between January 2019 and January 2024. Weekend admission was defined as arrival on a Saturday or Sunday. The primary outcome was in-hospital mortality; secondary outcomes were intensive care unit (ICU) admission, length of stay (LOS), and 30-day readmission. Groups were compared using chi-square and Wilcoxon rank-sum tests. A multivariable logistic regression model for mortality included weekend admission (forced entry), age, liver cirrhosis, and shock.

Results

Of 7,640 patients, 1,927 (25.2%) were admitted on a weekend. Baseline characteristics were broadly similar, although liver cirrhosis was modestly more frequent among weekend admissions (8.0% vs 6.5%, $P = 0.03$). Overall in-hospital mortality was 5.5% and did not differ by admission timing (adjusted odds ratio [aOR] 1.06, 95% CI 0.83–1.35, $P = 0.67$). Independent predictors of mortality were shock (aOR 19.08, 95% CI 15.33–23.76), liver cirrhosis (aOR 1.81, 95% CI 1.23–2.67), and age (aOR 1.04 per year, 95% CI 1.03–1.05). ICU admission (23.3% vs 21.9%, $P = 0.21$), median LOS (4.49 vs 4.66 days, $P = 0.43$), and 30-day readmission (1.8% vs 2.3%, $P = 0.18$) did not differ significantly.

Discussion

In a large multicenter cohort within an integrated health system, weekend admission was not associated with worse outcomes in UGIB. Disease severity, particularly shock and cirrhosis, was the dominant determinant of mortality. These findings support the effectiveness of standardized, 24/7 GI bleed care pathways in eliminating temporal disparities in UGIB outcomes.

STUDY HIGHLIGHTS

What is known

- The “weekend effect” - higher mortality after weekend admission - has been described across many acute conditions, including UGIB.
- Earlier UGIB studies linked weekend admission to higher mortality, particularly in nonvariceal bleeding, often attributed to delayed endoscopy and reduced after-hours resources.
- Whether this disparity persists in contemporary integrated systems with continuous endoscopy availability is uncertain.

What is new here

- Among 7,640 patients across a large integrated health system (2019–2024), weekend admission was not associated with in-hospital mortality, ICU admission, length of stay, or 30-day readmission.
- Disease severity—shock (aOR ≈ 19) and cirrhosis (aOR ≈ 1.8)—dominated mortality risk, whereas admission timing did not.
- The findings support standardized 24/7 GI bleed pathways as a means of eliminating temporal disparities in UGIB outcomes.

INTRODUCTION

Upper gastrointestinal bleeding (UGIB) remains a common medical emergency, with a reported incidence in North America of approximately 40 to 150 cases per 100,000 persons annually.¹ In-hospital mortality has historically ranged from 2% to 10% and remains substantially higher among patients with hemodynamic instability, advanced age, and significant comorbidity.^{1,2} Contemporary management requires rapid hemodynamic resuscitation, risk stratification using validated scores such as the Glasgow-Blatchford and AIMS65 scores, and timely endoscopic evaluation, generally within 24 hours of presentation.^{3,4}

The weekend effect describes the observation that patients admitted to acute-care hospitals on Saturdays or Sundays may experience worse outcomes than those admitted on weekdays. First characterized by *Bell and Redelmeier* in a population-based Canadian analysis, the phenomenon has been attributed to reduced weekend staffing, delayed access to specialized procedural services, attenuated senior supervision, and slower diagnostic turnaround.⁵ In UGIB, the proposed mechanism is intuitive: delays in endoscopic hemostasis, transfusion, or escalation of care during periods of constrained resources could translate into measurable harm.

Empirical data on the weekend effect in UGIB are inconsistent. An analysis of the Nationwide Inpatient Sample by *Shaheen and colleagues* demonstrated higher mortality among weekend admissions for peptic ulcer–related bleeding; notably, although weekend endoscopy was delayed, that delay did not fully account for the excess mortality.⁶ A 2018 systematic review and meta-analysis of 18 cohort studies (more than 1.2 million patients) confirmed an overall weekend effect on mortality that was concentrated in nonvariceal bleeding and accompanied by longer weekend time-to-endoscopy.⁷ Subsequent

investigations using contemporary administrative datasets and single-center cohorts have produced conflicting results, with some demonstrating attenuated or absent weekend effects and others showing persistent disparities, particularly among patients with variceal hemorrhage or those requiring urgent endoscopic intervention.^{8–10}

Northwell Health, the largest integrated health system in New York State, has implemented standardized GI bleed pathways across its hospitals, including structured 24/7 endoscopy availability, on-call interventional radiology, and protocolized initial resuscitation. Whether these system-level interventions abrogate temporal disparities in UGIB outcomes within a large, contemporary, ethnically diverse cohort has not been characterized.

We therefore conducted a retrospective multicenter cohort study to determine whether weekend admission is associated with worse in-hospital outcomes: mortality, ICU admission, LOS, and 30-day readmission, among adults hospitalized for UGIB across Northwell Health hospitals.

METHODS

Study design and setting

We performed a retrospective multicenter cohort study using electronic health record (EHR) data from hospitals within the Northwell Health system, which comprises tertiary academic medical centers, regional community hospitals, and specialty hospitals across New York State. The study period spanned January 1, 2019, through January 31, 2024. The Northwell Health Institutional Review Board approved the study and granted a waiver of informed consent given the use of de-identified retrospective data. The study is reported in accordance with the STROBE guidelines for observational research.

Study population

We included adults aged 18 to 89 years admitted to any Northwell Health hospital with a primary or secondary discharge diagnosis of UGIB, identified using International Classification of Diseases, Tenth Revision (ICD-10) diagnosis codes consistent with prior administrative database analyses of UGIB. Patients younger than 18 years, those older than 89 years, and those with incomplete admission-timing data were excluded.

Exposure and outcome definitions

The exposure of interest was weekend admission, defined a priori as hospital admission occurring between 00:00 on Saturday and 23:59 on Sunday; weekday admissions were those occurring Monday through Friday. Federal holidays falling on weekdays were not reclassified as weekend admissions.

The primary outcome was in-hospital mortality, defined as death during the index hospitalization. Secondary outcomes were (1) ICU admission, defined as any documented admission to an intensive care unit during the index hospitalization; (2) LOS, measured in days from admission to discharge; and (3) 30-day readmission, defined as any unplanned hospital readmission within 30 days of index discharge.

Covariates

Demographic covariates included age and sex. Clinical covariates extracted from the EHR included disseminated or metastatic malignancy, liver cirrhosis, altered mental status, acute kidney injury (AKI), sepsis, shock, and admission hemoglobin. Comorbid conditions were defined using a combination of ICD-10 codes and structured EHR flags consistent with institutional case definitions. Shock was defined by documented hemodynamic instability requiring vasopressor support or by a diagnosis code of hemorrhagic, septic, or undifferentiated shock during the admission. Hemoglobin reflected the first measured value at or near presentation.

We deliberately excluded in-hospital management variables that lie on the causal pathway between admission timing and mortality, such as time to endoscopy, packed red blood cell transfusion, rebleeding, and endoscopic therapy, from the primary mortality model. Adjusting for such mediators would bias the estimated effect of admission timing toward the null and obscure the system-level signal of interest.

Statistical analysis

Continuous variables were summarized as means with standard deviations and medians with interquartile ranges (IQR); categorical variables were summarized as frequencies and percentages. Between-group comparisons used chi-square or Fisher exact tests for categorical variables and the Wilcoxon rank-sum test for continuous variables, as appropriate.

To assess the independent association between weekend admission and in-hospital mortality, we constructed a multivariable logistic regression model. Candidate covariates were screened in univariable logistic regression; variables with $P < 0.10$ were retained for the final model, into which weekend admission was forced regardless of univariable significance. The final adjusted model included weekend admission, age (continuous), liver cirrhosis, and shock. Model discrimination was assessed using the c-statistic and calibration using the Hosmer–Lemeshow goodness-of-fit test. Covariate selection was constrained by the events-per-variable principle to mitigate overfitting. Missing data were limited (sex, $n = 3$; admission hemoglobin, $n = 85$) and were handled by complete-case analysis for the affected variables. All analyses were performed using SAS version 9.4 (SAS Institute, Cary, NC); two-sided P values < 0.05 were considered statistically significant.

RESULTS

Cohort characteristics

Among 7,640 adults hospitalized for UGIB across Northwell Health during the study period, 5,713 (74.8%) were admitted on weekdays and 1,927 (25.2%) on weekends. The mean age was 66.3 years (SD 16.6), and 55.4% were male. Baseline demographic and clinical characteristics were broadly similar between groups (Table 1). The median age was modestly lower among weekend admissions (69 years, IQR 56–78) than weekday admissions (70 years, IQR 57–80; $P = 0.04$), a difference unlikely to be clinically meaningful. Sex distribution did not differ ($P = 0.80$).

Table 1
Baseline demographic and clinical characteristics by admission timing.

Characteristic	Weekday (n = 5,713)	Weekend (n = 1,927)	P value
Age, years — mean (SD)	66.5 (16.7)	65.8 (16.3)	—
Age, years — median (IQR)	70 (57–80)	69 (56–78)	0.04
Male sex — n (%)	3,170 (55.5)	1,062 (55.2)	0.80
Liver cirrhosis — n (%)	373 (6.5)	154 (8.0)	0.03
Disseminated/metastatic malignancy — n (%)	241 (4.2)	77 (4.0)	0.67
Altered mental status — n (%)	93 (1.6)	36 (1.9)	0.48
Acute kidney injury — n (%)	1,450 (25.4)	487 (25.3)	0.92
Sepsis — n (%)	832 (14.6)	304 (15.8)	0.20
Shock — n (%)	477 (8.4)	177 (9.2)	0.26
<i>Continuous variables are reported as mean (SD) or median (IQR); categorical variables as frequencies and percentages. P values were derived from Wilcoxon rank-sum tests (continuous) and chi-square tests (categorical). Denominators for sex reflect three patients with missing data. IQR, interquartile range; SD, standard deviation.</i>			

Liver cirrhosis was slightly more prevalent among weekend admissions (8.0% vs 6.5%, $P = 0.03$). No significant between-group differences were observed in disseminated or metastatic malignancy (4.0% vs 4.2%, $P = 0.67$), altered mental status (1.9% vs 1.6%, $P = 0.48$), AKI (25.3% vs 25.4%, $P = 0.92$), sepsis (15.8% vs 14.6%, $P = 0.20$), or shock (9.2% vs 8.4%, $P = 0.26$).

Primary outcome: in-hospital mortality

Overall in-hospital mortality was 5.5% (421/7,640) and was nearly identical between groups (Table 3). In univariable analysis, advancing age (OR 1.035 per year, 95% CI 1.027–1.043, $P < 0.001$), liver cirrhosis (OR 1.50, 95% CI 1.07–2.09, $P = 0.02$), and shock (OR 20.01, 95% CI 16.13–24.84, $P < 0.001$) were each

significant predictors of mortality. Sex (OR 0.92, 95% CI 0.76–1.12, $P = 0.40$) and admission hemoglobin (OR 1.01 per g/dL, 95% CI 0.97–1.04, $P = 0.72$) were not associated with mortality.

Table 3
Primary and secondary clinical outcomes by admission timing.

Outcome	Weekday (n = 5,713)	Weekend (n = 1,927)	P value
In-hospital mortality – n (%)	315 (5.5)	106 (5.5)	0.67*
ICU admission – n (%)	1,252 (21.9)	449 (23.3)	0.21
Length of stay, days – median (IQR)	4.66 (2.54–8.70)	4.49 (2.74–8.86)	0.43
30-day readmission – n (%)	130 (2.3)	34 (1.8)	0.18
*P value from the multivariable logistic model adjusting for age, liver cirrhosis, and shock. Secondary-outcome P values are from unadjusted comparisons (chi-square for categorical variables; Wilcoxon rank-sum for length of stay). Total in-hospital mortality was 421/7,640 (5.5%); the multivariable model was fit on the full cohort. ICU, intensive care unit; IQR, interquartile range.			

In the multivariable model adjusting for age, liver cirrhosis, and shock, weekend admission was not associated with in-hospital mortality (aOR 1.06, 95% CI 0.83–1.35, $P = 0.67$). Independent predictors of mortality were shock (aOR 19.08, 95% CI 15.33–23.76, $P < 0.001$), liver cirrhosis (aOR 1.81, 95% CI 1.23–2.67, $P = 0.003$), and age (aOR 1.04 per year, 95% CI 1.03–1.05, $P < 0.001$) (Table 2). The model demonstrated good discrimination (c-statistic 0.82) and adequate calibration (Hosmer–Lemeshow $P = 0.14$).

Table 2
Multivariable logistic regression model for in-hospital mortality.

Variable	Adjusted OR	95% CI	P value
Weekend admission (vs weekday)	1.06	0.83–1.35	0.67
Age (per 1-year increase)	1.04	1.03–1.05	< 0.001
Liver cirrhosis (vs none)	1.81	1.23–2.67	0.003
Shock (vs none)	19.08	15.33–23.76	< 0.001
Model c-statistic 0.82; Hosmer–Lemeshow goodness-of-fit $P = 0.14$. Weekend admission was forced into the model; other covariates were selected from univariable screening at $P < 0.10$. CI, confidence interval; OR, odds ratio.			

Secondary outcomes

ICU admission occurred in 23.3% of weekend admissions versus 21.9% of weekday admissions ($P = 0.21$). Median LOS was 4.49 days (IQR 2.74–8.86) for weekend admissions and 4.66 days (IQR 2.54–8.70) for weekday admissions ($P = 0.43$). Thirty-day readmission rates were 1.8% versus 2.3%,

respectively ($P = 0.18$). None of the secondary outcomes differed significantly by admission timing (Table 3).

DISCUSSION

In this multicenter retrospective cohort of 7,640 adults hospitalized for UGIB across an integrated health system, weekend admission was not associated with increased in-hospital mortality, ICU admission, LOS, or 30-day readmission. After adjustment for age, liver cirrhosis, and shock, the odds ratio for mortality among weekend admissions approximated unity (aOR 1.06, 95% CI 0.83–1.35). Disease severity, particularly shock and underlying cirrhosis, was the dominant determinant of mortality, with shock conferring an approximately 19-fold increase in adjusted odds of death.

These findings contrast with several earlier reports. *Shaheen and colleagues*, using the Nationwide Inpatient Sample, observed higher weekend mortality for peptic ulcer bleeding,⁶ and a 2018 systematic review and meta-analysis confirmed an overall weekend effect that was, importantly, confined to nonvariceal bleeding and absent for variceal hemorrhage; the same analysis noted that the contribution of delayed endoscopy may be diminishing in the era of guideline-driven early endoscopy.⁷ *Abougergi and colleagues* similarly reported a weekend effect in a nationwide cohort.⁹ In contrast, a large UK prospective study found no difference in weekend versus weekday mortality after adjustment, despite weekend patients being more critically ill and experiencing longer delays to endoscopy.¹⁰ Our results align with this latter pattern. The most parsimonious interpretation is that institutional commitment to standardized care delivery, including dedicated GI bleed pathways, on-call endoscopy, and protocolized resuscitation, can attenuate or eliminate temporal disparities that were observable in earlier eras of less uniform after-hours staffing.

A null result here should not be read as a failed investigation; it is positive evidence that contemporary system-level interventions can deliver equivalent care across the temporal continuum. Within Northwell Health, the structural elements that plausibly contribute to this equivalence include continuous on-site or on-call gastroenterology coverage, embedded interventional radiology backup for refractory hemorrhage, institutional standardization of restrictive transfusion strategies, and integrated EHR-based order sets for risk stratification. Each addresses a mechanistic pathway through which weekend disparities have historically arisen.

The hierarchy of mortality predictors merits clinical emphasis. Shock conferred an adjusted odds ratio of approximately 19, far exceeding the effect of any temporal or demographic variable. This is consistent with prior evidence that hemodynamic compromise at presentation is the single strongest determinant of short-term mortality in UGIB and underscores the centrality of rapid resuscitation, point-of-care hemodynamic assessment, and early escalation to critical care, irrespective of the day of admission.^{3,4} Liver cirrhosis, with an adjusted odds ratio of 1.81, highlights the vulnerability of patients with portal hypertensive bleeding and hepatic synthetic dysfunction, in whom integrated hepatology consultation,

urgent endoscopic band ligation, and consideration of transjugular intrahepatic portosystemic shunt placement remain important determinants of survival.

Several methodologic features strengthen these findings. The cohort is large, drawn from a diverse population across multiple care settings within a single integrated system, and reflects contemporary practice. The pre-specified exclusion of in-hospital management variables, time to endoscopy, transfusion, rebleeding, and endoscopic intervention, from the primary mortality model is methodologically important: these variables lie on the causal pathway between admission timing and outcome, and their inclusion would constitute mediator adjustment and bias the exposure–outcome estimate toward the null. Future mediation analyses leveraging these process-of-care variables may help quantify the proportion of any residual temporal effect attributable to specific care-delivery domains.

Several limitations warrant consideration. First, the retrospective observational design precludes causal inference; unmeasured confounding, including bleeding etiology (variceal vs nonvariceal), specific anticoagulant or antiplatelet use, and severity-of-bleeding scores at presentation, may remain. Second, although the cohort is large, single health-system experience may limit generalizability to institutions without continuous endoscopy coverage or comparable infrastructure. Third, we did not stratify by bleeding source; future analyses incorporating endoscopic diagnostic data would permit examination of etiology-specific weekend effects, particularly for variceal hemorrhage. Fourth, the modest between-group difference in median age, while statistically significant, is clinically inconsequential and was accounted for in the multivariable model. Fifth, we did not examine holiday admissions, off-hours admissions within the weekday period, or seasonal variation.

In conclusion, weekend admission was not associated with worse clinical outcomes among adults hospitalized for UGIB across a large integrated health system. Disease severity, particularly shock and liver cirrhosis, dominated the risk landscape for in-hospital mortality. These findings provide reassurance that standardized, protocolized care delivered through dedicated GI bleed pathways and continuous endoscopy availability can mitigate the temporal disparities historically described in UGIB. Continued investment in system-level quality infrastructure, rather than redistribution of weekday resources alone, appears central to sustaining equitable outcomes in this common gastroenterologic emergency.

Declarations

Conflicts of interest:

The authors disclose no financial conflicts of interest related to this work.

Ethics statement

This retrospective cohort study was reviewed and approved by the Northwell Health Institutional Review Board, which granted a waiver of informed consent given the use of de-identified data.

Funding:

No external funding was received for this study.

Author Contribution

A.S. conceived the study, performed the literature review, and drafted the manuscript. J.J. designed and performed all statistical analyses. U.S.A.V. and B.G. contributed to data acquisition and interpretation. L.D. provided senior supervision, study oversight, and critical revision. All authors reviewed and approved the final version of the manuscript.

Data Availability

The data underlying this study are not publicly available because they consist of patient-level electronic health record data from Northwell Health containing protected health information. Public deposition is precluded by patient privacy obligations under the Health Insurance Portability and Accountability Act (HIPAA), by Northwell Health institutional policy, and by the terms of the Institutional Review Board approval, under which the data were obtained with a waiver of informed consent for retrospective use. De-identified data may be made available by the corresponding author on reasonable request, subject to a data-use agreement and the requisite institutional and IRB approvals. No data were deposited in a public repository, and no DOI or accession code is therefore available.

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