

The enigma of the weekend effect

Anoop Mathew¹, Saad Ahmed Fyyaz², Paul Richard Carter^{3,4}, Rahul Potluri⁴

¹Department of Cardiology, University of Alberta Hospital, Edmonton, Canada; ²Lewisham & Greenwich NHS Trust, London, UK; ³Department of Cardiovascular Medicine, University of Cambridge, Cambridge, UK; ⁴ACALM Study Unit in Collaboration with Aston Medical School, Aston University, Birmingham, UK

Correspondence to: Dr. Rahul Potluri. Founder of ACALM, Honorary Clinical Lecturer in Cardiology, Aston Medical School, Aston University, Birmingham, B4 7ET, UK. Email: rahulpotluri@outlook.com.

Provenance: This is an invited Editorial commissioned by Section Editor Dr. Ming Zhong (Department of Critical Care Medicine, Zhongshan Hospital, Fudan University, Shanghai, China).

Comment on: Walker AS, Mason A, Quan TP, *et al.* Mortality risks associated with emergency admissions during weekends and public holidays: an analysis of electronic health records, *Lancet* 2017;390:62-72.

Submitted Dec 01, 2017. Accepted for publication Dec 18, 2017.

doi: 10.21037/jtd.2017.12.115

View this article at: <http://dx.doi.org/10.21037/jtd.2017.12.115>

Increased mortality associated with weekend patient admissions is a global and pervasive phenomenon. Particularly in the UK, this has recently been the subject of intense media, political and scientific scrutiny (1,2). The “weekend effect” has often been highlighted with far-fetched conclusions regarding the likely causes. Specifically, it has been implied that the weekend effect is a result of the failure of healthcare management organizations to improve processes of care, including ensuring 24/7 accessibility to life-saving diagnostic and therapeutic procedures (2-4). As such, the body of evidence that has emerged over the last few years on the weekend effect has resulted in the UK government implementing a series of changes to facilitate the adoption of 24/7 hospital care across the National Health Services (1,4), engendering much controversy. The true existence of the “weekend effect” itself has been disputed (5). Although it is possible that variations in care and mortality do exist depending on the time of admission (6,7), there is limited consensus on the possible aetiologies and ramifications. Conceivably, the evidence behind the weekend effect is complex, multi-faceted and difficult to prove. This is where the paper by Walker and colleagues, regarding the weekend effect, is fascinating. Whilst the findings are not novel, they examine the subject with a greater granularity than the previously published research from the UK (8).

Recent meta-analyses and population based surveys indeed show an increase in mortality among patients

admitted out of hours (9,10), including among those admitted over the weekend (7-11). Out of hours mortality, has been used interchangeably with “weekend mortality”, although the definitions and the level of risk have varied across studies (12). A number of plausible explanations exist to point out why we should not simplistically attribute the “weekend effect” to variations in staffing or accessibility to diagnostic and interventional procedures alone.

Sicker patients are admitted over the weekend as compared to weekdays and hence patient level factors may explain differences in outcomes (8-13). Interestingly, as demonstrated by Walker *et al.*, commonly measured biochemical and haematological blood test results, as markers for disease severity, can account for about half of the residual excess mortality risk associated with weekend emergency admissions after adjustment for standard patient characteristics (8). Similarly, a study which used arrival by ambulance as a surrogate for illness severity, found that adjustment with this method alone corrected for any increase in mortality associated with out of hours admissions (14). Previous research had adjusted for patient level factors contributing to mortality utilising co-morbidities and demographics rather than using bio-markers (15). Another problem in assessing the weekend effect is that often, a lesser proportion of patients who attended Emergency services on weekends are admitted to hospital, thereby creating a selection bias (16). The reasons driving this change in admission threshold are not apparent,

although, hospital bed availability may in part dictate this, and concurrently, patients with milder symptoms are likely to elect to be at home. For instance, a review of heart failure admissions found Mondays had the highest admission rates, and Fridays the highest discharge rates (17). Interestingly, Friday discharge was also associated with the highest rate of re-admission (17). These findings could offer one possible insight into weekend mortality, as patients desire to be at home on weekends, and these preferences, in combination with bed availability pressures, are likely to influence physician decisions regarding admission and discharge.

Weekend effect on mortality is apparent only in a minority of diseases, and not across entire gamut of disease presentations (10,11). Consequently, variations in the case-mix, between weekends and weekdays, could explain the differences in outcomes (13). Malignancies account for 7 of the top 10 diagnostic conditions having the strongest association between out of hours admission and mortality (10). In the case of malignancies, reduced availability of end-of-life care in the community over weekends could possibly be the cause behind the phenomenon where cancer patients with more critical illnesses are admitted over the weekend (11-13,15-18). However, malignancies do not surface in the 10 most prevalent admission diagnoses in the cohort analysed by Walker *et al.* (8) and hence it is not clear how the case mix contributed to the association with mortality in this study. Conversely, other research has shown that cancer patients have a steady risk pattern with a relatively constant mortality risk across the week after admission (11).

Publication bias may exist especially in studies reporting adjusted odds ratio of the association between weekend effect and mortality (19). Survival analysis models that take only the day of admission into account often fail to account for the effect of confounders including other key milestones in the clinical pathway (14). For example, the timing of surgery (Sunday surgery) and the timing of discharge (Sunday or out of hours discharges) can impact outcomes (14). Hospital workload and staffing patterns do not seem to explain the association between weekend admissions and mortality. In one study, although there was reduced specialist staffing across weekends, this was likely compensated for by the significant increase in time spent evaluating emergency admissions. As a result, there was no statistically significant correlation between weekend staffing pattern of specialists and mortality risk for emergency admissions (20). This finding is echoed in the intensive care unit setting as well (21). Much of these analyses are based on administrative data and optimal adjustment of baseline

illness severity is vital. A recent clinical registry based audit showed no difference in 30-day survival between stroke patients admitted over the weekends when compared to those admitted on weekdays (22). Contrastingly, earlier studies based on administrative data showed a 26% increase in in-hospital mortality for patients admitted with stroke on Sundays compared to weekdays (23). Baseline patient characteristics, including severity scores like the National Early Warning Score and routinely available blood test results have been used across various studies to match the baseline risk of patients admitted over the weekend and on weekdays. However, coding may be inaccurate. Acute medical admissions are especially vulnerable to coding inaccuracies and can be subjective, at times (24). Erroneous coding is especially a problem in patients with multiple co-morbidities, where elective admissions for management of co-existing diseases are often miscoded as acute medical admissions. An analysis of systematic biases, inherent in evaluating the effect of weekend admissions on stroke mortality in the UK, revealed that coding inaccuracies abound in administrative data, especially the practise of coding false positive cases as weekday admissions resulting in a low case fatality rate in this group (25). These biases cannot be easily adjusted for, and could possibly explain the discordance in the association between weekend admission and stroke mortality across studies using administrative data and adjudicated clinical data (25). Data-duplication is another possible artefact that is especially a problem with meta-analyses (18).

Big data is being increasingly adopted as a tool to better understand the weekend effect on patient outcomes. However, these studies should call for improving coding standards and embracing more refined parameters to account for baseline disease severity, case-mix and hospital workload. There-in lies the biggest limitations with studies addressing the weekend effect from the UK and one that applies to Walker *et al.*'s paper too: the utilisation of routinely available administrative data. These large datasets have pre-defined fields ranging from demographics, diagnoses and co-morbidities cross-linked to robust mortality data from the Office of National Statistics. Beyond this, there is very limited information specifically in relation to such large numbers of patients and given that the weekend effects is multi-factorial, a multitude of factors such as availability of staff, the quality of staff, patient level data such as blood pressure, heart rate—to list a few, are all likely to play significant roles in the adjustment of the death rates just like blood test results. This data is difficult

to compile and Walker *et al.* must be congratulated in their efforts to incorporate blood test results in their model.

Even though the weekend effect is restricted to specific disease conditions (26), it has been implied as being ubiquitous across multiple healthcare systems (18). The weekend effect can be expected in the case of uncommon diseases requiring emergent and highly specialized diagnostic and interventional procedures. For instance, in the case of patients presenting with an impending rupture of an aortic aneurysm, issues with the availability of a vascular surgeon or an interventional radiologist may influence outcomes. Not surprisingly, aortic aneurysms have the strongest association between weekend admission and mortality (26-28). On the contrary, while we do not expect a weekend effect in the case of commoner conditions where emergent treatment is the standard of care, it is interesting to note that even in the case of ST-segment elevation myocardial infarction, out-of-hours presentation is associated with increased mortality and worse clinical performance measures (9). Additionally, it is important to consider that although weekend mortality effects have been replicated across various healthcare configurations including the United States (18), geographic variations do exist (9).

Research is now moving on, from debating the existence of the crude weekend effect, to better understanding the reasons and implications of this effect and addressing them. Walker *et al.*'s article sheds further light on some of these factors, particularly in the UK. However, the disappointing aspect of research addressing the weekend effect is the tendency to compile data across all diseases/conditions into a common weekend effect and suggest blanket strategies across all conditions. As discussed, the weekend effect is likely to be far greater in conditions such as aortic aneurysms and acute coronary syndromes rather than amongst rehab patients, for example. Therefore, whilst research encompassing millions of patients pointing to a weekend effect can be hypotheses generating, care should be taken before generalising and making expensive healthcare delivery changes based on these findings.

Going forward, innovative solutions like centralizing critical steps in healthcare delivery (29) and pre-hospital delivery of therapies (30), may improve outcomes and possibly negate the effects of weekend admissions on mortality. To analyse the effect of weekend admissions on outcomes, the focus of attention has to shift from unadjusted mortality rates to clinical performance and quality indicators. In addition, the natural experiment proposed by the provision of 24/7 hospital care services, across health

systems like in the UK, affords us the opportunity to analyse the impact of this health infrastructure improvement on the outcomes of patients admitted over the weekend. Deciphering the weekend effect in a transparent and systematic manner would likely improve the confidence of the key stakeholders, the patients, in the health care system.

Acknowledgements

None.

Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.

References

1. NHS Services Seven Days a Week Forum. Summary of initial findings, 2013.
2. Campbell D. Hospital patients admitted at weekends "15% more likely to die". Available online: <https://www.theguardian.com/society/2015/sep/05/bruce-keogh-hospital-patients-risk-death-admitted-weekends>
3. Research into "the weekend effect" on patient outcomes and mortality. Available online: <https://www.gov.uk/government/publications/research-into-the-weekend-effect-on-hospital-mortality/research-into-the-weekend-effect-on-patient-outcomes-and-mortality>
4. Freemantle N, Ray D, McNulty D, et al. Increased mortality associated with weekend hospital admission: a case for expanded seven day services? *BMJ* 2015;351:h4596.
5. McKee M. The weekend effect: now you see it, now you don't. *BMJ* 2016;353:i2750.
6. Agrawal S, Garg L, Sharma A, et al. Comparison of Inhospital Mortality and Frequency of Coronary Angiography on Weekend Versus Weekday Admissions in Patients With Non-ST-Segment Elevation Acute Myocardial Infarction. *Am J Cardiol* 2016;118:632-4.
7. Pauls LA, Johnson-paben R, Mcgready J, et al. The Weekend Effect in Hospitalized Patients: A Meta-Analysis. *J Hosp Med* 2017;12:760-6.
8. Walker AS, Mason A, Quan TP, et al. Mortality risks associated with emergency admissions during weekends and public holidays: an analysis of electronic health records *Lancet* 2017;390:62-72.
9. 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.
10. Zhou Y, Li W, Herath C, et al. Off-Hour Admission and Mortality Risk for 28 Specific Diseases: A Systematic Review and Meta-Analysis of 251 Cohorts. *J Am Heart Assoc* 2016;5:e003102.
 11. Concha OP, 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.
 12. Han L, Sutton M, Clough S, et al. Impact of out-of-hours admission on patient mortality: longitudinal analysis in a tertiary acute hospital. *BMJ Qual Saf* 2017. [Epub ahead of print].
 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. *England; Acute Med* 2011;10:182-7.
 14. Sayers A, Whitehouse MR, Berstock JR, et al. The association between the day of the week of milestones in the care pathway of patients with hip fracture and 30-day mortality: findings from a prospective national registry - The National Hip Fracture Database of England and Wales. *BMC Med* 2017;15:62.
 15. Aylin P, Yunus A, Bottle A, et al. Weekend mortality for emergency admissions. A large, multicentre study. *Qual Saf Health Care* 2010;19:213-7.
 16. Meacock R, Anselmi L, Kristensen SR, et al. Higher mortality rates amongst emergency patients admitted to hospital at weekends reflect a lower probability of admission. *J Health Serv Res Policy* 2017;22:12-9.
 17. Shah M, Patnaik S, Patel B, et al. The day of the week and acute heart failure admissions: Relationship with acute myocardial infarction, 30-day readmission rate and in-hospital mortality. *Int J Cardiol* 2017;249:292-300.
 18. Roberts SE, Brown TH, Thorne K, et al. Weekend admission and mortality for gastrointestinal disorders across England and Wales. *Br J Surg* 2017;104:1723-34.
 19. Hoshijima H, Takeuchi R, Mihara T, et al. Weekend versus weekday admission and short-term mortality: A meta-analysis of 88 cohort studies including 56,934,649 participants. *Medicine (Baltimore)* 2017;96:e6685.
 20. Aldridge C, Bion J, Boyal A, et al. Weekend specialist intensity and admission mortality in acute hospital trusts in England: a cross-sectional study. *Lancet* 2016;388:178-86.
 21. Kerlin MP, Adhikari NKJ, Rose L, et al. An Official American Thoracic Society Systematic Review: The Effect of Nighttime Intensivist Staffing on Mortality and Length of Stay among Intensive Care Unit Patients. *Am J Respir Crit Care Med* 2017;195:383-93.
 22. 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;388:170-7.
 23. Palmer WL, Bottle A, Davie C, et al. Dying for the weekend: a retrospective cohort study on the association between day of hospital presentation and the quality and safety of stroke care. *Arch Neurol* 2012;69:1296-302.
 24. Nouraei SA, Virk JS, Hudovsky A, et al. Accuracy of clinician-clinical coder information handover following acute medical admissions: implication for using administrative datasets in clinical outcomes management. *J Public Health (Oxf)* 2016;38:352-62.
 25. Li L, Rothwell PM. Biases in detection of apparent "weekend effect" on outcome with administrative coding data: population based study of stroke. *BMJ* 2016;353:i2648.
 26. Zhou Y, Li W, Herath C, et al. Off-Hour Admission and Mortality Risk for 28 Specific Diseases: A Systematic Review and Meta-Analysis of 251 Cohorts. *J Am Heart Assoc* 2016;5:e003102.
 27. Gallerani M, Imberti D, Bossone E, et al. Higher mortality in patients hospitalized for acute aortic rupture or dissection during weekends. *J Vasc Surg* 2012;55:1247-54.
 28. Groves EM, Khoshchehreh M, Le C, et al. Effects of weekend admission on the outcomes and management of ruptured aortic aneurysms. *J Vasc Surg* 2014;60:318-24.
 29. Morris S, Hunter RM, Ramsay AIG, et al. Impact of centralising acute stroke services in English metropolitan areas on mortality and length of hospital stay: difference-in-differences analysis. *BMJ* 2014;349:g4757.
 30. Danchin N, Blanchard D, Steg PG, et al. Impact of prehospital thrombolysis for acute myocardial infarction on 1-year outcome: results from the French Nationwide USIC 2000 Registry. *Circulation* 2004;110:1909-15.

Cite this article as: Mathew A, Fyyaz SA, Carter PR, Potluri R. The enigma of the weekend effect. *J Thorac Dis* 2018;10(1):102-105. doi: 10.21037/jtd.2017.12.115