

The impact of weekends on outcome for emergency patients

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ABSTRACT – Levels of staffing and access to diagnostics at weekends are recognised to be significantly lower than on weekdays. It is unclear if subsequent inpatient mortality and readmission rates for acute medical admissions are increased for weekend admissions compared to those on a weekday. A large Canadian study demonstrated increased weekend mortality but does the Edinburgh healthcare model support these findings? This study analysed all hospital admissions in 2001 to the Royal Infirmary of Edinburgh for six predetermined diagnoses (total 3,244): chronic obstructive pulmonary disease, cerebrovascular accidents, pulmonary embolism, pneumonia, collapse and upper gastrointestinal bleed. We compared hospital mortality rates, readmission rates and hospital length of stay for weekend admissions as compared to those on a weekday. Weekend admission was not associated with significantly higher in-hospital mortality, readmission rates or increased length of stay compared to the weekday equivalent for any of the six conditions. The implementation of an acute medical admissions unit in the Royal Infirmary of Edinburgh, with consistent staffing levels and 24-hour access to diagnostics for the early phase of critical illness, may have helped address the discrepancy in care suggested by previous studies.

KEY WORDS: hospital mortality, length of stay, levels of staffing, medical admissions units, outcome assessment, readmission rates, weekday admission, weekend admission

Within the health service, levels of staffing and access to diagnostics at weekends are recognised to be significantly lower than on weekdays. Working at the weekend is unpopular and those who do often have less seniority and experience compared to their weekday counterparts. There are few data investigating this ‘weekend phenomenon’ or the impact of these staffing disparities on subsequent patient mortality and morbidity. Moreover, while there have been multiple previous studies examining in-hospital mortality amongst surgical patients, few data exist regarding mortality and morbidity of acute medical

admissions. A recent British study found that weekend admission to the surgical intensive care unit (ICU) was associated with an increased hospital mortality rate, although this disparity was not reproduced for weekend admissions to the medical ICU.¹

Of the few analyses to date regarding in-hospital mortality for weekend medical admissions as compared to those admitted on weekdays, studies in the USA and Canada have shown that for a number of predetermined emergency conditions, including ruptured aortic aneurysms, acute epiglottitis and pulmonary embolism, risk adjusted mortality is both significantly and generally increased for the weekend groups.²⁻⁴ Other international studies have found higher mortality rates among infants born at weekends^{5,6} and acute myocardial infarctions admitted on Saturdays and Sundays.⁷ These studies have suggested that this difference is not explained by any greater severity of illness in patients presenting at the weekend. A 2003 study of deaths after emergency medical admission showed that the major shortfalls of care occurred in those admitted at night and included delay in both seeing doctors and initiating investigations in treatment.⁸ The analyses have also demonstrated an increased length of inpatient stay for weekend medical admissions for certain conditions including syncope, pneumonia and upper gastrointestinal bleeds.^{4,9,10}

We conducted a study of admissions for six predetermined common medical emergencies to the medical assessment unit (MAU) at the Royal Infirmary of Edinburgh over a 1-year period, to examine whether the British healthcare model supported these findings.

Methodology

Data collection

We identified all hospital admissions to the Royal Infirmary of Edinburgh between 1 January 2001 and 31 December 2001 via the Lothian NHS Trust (PAS) database. From these, consecutive patients with the six preselected conditions were extracted according to the diagnostic code in the *International classification of diseases, tenth revision* (ICD-10) detailed as the primary reason for their hospital admission.

These patients were then identified according to

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the day of the week when they were admitted. ‘Weekend’ was defined as the period from midnight on Friday to midnight on Sunday, in line with hospital admission dataset statistics. This is also the timeframe used by the Canadian study² and so was utilised in this analysis for comparative purposes. Public holidays were incorporated within the weekend groupings. Further data extracted included age and gender of the patients, the course and length of their hospital stay, discharge data regardless of whether they died in hospital, were discharged home or transferred to another facility within the Trust, and details of readmission within 6 months of discharge date. We maintained the confidentiality of the study data.

Preselected conditions

The conditions selected were common emergency conditions that are treatable, cared for in clinical settings other than a critical care unit or emergency department, and in which early management in hospital may be expected to influence outcome. The six chosen conditions were:

- 1 cerebrovascular accidents (CVAs) (excluding subarachnoid haemorrhage, non-traumatic subdural haemorrhage and non-traumatic extradural haemorrhage)
- 2 chronic obstructive pulmonary disease (COPD), including bronchitis and emphysema
- 3 pneumonia (all causes)
- 4 pulmonary embolism (PE)
- 5 syncope and collapse
- 6 upper gastrointestinal bleeds (UGIB)

Chest pain was excluded because it can incorporate a number of different conditions and is often cared for within the specialised cardiac care unit setting.

Statistical analyses

We compared the in-hospital mortality rates (for both total length of stay and early mortality within 2 days of admission), readmission rates within 6 months of discharge and hospital length of stay, for patients admitted at a weekend with those of weekday admissions. Relationships between day of admission and mortality and readmission were determined using logistic regression. To assess for statistical significance, differences are expressed as odds ratios, both unadjusted and adjusted for age and sex, for patients admitted at a weekend compared to those admitted on a weekday, with 95% confidence intervals (CI). We did not adjust data for severity of illness on admission although we did subsequently look for information on those admissions that had passed through high dependency unit (HDU) and ICU settings.

Results

Among the six diagnoses of interest, there were 3,244 emergency admissions to the Royal Infirmary of Edinburgh during the 1-year study period: 2,306 (71.1%) were on a weekday and 938 (28.9%) at a weekend or public holiday. The main diagnoses were COPD, representing 25.3% of the total admissions, CVA (16.2%), PE (4.2%), pneumonia (17.3%), collapse/syncope (19.0%) and UGIB (18.0%). A breakdown by disease and admission day is shown in Table 1. Mean age on admission was 67.7 years ranging from 13 to 102 years. There were no differences in baseline characteristics between patients admitted on weekdays and those admitted at weekends (Table 1).

Mortality

A total of 332 (10.2%) patients died in hospital, 91 (2.8%) of these within 2 days of admission. For the 561 patients admitted with pneumonia, the mortality rate was significantly lower for those

Table 1. Numbers of emergency admissions and characteristics of patients admitted on weekdays and weekends.

Condition	Characteristic	Weekday admissions	Weekend admissions
All conditions	Total – n (%)	2,306 (71.1)	938 (28.9)
	Female – n (%)	1,058 (45.9)	464 (49.5)
	Age (years) – mean (SD)	67.4 (16.8)	68.5 (17.1)
	≤54 – n (%)	453 (19.6)	170 (18.1)
	55 – 69	611 (26.5)	222 (23.7)
	70 – 79	672 (29.1)	273 (29.1)
	≥80	570 (24.7)	273 (29.1)
COPD	Total – n (%)	595 (72.4)	226 (27.6)
	Female – n (%)	298 (50.1)	125 (55.3)
	Age (years) – mean (SD)	70.6 (9.9)	71.2 (9.3)
CVA	Total – n (%)	342 (65.3)	182 (34.7)
	Female – n (%)	176 (51.5)	91 (50.0)
	Age (years) – mean (SD)	74.2 (11.0)	76.1 (11.3)
PE	Total – N (%)	112 (81.8)	25 (18.2)
	Female – N (%)	54 (48.2)	15 (60.0)
	Age (years) – mean (SD)	59.6 (18.0)	59.0 (17.5)
Pneumonia	Total – n (%)	408 (72.7)	153 (27.3)
	Female – n (%)	173 (42.4)	76 (49.7)
	Age (years) – mean (SD)	65.7 (18.9)	65.3 (18.9)
Collapse	Total – n (%)	409 (66.3)	208 (33.7)
	Female – n (%)	195 (47.7)	104 (50.0)
	Age (years) – mean (SD)	67.0 (20.1)	68.9 (20.2)
UGIB	Total – n (%)	440 (75.3)	144 (24.7)
	Female – n (%)	162 (36.8)	53 (36.8)
	Age (years) – mean (SD)	61.5 (19.1)	59.0 (19.7)

COPD = chronic obstructive pulmonary disease; CVA = cerebrovascular accidents; PE = pulmonary embolism; UGIB = upper gastrointestinal bleeds.

admitted at a weekend as compared with those admitted on a weekday. Using logistic regression, after adjusting for age and sex, the odds ratio for death during total hospital stay, among weekend admissions relative to midweek admissions, was significant at 0.50 (0.27–0.88, $p = 0.015$) (Table 2). There was no difference in early mortality (≤ 2 days from admission) for patients with pneumonia.

For the remaining conditions, there was no significant difference in mortality for total length of stay or within 2 days of admission, according to whether patients were admitted on a weekend or weekday (Table 2).

Length of stay and discharge data

Weekend admission was not associated with an increased length of hospital stay for the group of conditions studied. For weekday admissions, median length of stay was 5 days (range 0–252 days). For weekend admissions, median length of stay was the same at

5 days (range 0–186 days). We also looked at those patients discharged within 7 days of admission. There was very little difference in the proportions of patients discharged on a weekday versus at a weekend for any of the six conditions.

Readmission data

For the six studied conditions, of the 2,912 (89.8%) admissions where the patient was ultimately discharged or transferred from hospital, 994 (34.1%) patients were readmitted to the Royal Infirmary of Edinburgh within 6 months, with any diagnosis, and 72 (7.2%) of these patients subsequently died in hospital. The readmission rates at 6 months were not significantly different for patients previously admitted at a weekend as compared with previous weekday admissions (Table 3).

We also looked at early readmission data: 409 (14.0%) returned within 28 days of discharge date and 141 (4.8%) returned within 7 days, and the weekday (69.5%)/weekend (30.5%) pattern reflected the overall study findings.

Overall, weekend admission was not associated with higher in-hospital mortality, increased early readmission or readmission within 6 months of discharge or increased hospital length of stay, compared to the weekday equivalent. For patients admitted with pneumonia, the mortality rate was significantly lower for those admitted at a weekend as compared with those admitted on a weekday.

Discussion

In recent years, 90% of the hospitals in Scotland that receive more than 3,000 acute medical admissions annually have

Key Points

Previous studies have shown increased mortality for patients admitted at weekends

For selected medical admissions our study showed no weekday/weekend variability in mortality, length of stay or readmission rates

The role of medical admissions units and consistent access to diagnostics in supporting improved patient care should be considered

Table 2. In-hospital mortality for both total length of stay and early in-hospital mortality (≤ 2 days from admission).

Admission day	No of admissions	Mortality for total length of stay			Odds ratio (95% CI) for mortality within total length of stay			Early in-hospital mortality (≤ 2 days of admission)		Odds ratio (95% CI) for early in-hospital mortality		
		No of deaths	Mortality rate (%)		Unadjusted	Adjusted	p value	No of deaths	Mortality rate (%)	Unadjusted	Adjusted	p value
COPD	Weekday	595	36	6				17	3			
	Weekend	226	12	5	0.87	0.85 (0.42 to 1.62)	0.63	4	2	0.61	0.61 (0.17 to 1.66)	0.35
CVA	Weekday	342	99	29				28	8			
	Weekend	182	48	26	0.88	0.78 (0.51 to 1.18)	0.24	11	6	0.72	0.71 (0.33 to 1.43)	0.35
PE	Weekday	112	14	12				5	4			
	Weekend	25	2	8	0.61	0.61 (0.09 to 2.57)	0.53	0	0	–	–	–
Pneumonia	Weekday	408	76	19				11	3			
	Weekend	153	16	10	0.51	0.50 (0.27 to 0.88)	0.015	4	3	0.97	0.99 (0.27 to 3.01)	0.99
Collapse/syncope	Weekday	409	1	0.2				1	0.2			
	Weekend	208	0	0.0	–	–	–	0	0.0	–	–	–
UGIB	Weekday	440	19	4				5	1			
	Weekend	144	9	6	1.48	1.65 (0.69 to 3.71)	0.25	5	1	3.13	3.13 (0.93 to 12.81)	0.063

developed an acute admissions unit.¹¹ The medical assessment unit (MAU) at the Royal Infirmary of Edinburgh sees, on average, 1,500 patients per month. To be effective, such units must be appropriately resourced to provide a 24/7 service 365 days a year, with adequate staff numbers and staff mix and ready access to diagnostics and the allied health specialties, particularly physiotherapy and occupational therapy. The MAU has the same consultant and junior staffing ratios at weekends as mid-week, with four daily consultant ward rounds supplemented by therapy and pharmacy at weekends. Access to diagnostic radiology for investigations such as computed tomography of head and chest (CTPA) and ultrasound are similar throughout the 7-day period. Thus the previously described differences between mid-week and weekend admissions should be minimised.

On analysing more than 3,000 patients admitted through the unit over 1 year, we found that for the selected conditions, there was no increased risk of early or total in-hospital mortality in patients admitted at the weekend compared to the weekday equivalent. Admissions with pneumonia were, in fact, associated with a lower mortality for those patients admitted over a weekend. This is not readily explained and will merit further study. The fact that early pneumonia mortality is not significantly different would suggest that this does not relate to early consultant supervision or access to critical care. However, the study was designed to look for evidence of an adverse impact on weekend admission on clinical outcome and this was not reflected in any of the groups, including pneumonia.

We found no increase in hospital length of stay for weekend admissions versus weekday admission. In addition we found no increased rate of readmission for those previously admitted at a weekend over 6 months. Numbers readmitted within 7 days were small (141 patients) and the percentage re-admissions was

4.3% for weekday admissions and 4.6% for weekends. This is in contrast to recent work by the Scottish Executive Health Department which found that the number of elderly patients with repeated emergency admissions in a calendar year has been rising rapidly.¹² Our findings suggest that the apparent equality of care between weekends and weekdays may be the product of a healthcare model that aims to ensure equal provision of staffing and access to diagnostics and allied health services at weekends, thus facilitating optimisation of patients' outcomes.

The 2003 study investigating medical deaths after emergency medical admission has suggested that deaths often occur out of hours, at night, when staffing levels are low or when staff are more tired.⁸ This factor was not evaluated in this group of patients and certainly merits further analysis. The number and mix of staff are similar throughout the 24/7 cycle with the exception of the allied health professionals, whose numbers are slightly decreased at weekends.

In interpreting our findings, potential limitations of the study should be noted. Our data are limited to one large teaching hospital in Edinburgh and extrapolation to other areas requires further analysis. The outcomes of patients transferred out to other hospitals were not within the realms of this study, but may have attenuated or augmented our figures. We relied on administrative data that may have included coding errors, although it is unlikely that the accuracy of such information differed significantly between weekend and weekday admissions. All 3,244 admissions used in the study were coded, but the data did have missing information; of the 1,097 patients subsequently re-admitted, 20% had no main readmission diagnosis recorded and where the diagnosis was known, the spread of conditions was far wider than our six preselected conditions. Also, our study does not adjust for severity of illness on admission.

Table 3. Readmission within 6 months of discharge.

Condition	Day of admission	No discharged	No of readmissions	Readmission rate (%)	Odds ratio (95% CI)		
					Unadjusted	Adjusted	p value
COPD	Weekday	559	279	50	1.08	1.06 (0.77 to 1.46)	0.71
	Weekend	214	111	52			
CVA	Weekday	243	39	16	1.26	1.33 (0.76 to 2.31)	0.32
	Weekend	134	26	19			
PE	Weekday	98	20	20	1.08	1.10 (0.33 to 3.20)	0.86
	Weekend	23	5	22			
Pneumonia	Weekday	332	120	36	0.78	0.78 (0.50 to 1.20)	0.26
	Weekend	137	42	31			
Collapse/syncope	Weekday	408	102	25	1.05	1.04 (0.71 to 1.53)	0.83
	Weekend	208	54	26			
UGIB	Weekday	421	147	35	1.06	1.06 (0.71 to 1.59)	0.76
	Weekend	135	49	36			

Though we were able to use identifiers to track some patients through HDU and ICU settings, our study numbers are such that it may be statistically unsound to further process such adjustments. Nonetheless, previous studies have suggested that the increased mortality for weekend admissions is probably not due to unmeasured factors such as severity of illness.² Finally, the study does not allow for consideration of patients' satisfaction and other quality of care measures.

The 'no routine work at weekends' rule prevails in many hospitals, especially within the radiology departments (both diagnostic and therapeutic) and in the laboratory. Such practice conflicts with business practices in other sectors of society that aim for equality of activity regardless of the day of the week and can lead to the phenomenon of the 'lost hospital weekend'. This has both morbidity and mortality implications for groups of patients as well as financial and ethical consequences. Our findings indicate that weekend admission to the Royal Infirmary of Edinburgh MAU did not adversely affect patients' health outcomes and suggest that MAUs, which strive to provide equality of care with adequate staffing, senior review and access to diagnostics in the early phase of critical illness, may minimise previously observed discrepancies between weekend and weekday hospital care.

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