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Safe working in a seven-day service. Experience of Hip Fracture Care as documented by the UK National Hip Fracture Database

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ABSTRACT

Objective: to describe differences in care and 30-day mortality of patients admitted with hip fracture on weekends (Saturday–Sunday) compared to weekdays (Monday–Friday), and their relationship to the organisation of care.

Methods: data came from the National Hip Fracture Database (NHFD) linked to ONS mortality data on 52,599 patients presenting to 162 units in England between 1 January and 31 December 2014. This was combined with information on geriatrician staffing and major trauma centre (MTC) status. 30-Day mortality and care were compared for patients admitted at weekends and weekdays; separately for patients treated in units grouped by the mean level of input by geriatricians, weekend geriatrician clinical cover and MTC status. Differences were adjusted for variation in patients' characteristics.

Results: there was no evidence of differences in 30-day mortality between patients admitted at weekends compared to weekdays (7.2 vs 7.5%, $P = 0.3$) before or after adjusting for patient characteristics in either MTCs or general hospitals. The proportion receiving a preoperative geriatrician assessment was lower at weekends (42.8 vs 60.7%, $P < 0.001$). A 30-day mortality was lower in units with higher levels of geriatrician input, but there was no weekend mortality effect associated with lower levels of input or absence of weekend cover.

Conclusion: there was no evidence of a weekend mortality effect among patients treated for hip fracture in the English NHS. It appears that clinical teams provide comparably safe and effective care throughout the week. However, greater geriatrician involvement in teams was associated with overall lower mortality.

Introduction

The ongoing debate on increased mortality following weekend hospital admission and resultant pressures to expand seven-day services began with claims of an excess 30-day mortality of 11,000 deaths a year (1), and continued with concerns about the misrepresentation of such claims in support of radical and controversial staffing changes (2). Several investigations have expressed doubts about the 11,000 figure, including an investigation (3) pointing out that the weekend effect was strongest for presentations with high early mortality in the acute phase, such as abdominal aortic aneurysm and subarachnoid haemorrhage. This study also noted 'little or no weekend effect' for a range of conditions, including hip fracture.

Patients with hip fracture – who are generally old, often frail and admitted with the most serious common fracture - are among the most vulnerable of patients presenting acutely seven days a week. The UK National Hip Fracture Database (NHFD), a national collaborative clinician-led audit initiative was launched in 2007 to improve the quality of hip fracture care. Using agreed national clinical standards, a telephone helpline, data collection and continuous feedback on case-mix, care and outcomes, together with annual reports and regional meetings, it supports clinical teams and encourages the sharing of good practice.(4) Key standards of care, promoted by the NHFD, and incentivised under the Best Practice Tariff (BPT) scheme, (5) include surgery within 36 hours of admission, and medical review by a geriatrician within 72 hours.

A study using data from the NHFD linked to ONS mortality data for 2011-14 found no evidence that 30-day mortality was higher among patients admitted at the weekends compared to weekdays (6). However, an investigation of variations in care across different days of the week showed that patients who presented on Friday or Saturday were less likely to be medically reviewed by a geriatrician before having surgery (4). Neither study examined the relationship between the organisation of care, including levels of geriatrician staffing, and the presence or absence of a weekend mortality effect.

This study reports on the 30-day mortality of patients presenting with hip fracture treated in the English NHS; and explores the relationship between organisational characteristics and differences in care and mortality between patients admitted on weekdays (Monday-Friday) and weekends (Saturday-Sunday).

Methods

In 2014, there were 162 units providing acute hip fracture care in English NHS hospitals. We used data collected as part of the NHFD on the care of 52,599 patients admitted to these units between 1st January and 31st December 2014, linked to ONS mortality data. Times to surgery, to first assessment by a geriatrician, and to death were calculated using the difference between the time of initial presentation to A&E and time of each event, measured in hours. Extreme values (> 99th percentile) for the time-to-event variables were replaced with the 99th percentile value. Using data on the time of initial presentation to A&E, we were also able to distinguish weekend and weekday presentations. We excluded people who sustained a hip fracture while already in hospital (n = 2,194), since the time of initial presentation for this group would frequently relate to another condition.

We compared care and mortality for patients presenting at weekends (Sat-Sun) and weekdays (Mon-Fri) using means to summarize continuous time-to-event variables and percentages for binary variables. We adjusted differences in outcomes for variation in patients' characteristics, including age, sex, residence, anaesthetic (ASA) grade and pre-fracture mobility, using linear regression models for continuous outcome variables and logistic regression models for binary variables. We included units as random effects in these models to account for similarities in care and mortality among patients treated in the same unit compared to the population as a whole (i.e. across all units). For binary variables, adjusted relative differences are presented as odds ratios (ORs) with their 95% confidence intervals.

We repeated the analyses for sub-samples stratified by each of three organisational characteristics in turn: 1) whether the level of medical input by geriatricians was above or below the median input across all units (> 4 vs ≤ 4 hours per patient); 2) whether there was a reasonable level of weekend cover by geriatricians, defined pragmatically as $> 15\%$ of all new patients assessed on Saturday or Sunday; and 3) whether or not the unit was part of a major trauma centre (MTC) or general hospital. Information on geriatrician hours worked in the orthopaedic department, including consultant and middle grade doctors, was taken from the 2014 NHFD facilities survey (<https://nhfd.co.uk/>). This was divided by the number of patients treated for hip fracture to estimate the mean number of hours per patient within each unit.(7) The proportion of new patients assessed at weekends was estimated using individual records from the NHFD containing the day of assessment, aggregated to the unit level to estimate the proportion that occurred on Saturday or Sunday. MTC status was identified using a list provided by the Trauma & Audit Research Network for 2014 (<https://www.tarn.ac.uk/>).

Other studies have used alternative definitions of the weekend. We checked the robustness of our results by applying a measure that counted admissions between 5pm on Friday to 5pm on Sunday as weekend admissions since this may better reflect who will be initially assessed and treated by the weekend team. Results are presented for complete-case analyses, but we also checked the impact of imputing missing values of the ASA grade and pre-fracture mobility levels (see Appendix).(8)

Results

Fewer patients presented with a hip fracture at weekends (Sat-Sun) compared to weekdays - 13.5% on Saturday and 13.1% on Sunday, compared to 14.7% on weekdays, ranging from 14.4% on Friday to 14.9% on Monday.

There were only small differences in the observed characteristics of patients presenting at weekends (Appendix Table 1). The proportion of women was slightly higher (72.8% vs. 72.0%) and the proportion of patients admitted from a residential care or nursing home was slightly higher (19.9% vs 19.2%). The proportion with severe systemic illness (ASA grade 4-5) was slightly lower (12.5% vs 13.2%).

There were differences in the timing of care provided at weekends (Table 1). The proportion who had early surgery within 36 hours was lower (75.0% vs 76.4%) and the proportion receiving a preoperative medical assessment by a geriatrician was substantially lower (42.8% vs 60.7%).

There was no evidence of higher 30-day mortality among patients admitted at weekends compared to weekdays, either in MTCs or general hospitals (Table 2). In MTCs, mortality was slightly lower

among patients admitted at weekends. This may be partly attributable to the slightly better health status of patients presenting at weekends, but even after adjustment for measured patient characteristics, a small difference remained (see Appendix for further details).

Units with above-median levels of geriatrician input had significantly lower mortality at both weekends and weekdays than units with below-median levels of input (30-day mortality 7.1% vs 7.7%, $p < 0.0001$), but there was no weekend mortality effect in either group of units (Table 2). An estimated 19 units provided routine geriatrician cover at weekends (using cut-off of at least 15% of new patients assessed on Sat or Sun), in which higher proportions of patients were assessed pre-operatively by a geriatrician at weekends. There was no weekend mortality effect associated with the presence or absence of weekend geriatrician cover.

Discussion

These results represent an advance on the 'little or no weekend effect' findings of Roberts et al (3) and Sayers et al (4). They show that across all 162 units treating hip fracture in England, there was no statistically significant variation in 30-day mortality related to weekend admission, and this absence of a weekend mortality effect was not associated with particular organisational characteristics.

This result was robust in relation to the alternative definition of the weekend (ie, Friday 5pm to Sunday 5pm), to alternative, recommended ways of handling missing data (see Appendix) (8) and to adjustment for patient characteristics that have been found to predict 30-day mortality.(9)

The present analysis also identified small differences in the timing of surgical care provided at weekends, but more marked differences in medical care. In particular, patients were much less likely to be medically assessed by a geriatrician before their operation if they presented to A&E on Saturday or Sunday. This reflects that fact that the vast majority of units have full consultant cover by anaesthetists and orthopaedic surgeons over the weekend, whereas fewer have substantial consultant cover by geriatricians.

Importantly, in the present analysis of hip fractures during 2014, patients treated in units with above-median levels of geriatrician input overall had lower 30-day mortality. National clinical standards to promote geriatrician involvement in hip fracture care have been promoted by the NHFD initiative and incentivised under the Best Practice Tariff scheme since 2010 (6). Over the years 2010-2013, there was an increase of 2.5 hours per patient in the median number of hours worked by geriatricians in orthopaedic departments: from 1.5 to 4.0 hours. This increase was associated with higher rates of prompt surgery and, independently, with a reduction in mortality (7).

However, lower mortality associated with higher levels of geriatrician input did not appear to be specifically linked directly to geriatrician presence on the ward at weekends. There was no weekend mortality effect in units with lower levels of geriatrician input, or in those lacking geriatrician sessional cover on the wards at weekends.

In the context of concerns about radical and controversial staffing changes (2) that are still under discussion, these two pieces of evidence are of some interest. Measurably greater senior geriatrician involvement, predominantly on weekdays, reduces mortality. But there is no evidence that the lack of their sessional presence on the ward at weekends increases mortality. One

explanation for these findings could be that clinical teams who work well together seven days a week using protocols agreed by the three main disciplines (anaesthetics, orthopaedic surgery and geriatric medicine) provide safe and effective care throughout the week.

This study's main finding – that of no weekend mortality effect in hip fracture care – provides support for the view that safe care appears to be achievable throughout the week. It also confirms the benefits of greater geriatrician involvement in reducing mortality both at weekdays and weekends.

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Key messages:

- There was no weekend mortality effect among patients admitted with hip fracture in the English NHS.
- Mortality was significantly lower throughout the week in units with higher numbers of geriatrician hours per patient.
- It appears that clinical teams provide equally safe and effective care throughout the week
- Mortality did not differ between major trauma centres (MTCs) and other units.

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Authors' contributions

All authors took part in the design of the study and interpretation of the results. J.N. and C.C. drafted the article. All authors revised the article.

Conflict of interest

R.W., A.J. and C.B. are the clinical leads for orthopaedic surgery and geriatric medicine and the programme manager, respectively, for the NHFD. C.C. was formerly the lead for geriatric medicine (2007–10) and J.N., C.C. and D.C. previously carried out methodological work for the NHFD.

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Ethics approval

The project does not require NHS Research Ethics Committee approval because it involves secondary analysis of anonymised data. The project meets the requirements of the Office for National Statistics (ONS) for release of mortality data under Section 42(4) of the Statistics and Registration Service Act 2007 as amended by Section 287 of the Health and Social Care Act 2012.

Table 1 Differences in processes of care between patients admitted on weekends (Sat-Sun) vs other days (Mon-Fri)

	Weekend	Weekday	Adjusted difference‡ (95% CI)	p-value
<i>Surgical care</i>				
Underwent surgery	98.3%	98.0%	OR 1.07 (0.83 to 1.39)	0.60
Time to surgery (hours)†	29.4	29.7	Diff -0.1 (-0.5 to 0.4)	0.74
Surgery within 24 hours†	55.2%	55.8%	OR 0.96 (0.92 to 1.00)	0.06
Surgery within 36 hours†	75.0%	76.4%	OR 0.89 (0.85 to 0.94)	<0.001
<i>Medical care</i>				
Assessed by geriatrician	97.2%	97.4%	OR 0.82 (0.71 to 0.94)	0.003
Time to assessment (hours)†	38.2	32.3	Diff +6.0 (5.4 to 6.5)	<0.001
Assessed before surgery†	42.8%	60.7%	OR 0.45 (0.43 to 0.47)	<0.001
Assessed within 72 hours†	92.7%	90.5%	OR 1.39 (1.28 to 1.51)	<0.001

‡ Differences in care at weekends are expressed as differences in hours (to surgery, or assessment), or as odds ratios (ORs) for comparing odds of binary events at weekends vs. weekdays. Adjustment was made for age, sex, residence, ASA grade, pre-fracture mobility and hospital. Results are for samples with complete data on each of these variables (see Appendix).

† Mean hours to surgery and the % receiving surgery within specified time-frames were compared for only patients who had surgery, and who had the time of surgery documented (n = 49,405), likewise for geriatrician assessment (n = 47,924).

Table 2: Differences in 30-day mortality by weekend admission across organisational characteristics

Organisational characteristic (number of units)	Weekend	Weekday	Adjusted OR‡ (95% CI)	p-value
All units (N = 162)	7.2%	7.5%	0.98 (0.90 to 1.06)	0.56
Hospital type:				
Major trauma centre (N = 22)	6.3%	7.8%	0.78 (0.61 to 0.98)	0.03
General hospital (N = 140)	7.4%	7.5%	1.02 (0.94 to 1.11)	0.65
Average geriatrician input‡:				
> 4 hours per patient (N = 81)	6.5%	7.3%	0.91 (0.80 to 1.03)	0.13
≤ 4 hours per patient (N = 81)	7.8%	7.7%	1.03 (0.92 to 1.16)	0.59
Weekend geriatrician cover :				
Routine† (N = 19)	6.6%	7.2%	0.95 (0.76 to 1.18)	0.62
Not routine† (N = 142)	7.3%	7.6%	0.98 (0.90 to 1.07)	0.70

‡ Information on geriatrician hours worked in the orthopaedic department, including consultant and middle grade doctors, was taken from the 2014 NHFD facilities survey. This was divided by the reported number of hip fracture patients treated annually in the department.

† NHFD audit data on the date of geriatrician assessment were aggregated by unit to estimate the proportion assessed at the weekend (Sat-Sun). Units in which > 15% were assessed at weekends were classified as having routine geriatrician cover at weekends.