

Overestimation of Weekend and Off-hour Effect in a Public Hospital in Malaysia

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We read with interest the recent article by Lee *et al.*¹. The authors, compared in-patient mortality between during-office hours and off-office hours admissions, and between weekday and weekend admissions. Although we agree that this local analysis is timely for healthcare planning to provide quality and effective hospital care to patients, the method which the data was analyzed and interpreted may not be accurate.

The reported odds ratio (OR) of 1.67 for mortality in admissions during the off-office hours is very alarming but it could be an overestimation. Lee *et al.* had included both elective and emergency admissions in their analysis which we find inappropriate. Most of the elective and day surgery admissions are during office hours and these admissions are expected to have lower mortality². The inclusion of these admissions would certainly increase the survival rate of patients admitted at these times, causing unfavourable but distorted results for admission after office hours.

As we cannot differentiate elective and emergency admissions, we analyzed the same hospital data³ by looking into the mortality of patients, comparing patients who died within 24 hours of admission and its relationship with time of admission from Monday to Thursday; office hours defined as 8.00 am to 5.00 pm, after office hours as otherwise.

By focusing only on patients who died, we would have excluded majority of elective surgical and day care cases who survived. Besides that, we are also looking at the mortality pattern of the severely ill patients, of which the outcome is more dependent on the disease severity. The result shows that 'night admissions' effects on mortality is no longer statistically significant with OR = 1.11 (CI 0.93-1.31, $p = 0.24$). This shows that for patients who would have died within 24 hours of admission, there was no difference in mortality rate whether they were admitted during office hours or after office hours. We hypothesised that the night admissions effect is more closely related to disease-severity rather than health care system of the hospital.

In addition, we also hypothesised that the weekend effects on mortality were also overestimated for the same reason mentioned earlier. Odds ratio of 1.221 reported by the authors was higher compared to a large study in UK of similar cohort of patients (OR 1.11)⁴. Once again, we tried to exclude elective and day surgery admissions by focusing on the mortality pattern of the patients. We compared patients who died within 24 hours of admission and its relationship with day of admission (weekdays or weekends). The difference became not significant with odds ratio 1.08 (CI 0.93 to 1.25, $p = 0.33$)³. The

similarity of the ratios between different countries strengthen the hypothesis that the weekend effect is probably a combination of disease characteristic, patients' health seeking behaviour and health system. Besides having more elective cases admitted on weekdays, 4 out of 10 most common reasons for admission during weekend were cardiac related such as congestive heart failure, chest pain, heart attack and irregular heart beat² who have higher risk of mortality compared to elective admissions. Therefore, it is a hasty conclusion by the authors to have attributed the weekend effect solely to hospital staffing and training.

The authors also discussed findings by Khanna *et al.* who reported no adverse weekend and off-hour outcome in their practice⁵. It has to be noted that Khanna's study only included patients who were admitted from the Emergency Department. In that case, Khanna's finding may have supported our argument on the importance of removing elective admissions from the analysis because these admissions can distort the survival rate of patients admitted during office hours and on weekdays. With very little information on mortality, the application Khanna *et al.*'s finding in this discussion is debatable and misleading.

Moreover, Khanna *et al.* only reported incidence of adverse weekend and off-hour outcome in relation to their practice. Their study did not demonstrate the superiority of having equal staffing during weekends or the inferiority of otherwise. Therefore, we find that Lee's suggestion of having equal number of staff throughout the day and week based on Khanna's finding is inappropriate as it will impose a large amount of health care expenditure for the nation, bearing in mind the disproportionate workload depending on day or night session and days of the week. On the other hand, identification of patients need and providing the intensity of care proportionate to the disease severity has been proven to improve patient outcome^{6,7}. It is for this reason that special care unit such as intensive care unit (ICU) were established where weekend effect was not observed even when less staff were on duty during the night^{8,9}.

Redistribution of staffing and restructuring hospital working system in accordance to intensity of care is a more practical approach without adding burden to the cost of health care.

At present, the relevant authorities has already instituted measures of reducing staff fatigue by increasing number of staff, implementing shift duty for house officers, allowing half-day-duty on the next day after a night duty, giving adequate annual leave, and providing avenue for counselling to staff who developed work related stress.

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In conclusion, although weekend effects may exist, the causes are multifactorial. Disease characteristic (emergency versus elective admissions) and disease severity as well as their characteristic timing of admission remains as valid confounders that has to be addressed in future studies of the weekend effects. Past studies would suggest to redirect hospital staff to areas with higher workload and intensity of care as opposed to distributing them equally throughout.

Dedication

We would like to dedicate this commentary to the excellent achievements and contributions by Hospital's staff working through the night and weekend for the betterment of patients' care.

DECLARATION OF CONFLICTING INTERESTS

The authors declared no potential conflicts of interest with respect to the authorship and/or publication of this article.

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Reply:

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We thank Dr Cheah and colleagues for their interest in our work¹. We agree that the analysis of the association of weekend and off-hour effect with mortality is complex, and we did not risk-adjust all admissions by their severity of illnesses as stated in our limitation section. We fully agree that addressing this issue should be a key consideration for future research on this phenomenon.

Cheah *et al* highlight that most elective and day surgery admissions are expected to have lower mortality. Much interest revolved around this hypothesis that whether it has confounded the weekend effect. A recent retrospective study in England that specifically looks into elective admissions and finds weekend effect as an independent risk factor for hospital mortality and the risk is more pronounced in the

elective setting². In terms of elective surgery cases, Bhonegiri *et al* finds higher risk-adjusted mortality in ICU (intensive care unit) due to similar effect, and this variation in outcome is accounted for predominantly by elective surgical admissions during weekends, which was associated with increased mortality³. As such, it would be premature to presume that elective admissions have lower mortality, and therefore the methodology of the re-analysis by Cheah *et al* may have important bias, and yielded inaccurate interpretation as it is a subgroup analysis of death within 24 hours instead of the total mortality.

Cheah and colleagues also raise the question whether the weekend effect can be attributed solely to hospital staffing and training. We would like to reiterate that this phenomenon is complex and the direct contributing factors remain incompletely understood. Beside hospital factors (staffing, resource and quality of care), the extent of patient factors (disease severity and health-seeking behaviour) was under-explored. In our article, we cite the example of the success in a tertiary care hospital addressing the weekend effect. Khanna *et al* finds no association of weekend admissions from emergency department with worse hospitalization-relevant outcomes including mortality within 24 hours, and believe that the weekend effect can be potentially overcome by addressing adequately the deficiencies that we stated within the healthcare system⁴. While it is a norm that emergency admissions account for a larger portion of all admissions, and higher risk-adjusted odds of mortality of emergency admissions has been shown in previous studies^{5,6} we could not agree that our suggestion of considering some of the healthcare system-improving measures was deemed inappropriate. Khanna *et al* mention that the staffing ratio in their hospital is higher during the day, remains same on weekends and may be higher in emergency department and ICU, explaining that the importance of staff distribution according to care needs.

We recognize that it is crucial to understand the precise cause of the excess weekend and off-hour mortality before healthcare measures can be taken, given the large costs involved in upgrading services. We hope our study findings will bring positive impact in terms of improving patient care, and perhaps further research can be done to fully understand the mechanisms and lead to effective measures in reducing patient mortality.

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