

ORIGINAL ARTICLE

The weekend effect does not influence management of inflammatory bowel disease

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Introduction

Weekend effect describes the increase in morbidity and mortality seen in hospitals over the weekend compared to weekdays.^{1,2} This has been examined extensively in many studies from around the world in a variety of specialties.³ It has been hypothesized that patients requiring weekend admission are managed with decreased staffing⁴ despite requiring increased resources,³ which is among the multitude of reasons for worse outcomes in this cohort.

Inflammatory bowel disease (IBD) is comprised of ulcerative colitis and Crohn's disease, chronic gastrointestinal disorders with multifactorial etiology involving immunology, genetics, and microbiology playing roles in the pathogenesis of the disease.⁵ However, in recent years, this has been viewed as less of an autoimmune disease and more of a 'complex barrier disorder'.⁵ As the pathophysiology is quite intricate, investigation of IBD is a particularly active area of research at the moment. This may in part be attributed to the devastating mental, physical, and financial effects of IBD.^{5,6} Although largely managed in the outpatient

Abstract

Background: The weekend effect describes worsened outcomes due to perceived inefficiency occurring over the weekend. This effect has not been studied in inflammatory bowel disease (IBD) despite increasing prevalence in the community. Therefore, our aim is to assess differences in the outcomes of weekend *versus* weekday management of IBD exacerbations.

Methods: The National Inpatient Sample database comprises approximately 20% of admissions to nonfederal hospitals in the United States. Complications requiring hospitalization ("flares") were the criteria upon which patient selection was based. A total of 193,848 flares were identified from 2008 to 2014 using the International Classification of Diseases 9th edition codes. Differences in time to first procedure, length of stay (LOS), and cost were evaluated for patients with flares between weekend and weekday admissions.

Results: The time to first procedure was 3.33 days on weekends *versus* 3.19 days on weekdays ($P < 0.001$). The mean LOS was shorter when admissions occurred on weekends *versus* weekdays (8.01 days *vs* 8.22 days, $P < 0.001$). Finally, the cost of hospitalization was higher for weekday admissions *versus* weekend admissions (\$18 072 *vs* \$17 495, $P < 0.001$).

Conclusion: Our results showed a similar LOS and cost associated with the management of exacerbations on the weekend compared to weekdays. While many high-risk conditions exhibit increased mortality and prolonged hospital course over the weekend, this phenomenon does not appear to affect IBD. These findings indicate efficient patient care on the weekend and can be utilized for logistical purposes such as resource allocation and procedure scheduling in the endoscopy suite.

setting, "flares" are acute episodes of disease worsening that often require hospital admission for surgery, steroids, or further medical management.⁷

To date, few studies have evaluated the effect that weekend management has on the disease course in IBD. It is our aim to investigate the monetary/economic effects of weekend management of IBD, as well as the overall influence on morbidity and mortality.

Materials and methods

Data source. The National Inpatient Sample (NIS) is the largest national inpatient database. It is sponsored by the Agency for Healthcare Research and Quality and contains longitudinal data from 1988 to 2016. While Federal VA Medical Centers, nursing homes, and long-term care facilities are excluded from contributing to the NIS database, records are obtained from several sources, including community and private hospitals.⁸ NIS is comprised of 20% of all discharge records from these facilities.

Sampling weights are applied, which are then used to determine the national estimate of hospitalizations.^{8,9} NIS supplies information that can be obtained through administrative records such as discharge diagnoses, demographics, payer status, charges incurred during admission, hospitalization length of stay (LOS), mortality, and comorbidities.^{8,9} However, diagnostic information such as laboratory values and imaging studies are not readily available. Nevertheless, several works have utilized this database and found it to have far-reaching clinical applications; thus, it was used for this study.

Study design and cohort. Previous works have shown that patients fare worse when admitted to the hospital for serious medical conditions on the weekend.^{1,2} This is a retrospective cohort study conducted using NIS database records of 2008–2014. The International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9 codes) was utilized to select patients with IBD flares within the NIS database. This population with IBD flares was divided into those patients with hospital admission on the weekend and those admitted on the weekday. This work evaluated whether there were worsened outcomes (i.e. increased LOS, increased cost of hospitalization, and death) for those patients admitted on the weekends compared to the weekdays.

Inclusion criteria were all adults (≥ 18 years old) with ulcerative colitis or Crohn's disease who also experienced flares, necessitating hospital admission between 2008 and 2014. This was performed by selecting patients with a primary ICD-9 code of ulcerative colitis (556.x) or Crohn's disease (555.x) or a secondary ICD-9 code of ulcerative colitis or Crohn's disease and a primary ICD-9 code of an IBD-related complication. Flares were defined as IBD-related complications and included: gastrointestinal hemorrhage (578.1, 578.9, 569.3), intestinal obstruction (560.x, 568.0), and fistula or intra-abdominal abscess (537.4, 565.1, 567.x, 569.5, 569.81, 569.83, 596.1, 619.1); stricturing disease (560.9, 569.2, 537.3); perianal abscess (566.x, 569.4x); hypovolemia (276.5x); anemia (280.x, 285.1, 285.9); electrolyte imbalance (276.1, 276.8, 275.2, 275.3); or malnutrition (260, 261, 262, 263.x).⁵ Exclusion criteria were patients younger than 18 years of age, without a formal diagnosis of ulcerative colitis or Crohn's disease.

The hospitalizations were then divided into admissions on weekends and admissions on weekdays, and primary endpoints were determined. These included differences in time to first endoscopy or colonoscopy, LOS, cost of admission, and mortality. As defined by NIS, mortality refers to death due to any cause, which occurred during the course of the hospitalization. This definition also applies to mortalities that occurred in this study. Moreover, values were adjusted for comorbidities via the Deyo modification of the Charlson Comorbidity Index. Statistical analyses were performed to measure the significance of these findings.⁸ As shown in Table 2, the NIS database was also queried to identify demographic variables, including patient age, race, gender, hospital size, hospital region, and hospital teaching status.⁹ As mentioned above, weighed values were analyzed for each admission to control for variations among hospitals in the study.⁹

Data handling and analyses. Linear and multiple logistic regressions of data were performed using Statistical Package for the Social Sciences (SPSS-version 22.0, Chicago, IL, USA). Primary outcome measures (time to first endoscopy/colonoscopy, LOS, cost of admission, and mortality) were determined for both ulcerative colitis and Crohn's disease patients for weekend admissions *versus* weekday admissions. A P -value < 0.05 was considered statistically significant. Categorical variables include age and gender, as well as any complications; these variables were evaluated with the Chi Square test. Continuous variables included age, LOS, and cost of admission and were evaluated using an independent sample t test. Moreover, comorbidity comparison utilized the Chi-square test, and longitudinal LOS was computed with the one-way ANOVA.

Ethical considerations. The data in the NIS are publicly available, and as a retrospective study, no patients were actively involved in the data collection process. Thus, it was not subject to Institutional Review Board approval, and informed consent was not needed.⁵

Results

As shown in Table 1, between 2008 and 2014, there were 206, 251 cases of IBD flares identified. After adjusting for race, gender, and age, there were actually 193 848 cases, with 152 089 cases admitted on weekdays *versus* 41 759 cases on a weekend. When analyzing the demographics of the population, the median age for weekend and weekday was between 49 and 50 years old. A predominance of women was noted throughout the study, but there was no significant difference between these cohorts (56.8% females in weekday cohort *vs* 57.3% females in weekend cohort, $P = 0.059$). There was a majority of Caucasians affected in both populations, followed to a lesser extent by Blacks ($P < 0.001$). As seen in Table 2, the cohort of patients in the southern United States comprised nearly half of the patients in the study ($\sim 41\%$), which was statistically significant ($P < 0.001$). It was also observed that, in both populations, there was a greater proportion of IBD flares treated in larger teaching hospitals *versus* non-teaching hospitals ($P < 0.001$).

There is a nearly fourfold increase in the admissions encountered on the weekday compared to the weekend

Table 1 Patient demographics

Variable	All patients	Weekend admissions	Weekday admissions	P value
Total population	193 484	41 759	152 089	
Median age (years)	49	50	49	< 0.001
Gender				0.059
Female	56.90%	57.30%	56.80%	
Male	43.10%	42.70%	43.20%	
Race				< 0.001
Caucasian	73.70%	73.10%	73.90%	
Black	13.70%	13.90%	13.60%	
Hispanic	7.90%	8.10%	7.80%	
Asian	1.40%	1.60%	1.40%	
Native American	0.40%	0.50%	0.40%	

Table 2 Hospital characteristics

Variable	All patients (%)	Weekend admissions (%)	Weekday admission (%)	<i>P</i> value
Hospital bed size				
Small	11.00	10.90	11.10	
Medium	25.30	25.10	25.30	
Large	63.00	63.10	62.90	
Hospital region				<0.001
Northeast	18.80	18.40	18.90	
Midwest	21.60	21.40	21.60	
South	40.90	40.80	40.90	
West	18.70	19.50	18.50	
Hospital teaching status				<0.001
Teaching	53.90	54.50	51.70	
Non-teaching	46.10	45.50	48.30	

(~160 000 vs 60 000 admission), shown in Table 3. This trend is likely a result of greater availability during the week. The time to first endoscopy or colonoscopy was 3.33 days on weekends *versus* 3.19 days on weekdays ($P < 0.001$). LOS between the weekday *versus* weekend cohort (8.01 days *vs* 8.22 days) was clinically very similar. The cost of hospitalization was minimally higher in weekday admissions *versus* weekend admissions (\$18 072 *vs* \$17 495, $P < 0.001$). Interestingly, the mortality rate was 1.2% in the total population, as well as both the weekday and weekend admissions. As devastating as IBD can be, it is not a frequent source of mortality. When comparing the severity of illness, the Charlson Comorbidity Index showed that both populations were very similar. Using linear logistic regression and binary logistic regression models and adjusting for baseline patient demographics, comorbid conditions, and hospital characteristics, the time to first procedure, LOS, and cost remained statistically significant.

Table 4 demonstrates the various IBD complications with which patients originally presented. There was a large proportion that developed electrolyte abnormalities, both on the weekend

Table 3 Descriptive characteristics

Variable	Weekend admissions	Weekday admissions	<i>P</i> value
Original weighted cases	44 328	161 923	
Weighted cases (adjusted for age, race, and gender)	41 759	152 089	
Mean time to procedure (days)	3.33 (SD 8.37)	3.19 (SD 8.91)	$P < 0.001$
Mean LOS (days)	8.01 (SD 8.37)	8.22 (SD 8.91)	$P < 0.001$
Cost of admission	\$17 495.39 (SD \$24 793)	\$18 071.89 (SD \$23 777)	$P < 0.001$
Mortality	1.20%	1.20%	

LOS, length of stay.

Table 4 Inflammatory bowel disease complications

Complication	Total (%)	Weekend (%)	Weekday (%)	<i>P</i> value
Fistula or abscess	3.10	2.70	3.10	<0.001
Stricture Disease	5.60	6.10	5.40	<0.001
Obstruction	10.40	9.90	10.50	<0.001
Perianal abscess	1.20	1.30	1.20	<0.05
GI bleeding	4.80	5.30	4.60	<0.001
Electrolyte abnormalities	22.10	24.80	21.40	<0.001
Anemia	26.50	26.40	26.60	<0.05
Malnutrition	8.30	8.30	8.30	0.28
Any other complication	52.60	54	52	<0.001
Colonoscopy or Flex Sig	13.60	14.30	13.40	<0.001
EGD	7.90	8.30	7.80	<0.001

EGD, esophagogastroduodenotomy; Flex Sig, Flexible Sigmoidoscopy.

and the weekday (22.1% overall). This was followed by obstruction and stricture formation. While 26.5% of the total population developed anemia, there was no significant difference between the weekday and weekend cohort ($P < 0.05$). Otherwise, fistula, perianal disease, and bleeding were all present in a minority of cases. Colonoscopy was needed in 13–14% of cases, while endoscopy was only needed in 7–8% of the total population ($P < 0.001$). Overall, both cohorts were affected to the same degree by the various IBD complications, and while there were statistically significant differences, these were clinically apparent.

Table 5 shows the distribution of comorbidities between the two cohorts from 2008 to 2014. There is a predominance of hypertension and anemia in this IBD population, followed to a lesser extent by hyperlipidemia and uncomplicated diabetes mellitus type 2. With the exception of hypertension and obesity, comorbid conditions are more heavily represented in the weekend population. While the overall Charlson Index score did not

Table 5 Chronic comorbidities

Comorbidities	Weekend (%)	Weekday (%)	<i>P</i> value
HTN	36.30	35.40	<0.001
DM2—no complications	12.40	12.10	<0.001
DM2—with complications	2.40	2.30	<0.001
CKD	7.90	7.40	<0.001
CAD	8.80	8.30	<0.001
Anemia	24.10	23.30	<0.001
CHF	5.70	5.00	<0.001
Obesity	7.40	7.60	<0.05
Asthma	5.80	5.90	<0.001
COPD	0.50	0.40	<0.001
HLD	14.60	14.40	<0.001
Liver disease	4.00	3.70	<0.001

DM2 complications—retinopathy, nephropathy, and neuropathy. Liver disease includes cirrhosis, non-alcoholic fatty liver disease, and alcoholic liver disease.

CAD, coronary artery disease; CHF, congestive heart failure; CKD, chronic kidney disease; COPD, chronic obstructive pulmonary disease; DM2, diabetes mellitus 2; HLD, hyperlipidemia; HTN, hypertension.

demonstrate a significant difference between the two cohorts, the slightly increased prevalence of chronic illnesses in the weekend cohort may account for their admission prior to Monday.

Discussion

There were a few interesting points with regard to demographics and hospital characteristics. Most cases of IBD flares were managed at larger teaching hospitals. This is probably due to the higher level of care required for severe exacerbations of disease. While IBD is usually equally distributed between males and females,¹⁰ in this study, females may have been predominantly affected (however, this is not statistically significant). In addition, other studies have demonstrated greater rates of IBD in the northern states, likely due to levels of ultraviolet exposure and Vitamin D.⁸ Stein *et al.* refers specifically to several states above the 40th parallel, namely, Illinois, Massachusetts, Connecticut, Iowa, Michigan, Minnesota, New Hampshire, Oregon, Rhode Island, Vermont, Washington, and Wisconsin.⁸ However, the greatest rates of IBD in this study were found in the southern states. This region was defined by the NIS regional designation, which includes South Atlantic states (Delaware, Maryland, District of Columbia, West Virginia, Virginia, North Carolina, South Carolina, Georgia, Florida), East South Central states (Kentucky, Tennessee, Mississippi, Alabama), and West South Central states (Oklahoma, Texas, Arkansas, and Louisiana). These findings could be attributed to practice variation⁸ or the diverse and varied nature of this disease. However, it may also be the case that this particular patient population is the most prone to IBD flares, requiring hospitalization. Finally, the Caucasian demographic was the dominant race affected with IBD, in keeping with previously published studies.

The weekend effect has been shown to influence management in several acute emergencies—myocardial infarction, abdominal aortic aneurysm, acute epiglottitis, and pulmonary embolism.¹¹ This often results in increased mortality rates on the weekend.^{3,11} Although IBD is usually managed in the outpatient setting, acute flares, especially involving hemorrhage or impending bowel perforation, are life-threatening and require hospital admission.¹² Indeed, approximately 31% of the total cost of IBD is a result of hospital admissions, with 12% due to surgery.⁶ Despite this, the weekend effect has never before been examined in this particular cohort. In other studies, the weekend effect has been attributed to decreased staffing on the weekend, unfamiliarity with patients, and reduced physician experience.^{3,11} Limited staffing may be a result of financial strains or employee discontent.³ Other studies further elaborate this point, citing decreased access to diagnostic services, higher error rates, prolonged delays, and increased rates of preventable adverse incidents² on the weekend. Typically, this would extend the hospital course; however, the opposite trend was noted in our analyses. Admissions on the weekend are, on average, 8.01 days compared to 8.22 days during the week ($P < 0.001$). While this may not appear clinically significant, the vast majority of conditions actually have a prolonged course admitted over the weekend.¹³ Indeed, shortened LOS decreases overall morbidity and mortality and decreases rehospitalization rates.³ Moreover, the cost of admission is slightly less over the weekend (\$17 500 *vs* \$18 000), which could create an impact on the US economy,

given the \$6.3 billion that is already spent annually on IBD management.⁶

It has been acknowledged that patients presenting on the weekend may be more critically ill,⁴ while staffing is decreased.^{1,11} Despite possibly requiring more resources for acuity of illness,¹⁴ there is a minimal difference in the overall hospitalization mortality, time, or cost of weekend admissions compared with the weekdays. Thus, it would appear that the weekend effect does not seem to influence weekend management of IBD. On the contrary, these figures actually demonstrate efficient use of resources during a time where asset utilization is of the utmost importance. Patients presenting with flares typically arrive in an acute stage of illness, whether over the weekend or weekdays. However, these figures should reassure patients (and managing teams) that weekend care is not suboptimal for IBD. In fact, if patients are in a position to decide if admission can be stalled through the weekend, these findings would urge against waiting to take advantage of possible accelerated care on the weekend.

To extrapolate these findings, if in fact hospitals are run in a more efficient manner on the weekend without increased mortality, there is a possibility of monetary gain by allocating more resources to this period. With additional funds or staffing, greater patient loads could be managed on the weekend, thereby creating more availability during the week.^{1,11} In theory, the hospital itself could benefit from more appropriate bed utilization and more organized patient placement.¹⁵ This concept is of great significance at the moment; in fact, several studies are focused on the importance of optimal bed management and its role in hospital dynamics and patient flow.^{16,17}

However, a few surgical journals demonstrate that there has been increased incidence of ulcerative colitis (not Crohn's disease) postoperative complications over the weekend in recent years.¹⁸ Despite this, our analyses (and the above cited study) demonstrate that the overall mortality, cost, and LOS within the same cohort remain largely unchanged between weekend and weekday hospitalizations. This discrepancy may be explained by the fact that surgery, while a crucial component of flare management, is not the sole therapy. Patients with severe and complicated flares are often treated with IV steroids, as well as biological medications, as inpatients.¹² Thus, these findings are reflective of only a fraction of the cohort of IBD flares. As a result, these postoperative complications may not drastically change outcomes over the weekend and are not course-altering events.

There are several strengths of this study. The NIS is a nation-wide record of hospital admission based on ICD-9-related parameters. The outcomes examined within this database reflect nation-wide data, which make the trends difficult to dispute. This longitudinal monitoring over decades make trends readily apparent. A limitation of NIS is the inability to follow individual characteristics, laboratory studies,¹⁸ and the quantity of yearly admissions for a given patient. As many academic centers contribute to the NIS database, it is unknown whether the admissions are a result of direct hospital admission or transfers from outside facilities (*i.e.* under-/overreporting). Moreover, as the database is predicated on the ICD-9 code, incorrect coding of a condition is possible and could significantly affect a study.¹³ Furthermore, if patients were given additional medications

(in addition to surgery or endoscopy), this is not reflected in NIS records.¹³

Conclusions

Our results showed a similar LOS and cost associated with the management of IBD exacerbations on the weekend compared to weekdays. While many high-risk conditions exhibit increased mortality and prolonged hospital course over the weekend, this phenomenon does not appear to affect IBD. As these findings do indicate efficient patient care, it should dispel some apprehension regarding the weekend treatment of IBD flares. In terms of future directions, it would be interesting to determine if additional resource allocation to the weekend would, in turn, improve weekday schedules and free physicians for other professional endeavors.

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