



# **CHKS Health Insight report**

## **Weekend mortality in the NHS**

### **– debunking the myths**

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# Introduction

## Should we blame hospital care for the rise in mortality from weekend admission? Probably not.

New evidence suggests the rise can be fully attributed to an increase in average severity at weekends as cases become more concentrated in fewer emergency admissions. The rise in average severity is not accounted for in mortality models because severity itself is not recorded in the underlying data.

Weekend mortality in the NHS has been a topic of debate for a number of years. While it is agreed that there is an increase in mortality for patients admitted at the weekend, there isn't a consensus on the underlying causes for this weekend effect. A number of suggested causes include decreased senior staffing levels, reduced access to primary and community services out of hospital, and a lack of specialist services, for example diagnostics, at weekends<sup>1</sup>.

A number of recent studies have focused on the differences in mortality rate and quality of care between patients admitted at weekends and those admitted during the week<sup>2</sup>. However, studies looking at the severity of disease and its relationship to increase in weekend mortality rates are very few, and in general limited to studying outcomes for stroke. Previous research into stroke mortality showed that the weekend effect may be influenced by variation in stroke severity. Stroke mortality was shown to increase by 19% for admissions on weekends compared to weekdays, but with a lower admission rate (down by 21%) on weekends, the only factor with significant variation in mortality over the weekend being stroke subtype<sup>3</sup>. A further study on stroke by Bray et al<sup>4</sup> found no difference in adjusted 30 day survival for stroke between patients admitted during the day at the weekend and those admitted on weekdays.

While the relationship between reduced emergency admissions at weekends and higher mortality rates has been suggested before, it has never been fully investigated. Meacock et al raised the possibility that the population admitted at weekends is on average sicker than the population admitted on weekdays, which contributes to the higher mortality rates among the population of patients admitted to hospital in an emergency at weekends<sup>5</sup>. We set out to establish the correlation between the severity of presentation on the weekend and increase in weekend mortality.



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1. NHS England, Seven Days a Week Forum. NHS Services, Seven Days a Week Forum Evidence base and clinical standards for the care and onward transfer of acute inpatients. Report. Gateway reference 00889

2. Black N. Is hospital mortality higher at weekends? If so, why? *Lancet*; Published Online May 10, 2016. [http://dx.doi.org/10.1016/S0140-6736\(16\)30505-0](http://dx.doi.org/10.1016/S0140-6736(16)30505-0)

3. Roberts SE, Thorne K, Akbari A, et al. Mortality following Stroke, the Weekend Effect and Related Factors: Record Linkage Study *PLoS ONE*; 10(6): e0131836. doi:10.1371/journal.pone.0131836

4. Bray BD, Cloud GC, James MA, et al. Weekly variation in health-care quality by day and time of admission: a nationwide, registry-based, prospective cohort study of acute stroke care *Lancet*; 2016; 388: 170–77

5. Meacock R, Anselmi L, et al. Higher mortality rates amongst emergency patients admitted to hospital at weekends reflect a lower probability of admission *J Health Serv Res Policy*; Online First published on May 6, 2016. doi:10.1177/1355819616649630

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# Our methodology

**We analysed over 25 million emergency (admission method 21, 22, 23, 24, 28) hospital spells in all English acute non-specialist trusts over a five year period from 2011 to 2015.**

To this we applied the Summary Hospital-level Mortality Index (SHMI) 2015 model to generate expected deaths. Per the standard SHMI method we excluded 22,000 deaths leaving 928,000 of which 242,000 followed weekend admissions. We specifically used the official SHMI method and covered a long (five year) observation period so we could investigate individual conditions with greater accuracy.

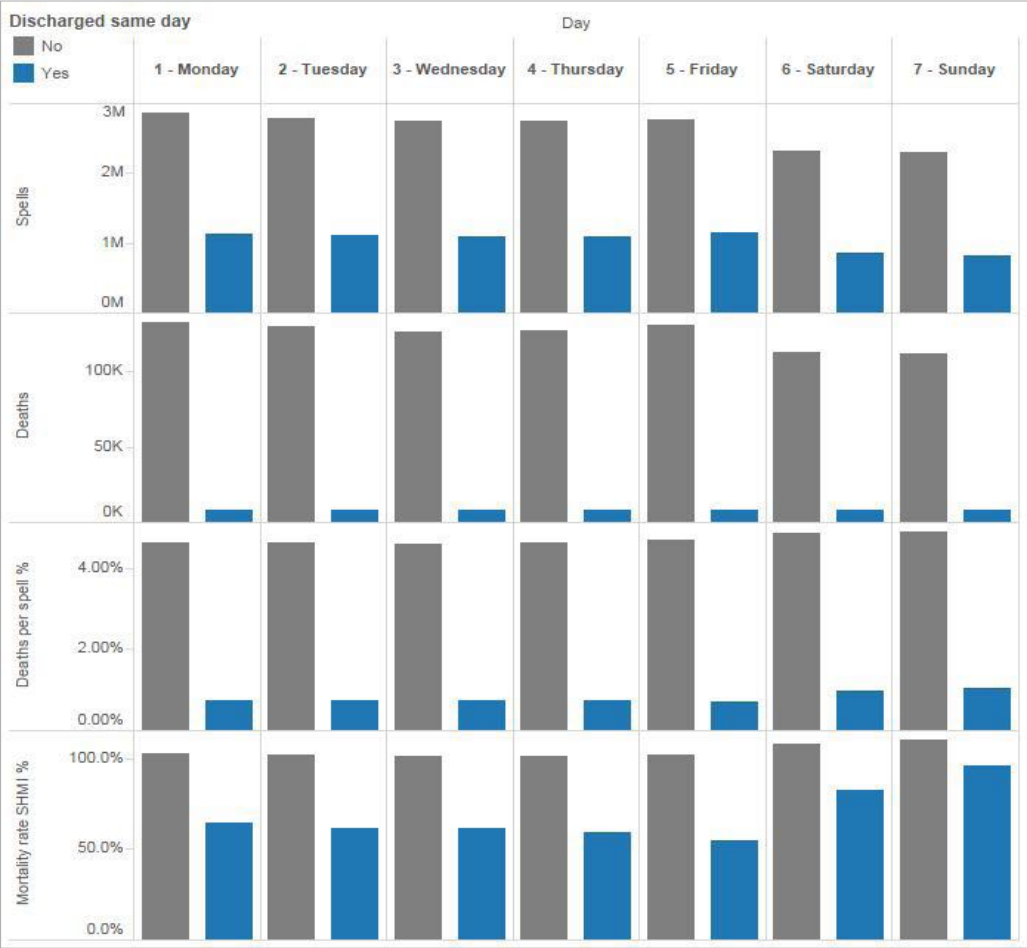
We wanted to test two hypotheses: firstly, that the dip in volume of admissions at the weekend is associated with a rise in mortality rate. Secondly, whether the dip also causes the average severity to rise. In both cases we used condition (primary diagnosis at ICD 3-digit level) as the categorical variable.



# Our findings

We found that emergency admissions reduce by almost a fifth at weekends, caused mainly by a large drop in admissions from GPs. The total number of deaths also decreases at the weekend but there is a slight increase in the mortality rate. We found a number of pieces of evidence suggesting that this is due to higher severity of cases admitted at the weekend.

Firstly, mortality rates for zero-length spells (admitted and discharged or died same day) exhibit a sharper rise in mortality - 38% and 47% on deaths per spell and SHMI respectively following weekend admission than non-zero-length stays (6% and 7% respectively) - See Figure 1. Short stay patients are less likely to be affected by hospital care than those in hospital for longer, so hospital care, or worse hospital care, is unlikely to be the cause of this observation: weekend zero-length stays appear to be more acutely ill.



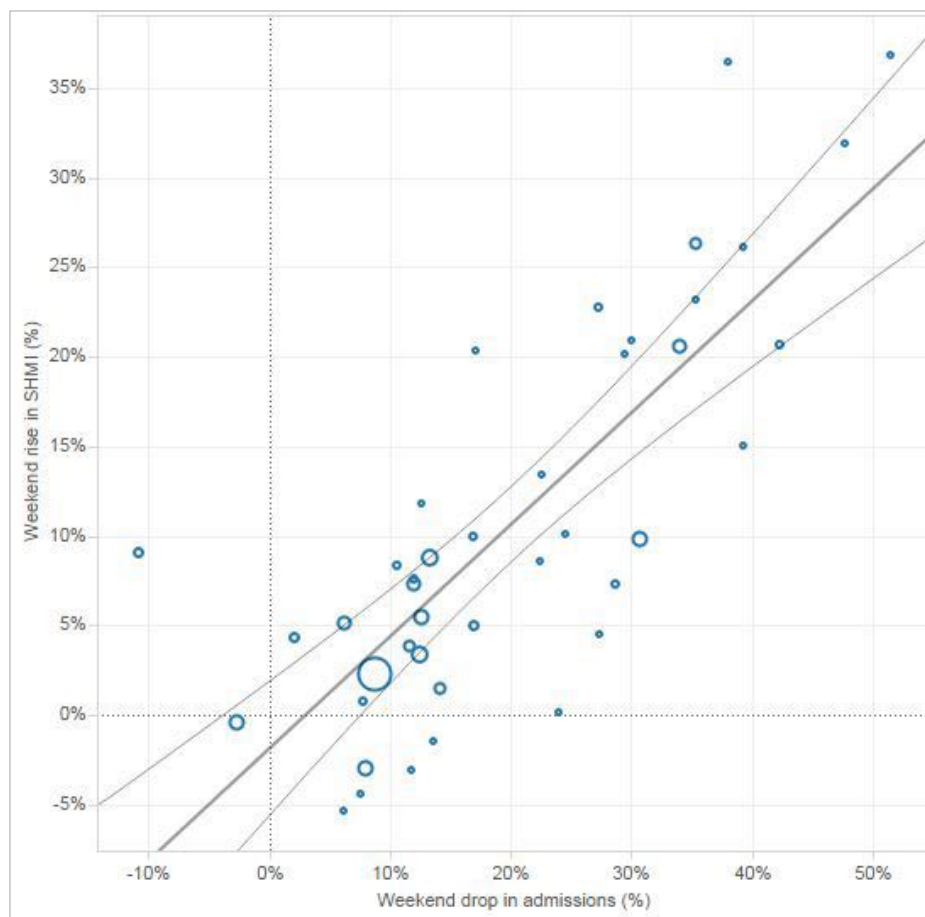
**Figure 1: Total non-elective spells, crude deaths and rebased SHMI figures.**  
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Secondly, including all patients, risk adjusted mortality exhibits the same weekend rise (9.5%) as crude deaths per spell (9.4%). This is surprising as we would normally expect a fully risk-adjusted calculation to yield lower differences than its simpler counterpart. Before reaching conclusions about the cause, we should question how effectively the case-mix adjustment within SHMI corrects for any weekly systematic severity variation. Such variation clearly exists. With GP admissions reducing to less than half their weekday average at the weekend, it is clear that some GP patients with less severe symptoms - but ultimately the same coded diagnosis wait until the following week for admission, effectively diluting the weekday case-mix, and concentrating the weekend severity.

Such severity difference is not fully captured in the administrative data on which mortality monitoring is based: diagnosis information captures only the cause e.g. cerebral infarction, acute myocardial infarction. We conclude that even risk adjusted mortality measures cannot (and therefore do not) take full account of the systematic weekly variation in severity which arises within diagnostic categories.

Thirdly, at individual diagnosis level, we found that admissions due to catastrophic, sudden events e.g. cardiac arrest, fracture neck of femur, which always require immediate admission show almost no dip at weekends, and hardly any rise in mortality. In contrast, admissions for some long term conditions, where some less severe weekend patients may wait until the next week to see their own GP before admission, dip the most, with a much larger rise in mortality.

Across all conditions - where there are sufficient deaths to provide statistically meaningful comparison it is clear that the size of the weekend dip in admissions for a particular condition, and the increase in mortality at the weekend are strongly associated (Figure 2). Crucially, the line of best fit appears to cross the axis at the origin, suggesting that there would be no rise in mortality from weekend admissions if there were no weekly cycle in volume of admissions.



**Figure 2: Weekend admissions vs mortality.**

Each bubble represents a primary diagnosis with more than 1,000 weekend deaths and the sizes of bubbles reflect the number of weekend deaths. Error bars removed for clarity, but just one outlier differs significantly from line of best fit. This is the point on the extreme left, intracranial injury (SO6), which shows a weekend rise in admissions possibly due to increase in alcohol-related admissions on weekends. R-squared (exc SO6) is 70%.

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Finally, substituting crude mortality for SHMI, we observed an almost identical plot to figure 2, suggesting that the drop in weekend admissions causes a systematic increase in severity (as measured by crude mortality), and confirming that case mix adjustment within SHMI is relatively ineffective for this specific application. In this context there is no difference between crude and risk adjusted measures: The correlation between weekend increases in SHMI and those for crude mortality was particularly strong (r-squared 94% excluding S06).

## Conclusions

We have seen a correlation between the increase in weekend mortality rate and the drop in weekend emergency admissions. We also found clear evidence of a corresponding rise in average severity at weekends which appears not to be controlled for in the risk adjustment within SHMI. We conclude that all of the reported rise in mortality for weekend admissions can be explained by the weekly admissions cycle. The results confirm recent findings of the team from Manchester University (Meacock et al) who generated their own risk adjustment and used an 11 month data set.



### About the authors

- Chris Raspin leads research at CHKS and conducts the analysis for our national Top Hospitals Award programme. He previously worked in the Audit Commission developing audits, undertaking research and writing its health data briefings.
- Dr Suraj Bassi is a healthcare management consultant and a clinician by background. He is currently working as a clinical advisor for CHKS.

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# About CHKS

CHKS is part of Capita Health Partners, a 200-strong team made up of clinicians, analysts, developers and healthcare experts. We combine talent and technology from across our CHKS, Cymbio, Health Analytics and Advisory teams to create actionable intelligence and deliver transformation, helping you to build sustainable health and care services.

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