

The ubiquitous weekend effect: moving past proving it exists to clarifying what causes it

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Since the publication of the influential paper by Bell and Redelmeier in 2001,¹ the ‘weekend effect’, whereby patients admitted to hospital over the weekend experience worse outcomes compared with apparently similar patients admitted during weekdays, has been explored in at least 105 studies.^{2–6} In this issue, Ruiz *et al*⁷ document such an effect across four countries (Australia, England, Netherlands, and the USA) that contribute to the Global Comparators Project⁸ where electronic summary data are combined across borders. Twenty-eight metropolitan city hospitals contributed data from nearly 3 million admissions. The ubiquitous weekend effect is replicated yet again among emergency admissions in all four countries for hospital mortality measured at 7 days and, except for Australia, at 30 days. For elective surgical procedures, a weekend effect on mortality was observed in all four countries and additionally a ‘Friday effect’ was seen in Dutch hospitals included in the study. The findings are interesting, but should we all rush to Australia to see how acute medical services should be organised so as to avoid a high 30-day mortality rate associated with emergency admissions?

Hospitals included in this study constitute only a very small proportion of all hospitals in respective countries. The data are unlikely to be representative and consequently drawing any conclusion with regard to international comparison could be misleading. The existence of weekend mortality effects within 7 days following admission has been demonstrated previously in a larger study covering >500 hospitals in Australia.⁹ Failure to confirm the 7-day weekend mortality hike at 30 days in the current study can plausibly be ascribed to a diminished signal-to-noise ratio; as time passes new

and recurrent illness supervenes, diluting any effect from the admission itself. So, taken in the round, the paper confirms that the weekend effect is a common finding at the hospital-wide level. Replicating this further would seem to fulfil no useful purpose. The question is what causes the weekend effect. Understanding the weekend effect is an extremely important task since it is large at about 10% in relative risk terms and 0.4% in percentage point terms. This amounts to about 160 additional deaths in a hospital with 40 000 discharges per year. But how much of the observed increase results from service failure? And here is the rub, for while a 0.4 percentage point represents a large, potentially scandalous, number of deaths, it is quite a small proportional change. Working out the proportions of these deaths that result from avoidable and unavoidable factors is thus no easy task. So how may the issue of weekend effect be further explicated when we move from whether the weekend effect exists to why?

1. More detailed analyses of databases: Candidate explanations for the weekend effect consist of differences in case-mix and service quality.¹⁰ In all four countries in the current study, more patients were admitted on weekdays than at weekends—about 20% more. It follows that pathways to admission differ, with a higher proportion of patients admitted through the emergency department over the weekend.¹¹ Patients admitted at weekends may be sicker and clinically more unstable.¹² Unfortunately, data held on routine databases such as those used in current study are often limited in quality and detail to enable the necessary statistical adjustment to be made. This limitation can be mitigated by data collected from clinical records and registries. For example, a single-centre study from



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Dublin showed that the overall weekend effect weakened when risk adjustment was made over a richer set of data that included physiological measurements at admission,¹³ whereas data from the US Myocardial Infarction Data Acquisition System (MIDAS) demonstrated a robust weekend effect on mortality having adjusted for clinical features such as type and site of infarction.¹⁴ However, risk adjustment can also obscure a genuine effect when care quality declines in line with increasing risk. In short, risk adjustment is a blunt tool, particularly when, as in the case of hospital mortality, most deaths are not preventable.¹⁵ Analyses of large datasets may provide clues to the causes of the weekend effect, but the issue of causality can never be resolved by purely 'desktop studies'.

2. Direct examination of quality of care during weekdays and over weekends: There are a priori reasons to suspect suboptimal standards of care during weekends since staffing ratios (especially for medical staff) and access to diagnostic services are reduced.¹⁶ Quantitative and qualitative observations of the quality of clinical care at weekend have shown that clinical processes are affected over weekends with higher error rates¹⁷ including longer delays,^{2 6} lower likelihood of receiving effective interventions¹⁴ and higher rates of preventable adverse events.¹⁸
3. Disease-specific studies: Previous studies have shown that the weekend effect does not apply to all diagnoses.^{1 2 9} There are both theoretical grounds and empirical evidence to suggest that weekend effect on mortality is more likely to occur in conditions such as cardiac arrhythmia and pulmonary embolism,^{1 9} where there is a high risk of death immediately after the onset of clinical events, during which timely interventions can reduce the risk. The increasing availability of routine databases covering large populations will allow more in-depth analyses by individual diagnoses in the future. Good examples include the aforementioned myocardial infarction study based on MIDAS,¹⁴ which evaluated the association between measures of quality of care and disease-specific outcomes; and the Australian study by Perez Concha and colleagues, in which temporal patterns (time-course) of the weekend effect for different diagnoses were studied in detail to elucidate possible causes.⁹ One potential caveat for examining disease-specific outcomes is that it depends on accurate diagnosis, but one of the putative reasons for weekend effect is that people might not be given correct diagnosis at weekends.
4. Intervention studies: Finding further evidence of the weekend effect and the necessary actions to mitigate it (where exists) requires appropriate evaluation studies alongside the introduction of an intervention. The English National Health Service is following a policy of incentivising hospitals to increase consultant cover over weekends. This policy is being evaluated by means of a study to track the effects of the intervention.¹⁹ The weekend effect will be compared over time in all hospitals in England (a difference in difference-type approach—the difference in mortality between weekend and

weekday admissions over different time periods). Difference in rates at which hospitals acquire extra staff will also be exploited (a difference in difference in difference type of approach). English hospitals will also be compared with the other three countries of the UK that are not pursuing the policy. The study will also examine the differences in mortality according to pathways by which patients gain emergency admission (eg, A&E vs outpatient department). Lastly, in-depth observations of the quality of care will be made from subsets of hospitals using mixed methods approaches,²⁰ based on ethnography and case note review. Of course, this is not a randomised comparison and therefore falls short of the kind of proof that would be usual in clinical research. Moreover, there are many other changes taking place in the service that might affect the findings. Nevertheless, by triangulating data of different types by means of a formal model and including expert opinion informed by the literature,²¹ the study hopes to offer deeper insights than statistical analyses of routine data are able to provide.

Ruiz *et al* have exploited a truly novel database, and international comparisons always make for compelling reading. Readers of the journal will enjoy the paper, which shows that the weekend effect that has persisted over time also persists across space. However, attention should now turn to in-depth studies that can shed some light on the cause of weekend effect or on how it might be mitigated.

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REFERENCES

- 1 Bell CM, Redelmeier DA. Mortality among patients admitted to hospitals on weekends as compared with weekdays. *N Engl J Med* 2001;345:663–8.
- 2 Canadian Institute for Health Information. *Weekend admissions and in-hospital mortality*. [Report] June 2014. https://secure.cihi.ca/free_products/Mortality_Report_2014_en.pdf
- 3 Webb M. The weekend effect: a rapid review of the literature. 2011. <http://www2.nphs.wales.nhs.uk:8080/healthserviceqtdtdocs.nsf/Main%20Frameset?OpenFrameSet&Frame=Right&Src=%2Fhealthserviceqtdtdocs.nsf%2F61c1e930f9121fd080256f2a004937ed%2F7f113a4146140de1802578b1002d7781%3FOpenDocument%26AutoFramed>

- 4 Cavallazzi R, Marik PE, Hirani A, *et al.* Association between time of admission to the ICU and mortality: a systematic review and metaanalysis. *Chest* 2010;138:68–75.
- 5 Sorita A, Ahmed A, Starr SR, *et al.* Off-hour presentation and outcomes in patients with acute ischemic stroke: a systematic review and meta-analysis. *Eur J Intern Med* 2014;25:394–400.
- 6 Sorita A, Ahmed A, Starr SR, *et al.* Off-hour presentation and outcomes in patients with acute myocardial infarction: systematic review and meta-analysis. *BMJ* 2014;348:f7393.
- 7 Ruiz M, *et al.* The Global Comparators Project: International comparison of 30-day in-hospital mortality by day of the week. *BMJ Qual Saf* 2015;24:492–504.
- 8 Bottle A, Middleton S, Kalkman CJ, *et al.* Global comparators project: international comparison of hospital outcomes using administrative data. *Health Serv Res* 2013;48(6 Pt 1):2081–100.
- 9 Perez Concha O, Gallego B, Hillman K, *et al.* Do variations in hospital mortality patterns after weekend admission reflect reduced quality of care or different patient cohorts? A population-based study. *BMJ Qual Saf* 2014;23:215–22.
- 10 Lilford R, Mohammed MA, Spiegelhalter D, *et al.* Use and misuse of process and outcome data in managing performance of acute medical care: avoiding institutional stigma. *Lancet* 2004;363:1147–54.
- 11 Ryan K, Levit K, Davis H. Characteristics of weekday and weekend hospital admissions. AHRQ Healthcare Cost and Utilization Project 2010: Statistical brief #87.
- 12 Aujesky D, Jimenez D, Mor MK, *et al.* Weekend versus weekday admission and mortality after acute pulmonary embolism. *Circulation* 2009;119:962–8.
- 13 Mikulich O, Callaly E, Bennett K, *et al.* The increased mortality associated with a weekend emergency admission is due to increased illness severity and altered case-mix. *Acute Med* 2011;10:182–7.
- 14 Kostis WJ, Demissie K, Marcella SW, *et al.* Weekend versus weekday admission and mortality from myocardial infarction. *N Engl J Med* 2007;356:1099–109.
- 15 Girling AJ, Hofer TP, Wu J, *et al.* Case-mix adjusted hospital mortality is a poor proxy for preventable mortality: a modelling study. *BMJ Qual Saf* 2012;21:1052–6.
- 16 Percival F, Day N, Lambourne A, *et al.* An evaluation of consultant input into acute medical admissions management in England, Wales and Northern Ireland. 2010. <https://www.rcplondon.ac.uk/sites/default/files/consultant-input-into-acute-medical-admissions-management-oct-2010.pdf>
- 17 Buckley D, Bulger D. Trends and weekly and seasonal cycles in the rate of errors in the clinical management of hospitalized patients. *Chronobiol Int* 2012;29:947–54.
- 18 Attenello FJ, Wen T, Cen SY, *et al.* Incidence of “never events” among weekend admissions versus weekday admissions to US hospitals: national analysis. *BMJ* 2015;350:h1460.
- 19 HiSLAC. An evaluation of the impact of High-Intensity Specialist-Led Acute Care (HiSLAC) on emergency admissions to NHS hospitals at weekends. 2015. <http://www.hislac.org/>
- 20 Brown C, Lilford R. Evaluating service delivery interventions to enhance patient safety. *BMJ* 2008;337:a2746.
- 21 Yao GL, Novielli N, Manaseki-Holland S, *et al.* Evaluation of a predevelopment service delivery intervention: an application to improve clinical handovers. *BMJ Qual Saf* 2012;21(Suppl 1):i29–38.

Heightened hospital weekend death risk common in several developed countries

Not just a problem for hospitals in England; also evident in Australia, USA, and The Netherlands

The heightened risk of death after admission to hospital at the weekend—the so-called ‘weekend effect’—is a feature of several developed countries’ healthcare systems, and not just a problem for hospitals in England, reveals research published online in *BMJ Quality & Safety*.

The international nature of the findings suggests that this is a systematic phenomenon that not only crosses time, but also space, say the researchers.

In a bid to look in more detail at the evidence for the link between higher rates of death for patients admitted to hospital at weekends compared with other days of the week, the researchers drew on international data from the Global Comparators project.

This is a database to which more than 50 different hospitals in the UK, USA, Australia, The Netherlands, Italy, Spain, Belgium, Finland, Norway and Denmark now contribute outcomes data on admissions.

For the current study, the researchers looked at data on almost 3 million admissions between 2009 and 2012 from 28 metropolitan teaching hospitals in England, Australia, USA and The Netherlands.

They focused on deaths occurring in hospital within 30 days of an emergency admission or planned (elective) surgery.

They found that, after taking account of influential factors, the risk of dying within 30 days was higher for emergency admissions at weekends at hospitals in three out of the four countries.

This risk was 8% higher in 11 hospitals in England, 13% higher in five of the US hospitals, and 20% higher in six Dutch hospitals.

There was no significant daily variation in the heightened risk of death within 30 days for emergency admissions at weekends in the Australian hospitals, and these hospitals between them had the largest proportion of emergency admissions. But a weekend effect became apparent for deaths within 7 days.

And, across the board, all patients admitted at the weekend for planned surgery were more likely to die within 30 days than those admitted on other days of the week, the findings showed.

Furthermore, the data indicated a ‘Friday effect’ for patients undergoing planned surgery in the hospitals in The Netherlands: their risk of death was 33% higher if admitted on a Friday than on a Monday.

The researchers acknowledge that the number of participating hospitals in this study was small, but these hospitals represent varying models of service delivery, they say.

“Although these results are limited to the small number of participating hospitals, the international nature of our database suggests that this is a systematic phenomenon affecting healthcare providers across borders,” they write.

The researchers speculate on the reasons for the findings, pointing out that no one single factor is going to be responsible.

They suggest that certain diagnoses and procedures may be particularly sensitive to reduced access to test results and diagnostics at weekends. Similarly, weekend staff may be fewer in number and less experienced, while patients requiring urgent care may have to wait longer, which might affect the success of any treatment and interventions.

In a linked editorial, Professor Richard Lilford and Dr Yen-Fu Chen of Warwick Medical School, caution against rushing to conclusions, on the grounds that the data are unlikely to be nationally representative.

They suggest that the time has come to focus more on shedding light on the causes behind the 'weekend effect' rather than just proving its existence across time and space.

"Understanding the weekend effect is an extremely important task since it is large, at about 10% in relative risk terms and 0.4% in percentage point terms. This amounts to about 160 additional deaths in a hospital with 40,000 discharges per year," they write.

"But how much of the observed increase results from service failure? And here is the rub, for while a 0.4 percentage point represents a large, potentially scandalous, number of deaths, it is quite a small proportional change," they add.