

# The “Weekend Effect” Among Patients Presenting with Acute Coronary Syndrome at the Philippine General Hospital

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## Abstract

**Introduction:** Studies have shown that weekend and holiday admissions for patients with acute coronary syndrome (ACS) are associated with higher incidence of in-hospital mortality and major adverse cardiovascular events (MACE). This has been referred to as the “weekend effect.”

**Objectives:** We aim to determine whether adults with ACS admitted on weekends have an increased risk for adverse outcomes, primarily in-hospital mortality.

**Methodology:** This is a retrospective cohort observational study. An ACS database of a prospectively collected cohort was reviewed. Participants in this database included patients with a diagnosis of ACS who satisfied pre-defined inclusion and exclusion criteria. Clinical characteristics and admission data (weekend/holiday versus regular day admission) of all patients were collected. Outcomes of interest were in-hospital mortality, severe heart failure, and re-infarction.

**Analysis:** Descriptive analysis was done by obtaining the mean and standard deviation of quantitative variables. Proportions and frequencies were reported for

qualitative variables. For quantitative variables, T-test of two independent samples was used to determine if there is a significant difference. For categorical variables, the Z-test was used. Multiple logistic regression was also done to explore the predictors of the weekend effect.

**Results:** A total of 175 patients were included in this study, 59 were admitted on a weekend/holiday and 116 on a regular day. The duration of symptoms prior to admission were longer among those who were admitted during the weekend ( $40.86 \pm 54.11$  hrs vs  $11.83 \pm 8.40$  hrs,  $p < 0.0001$ ). A weekend hospital admission was found to be an independent predictor of in-hospital mortality.

**Conclusion:** For patients with ACS, a weekend admission was associated with increased in-hospital mortality despite similar management approach in both groups. There is a need to further explore the factors that contribute to this “weekend effect” in our setting by a prospective trial.

**Keywords:** acute coronary syndrome, weekend effect

## Introduction

The “weekend effect” refers to the observation that a weekend admission is associated with significantly increased adverse events, particularly mortality.<sup>1, 2</sup> In some studies, it is defined to include the effect of “off-hours” – from 7:00 PM to 7:00 AM of weeknights, and statutory holidays.<sup>3</sup>

The weekend effect has been demonstrated in a variety of conditions such as abdominal aortic aneurysms, pulmonary embolism, gynecologic malignancies;<sup>1, 4</sup> and in different clinical settings such as the emergency room<sup>5</sup> and the intensive care units.<sup>6</sup> Foreign literature attributes this

effect to various system factors: reduced staffing of hospitals in terms of number and expertise, less number of senior physicians to supervise patient care, and less availability of specialized diagnostics and certain procedures.<sup>1, 2, 4, 7</sup>

Acute coronary syndrome (ACS) is a condition where onset is sudden and the course rapidly progressive; hence, management is very time-dependent. Patients with ACS need to be admitted and treated without delay.<sup>8</sup> The weekend effect therefore becomes very relevant in this scenario. Several studies have, in fact, found that this phenomenon also extended to patients with ACS.<sup>5, 7, 9</sup> Similar system factors were also proposed as contributing to an increase in in-hospital mortality among ACS patients admitted on a weekend or during “off-hour.” Consistent factors identified are the lack of availability and the general delay in access of certain procedures, such as primary coronary intervention, during the weekend. Other studies, however, did not validate the existence of a weekend effect in ACS patients in their respective settings.<sup>1-4, 8</sup>

To our knowledge, there has been no study yet that investigated the weekend effect in our setting. It would

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be important to know if the weekend effect existed in our hospitals, to demonstrate it, and to determine the factors that could explain it. We, therefore, sought to determine if a weekend/holiday admission is associated with adverse outcomes, particularly in-hospital mortality, among ACS patients. We also would like to determine if clinical management differed during a weekend/holiday admission. Information derived from our study would help in instituting measures to address the weekend effect, if present.

## OBJECTIVES

**General objective:** To determine if a weekend/holiday admission is associated with adverse outcomes in patients diagnosed with ACS

### Specific objectives:

1. To describe the clinical profile of patients with ACS admitted in PGH on a weekend/holiday as compared to a regular day admission
2. To compare the management of ACS patients between a weekend/holiday versus a regular day admission
  - a. Performance of diagnostics, specifically echocardiography
  - b. Type of admission: pay versus service
  - c. Location of admission: intensive care unit versus regular ward
  - d. Medications
3. To determine if a weekend/holiday admission among patients with ACS is associated with occurrence of adverse outcomes
  - a. Primary outcome: In-hospital / 30-day mortality
  - b. Secondary outcomes: severe heart failure, re-infarction

## Methodology

This is a retrospective cohort observational study. An ACS database of a prospectively collected cohort was reviewed.<sup>10</sup> Participants in this database included patients with a diagnosis of ACS (Unstable Angina, Non ST segment Elevation Myocardial Infarction, Non ST segment Elevation Myocardial Infarction) who satisfied pre-defined inclusion and exclusion criteria. The diagnosis of ACS for the patients in the database was verified independently by two of the investigators in that study using the universal definition of ACS (see definitions).<sup>11</sup> Those who did not fit the universal definition of ACS were excluded from the study.

### Inclusion Criteria

- Adult patients, both females and males, admitted with a diagnosis of acute coronary syndrome (unstable angina, NSTEMI, STEMI)
- Those with complete blood counts taken at the PGH central laboratory on admission

### Exclusion Criteria

- Diagnosed with any form of bacterial or viral infection on admission
- Diagnosed with acute inflammatory conditions other than ACS on admission (ie. acute renal failure, gout in flare, SLE in flare, etc)
- Active tuberculosis / TB disease (TB infection or suspect is not excluded)
- Diagnosed with any hematologic disease prior to or during admission
- Those with bleeding in any form
- Those who were managed in a different facility, prior to PGH
- Those who do not consent

*\*Inclusion / Exclusion Criteria of the Neutrophil-Lymphocyte Ratio Study of PGH (Ahererra et al. 2014)*

The database was abstracted for patient, clinical management, and outcome data. Patient characteristics collected from the database included date of admission with which we determined a weekend/holiday admission, age, sex, BMI, presence of comorbidities such as diabetes mellitus, hypertension and dyslipidemia among others, smoking status, duration of symptoms, and TIMI score; clinical management data included diagnosis, medications given, electrocardiogram (ECG) findings, ejection fraction from 2-D echocardiogram (if done), admission to either a pay or charity service, intensive care unit (ICU) or regular ward admission, cardiac enzyme levels, and revascularization procedures done. Outcome data included in-hospital/30-day mortality, severe congestive heart failure (CHF), and re-infarction.

### Outcomes

Outcomes collected in this present study was similar to the outcomes prospectively collected in the database reviewed.<sup>10</sup> Outcomes are below:

1. In hospital Outcome - Death from cardiac or non - cardiac causes developing within the course of hospitalization
2. Heart Failure - Development of a new or worsening of previously compensated manifestations attributable to congestive heart failure (dyspnea, orthopnea, hypotension)
3. Re- Infarction - Development of recurrence of symptoms during the admission after initial management. It may be an STEMI or NSTEMI

## Operational Definition

- **Weekend admission**  
Defined as admission during the period from Saturday midnight (00:00 hr) to Sunday 11:59PM (23:59 hrs)
- **Holiday admission**  
Defined as admission during the midnight (00:00hr) to 11:59 PM (23:59 hrs) of an officially declared non-working government or religious holiday, including but not limited to New Years Day, Labor Day, Philippine Independence Day, National Heroes Day, Christmas day, Rizal Day
- **Regular day admission**  
Defined as admission on a day not satisfying the definition for weekend and holiday
- **Myocardial infarction**  
Defined by the presence of symptoms suggestive of ischemia or infarction, with either electrocardiographic evidence (new Q waves in two or more leads) or cardiac-marker evidence of infarction, according to the standard Thrombolysis in Myocardial Infarction (TIMI) and American College of Cardiology definition<sup>11</sup>
- **Unstable angina**  
Defined as ischemic discomfort at rest for at least 10 minutes prompting re-hospitalization, combined with one of the following: ST-segment or T-wave changes, cardiac-marker elevations that were above the upper limit of normal but did not meet the criteria for myocardial infarction, or a second episode of ischemic chest discomfort lasting more than 10 minutes and that was distinct from the episode that had prompted hospitalization.<sup>11</sup>
- **Heart Failure (HF)**  
Defined as development of signs / symptoms of systolic dysfunction such as dyspnea, orthopnea, neck vein engorgement, rales / crackles, edema, pulmonary congestion on chest X-ray, or ejection fraction < 50% on echocardiography.<sup>11</sup> Mild HF: Rales over 50% or less of the lung fields Severe HF: Rales over more than 50% of the lung fields / evidence of pulmonary edema

## Data Analysis

Descriptive analysis was done by obtaining the mean and standard deviation of quantitative variables. Proportions and frequencies were reported for qualitative variables. For quantitative variables, T-test of two independent samples was used to determine if there is a

significant difference. For categorical variables, the Z-test was used.

For single logistic regression, the age, sex, BMI, number of comorbidities, the duration of symptoms prior to consult and admission, the day of admission, the type and location of admission (pay versus charity, ward or ICU), and management were considered. A p-value of <0.25 was considered as statistically significant. All significant variables were included in the final model of multivariate analysis. Stepwise logistic regression was used to identify significant predictors of the dependent variables, especially of in-hospital mortality. The other dependent variables considered for the study are severe congestive heart failure and development of re-infarction.

## Ethical Considerations

The protocol was submitted to University of the Philippines Manila Research Ethics Board (UPMREB) for ethics review and approval. Study was conducted only upon approval from the UPMREB. All patient information obtained from the database was kept anonymous and confidential. There is no conflict of interest in this study which may arise from financial, familial, or proprietary considerations of the primary and co-investigators or the study site. Cost of this research was shouldered by the primary investigator.

## Results

### Baseline Clinical Profile of Patients with ACS

A total of 175 patients with ACS were included in the database; and all were included in this study. Fifty-nine (33.7%) were admitted on a weekend / holiday and 116 (66.3%) on a regular day. The mean age was  $58.98 \pm 12.59$ , and mostly male (72.57%). Patient characteristics are shown in Table I, classified according to the day of admission, whether weekend/holiday or regular day. Baseline characteristics did not differ between the two groups, except for a history of previous revascularization (0% vs 10%,  $p=0.010$ ) in the regular day group. Diagnosis on admission was unstable angina (26%), NSTEMI (34%), and STEMI (40%), and the proportion of each diagnosis was similar. Both groups also had similar proportions of patients presenting with high-risk features, as per TIMI score, and cardiac enzyme elevations. The duration of symptoms prior to admission was significantly longer among those who were admitted during the weekend:

**Table I. Patient Characteristics and Clinical Profile**

| Variables                                                 | Total<br>(n=175)    | Weekend/Holiday<br>(n=59) | Regular Day<br>(n=116) | p-value |
|-----------------------------------------------------------|---------------------|---------------------------|------------------------|---------|
| <b>Age</b> (mean $\pm$ SD)                                | 58.98 $\pm$ 12.59   | 59.25 $\pm$ 13.49         | 58.84 $\pm$ 12.16      | 0.8362  |
| <b>Sex</b>                                                |                     |                           |                        |         |
| Male                                                      | <b>127 (72.57)</b>  | <b>47 (79.66)</b>         | 80 (68.97)             | 0.1338  |
| Female                                                    | <b>48 (27.43)</b>   | <b>12 (20.34)</b>         | 36 (31.03)             |         |
| <b>BMI in kg/m<sup>2</sup></b> (mean $\pm$ SD)            | 24.98 $\pm$ 3.37    | 25.25 $\pm$ 3.53          | 24.84 $\pm$ 3.30       | 0.4562  |
| <b>Comorbidities</b>                                      |                     |                           |                        |         |
| Diabetes Mellitus                                         | 55 (31.43)          | 20 (33.90)                | 35 (30.17)             | 0.6157  |
| Hypertension                                              | 128 (73.14)         | 44 (74.58)                | 84 (72.41)             | 0.7603  |
| Dyslipidemia                                              | 67 (38.29)          | 23 (38.98)                | 44 (37.93)             | 0.8923  |
| Peripheral arterial disease                               | 5 (2.86)            | 2 (3.39)                  | 3 (2.59)               | 0.7629  |
| CKD                                                       | 22 (12.57)          | 11 (18.64)                | 11 (9.48)              | 0.0840  |
| Family history of CAD                                     | 26 (14.86)          | 9 (15.25)                 | 17 (14.66)             | 0.9161  |
| Substance abuse                                           | 3 (1.71)            | 2 (3.39)                  | 1 (0.86)               | 0.2233  |
| Known CAD                                                 | 19 (10.86)          | 4 (6.78)                  | 15 (12.93)             | 0.2163  |
| Prior MI                                                  | 49 (28.00)          | 20 (33.90)                | 29 (25.00)             | 0.2152  |
| CHF                                                       | 20 (11.43)          | 7 (11.86)                 | 13 (11.21)             | 0.8972  |
| Prev Revasc                                               | 12 (6.86)           | 0 (0.00)                  | 12 (10.34)             | 0.0105  |
| <b>Smoking status</b>                                     |                     |                           |                        |         |
| Former                                                    | 35 (20.00)          | 14 (23.73)                | 21 (18.10)             | 0.3791  |
| Current                                                   | 38 (21.71)          | 14 (23.73)                | 24 (20.69)             | 0.6448  |
| <b>Duration of symptom prior to consult and admission</b> |                     |                           |                        |         |
| In Hours (mean $\pm$ SD)                                  | 21.62 $\pm$ 34.82   | 40.86 $\pm$ 54.11         | 11.83 $\pm$ 8.40       | <0.0001 |
| >1 Day Delay in Consult                                   | 63 (36.00)          | 39 (66.10)                | 24 (20.69)             | <0.0001 |
| <b>Diagnosis</b>                                          |                     |                           |                        |         |
| UA                                                        | 45 (25.71)          | 18 (30.51)                | 27 (23.28)             |         |
| NSTEMI                                                    | 60 (34.29)          | 23 (38.98)                | 37 (31.90)             | 0.1850  |
| STEMI                                                     | 70 (40.00)          | 18 (30.51)                | 52 (44.83)             |         |
| <b>High Risk TIMI **</b>                                  | 66 (37.71)          | 22 (37.29)                | 44 (37.93)             | 0.9339  |
| <b>Cardiac enzymes</b>                                    |                     |                           |                        |         |
| Trop (n=130, mean $\pm$ SD)                               | 18.05 $\pm$ 27.02   | 11.39 $\pm$ 19.68         | 21.23 $\pm$ 29.47      | 0.0519  |
| CKMB (n=53, mean $\pm$ SD)                                | 72.09 $\pm$ 106.69  | 89.72 $\pm$ 139.01        | 58.58 $\pm$ 72.92      | 0.2968  |
| <b>Echo</b>                                               |                     |                           |                        |         |
| EF (n=125, mean $\pm$ SD)                                 | 49.48 $\pm$ 13.61   | 49.00 $\pm$ 14.25         | 49.74 $\pm$ 13.33      | 0.7726  |
| EF < 40%                                                  | n=125<br>33 (26.40) | n=44<br>14 (31.82)        | n=81<br>19 (23.46)     | 0.3111  |

\* PAD-peripheral artery disease, CKD-chronic kidney disease, CAD-coronary artery disease, MI-myocardial infarction, CHF-congestive heart failure, UA-unstable angina, NSTEMI-Non-ST elevation myocardial infarction, STEMI- ST elevation myocardial infarction, LVH-left ventricular hypertrophy, AVB-atrioventricular block, CKMB-creatinine kinase myoglobin, EF – ejection fraction

†High Risk TIMI: > 5 points for STEMI; >3 for UA/NSTEMI

e.g. longer time in hours before consult ( $40.86 \pm 54.11$  hours vs  $11.83 \pm 8.40$  hours,  $p < 0.0001$ ). Of note, the weekend/holiday group also had a greater proportion of patients delaying consult and admission for more than one day (66.1% vs 20.7%,  $p < 0.0001$ ).

### General Approach and Management

Management of patients was generally not statistically different between the two groups (weekend versus weekday group) in terms of type of admission (pay versus service / charity), location of admission (ICU versus regular room), and performance of diagnostic procedures. All patients were managed similarly with optimal medical therapy and included dual anti-platelets, beta blockers, ACE-inhibitors or ARBs, anti-coagulation, statins, and nitrates, in similar proportions. Early revascularization was also similar, whether admitted on a weekend/holiday or on a regular day. Table II summarizes the management of patients.

### Primary Outcome: In-Hospital Mortality

The primary outcome of in-hospital mortality occurred in 30 patients (17%). Majority of the deaths were due to cardiac causes: heart failure, shock, and arrhythmias. There was a statistically higher number of deaths in the weekend/holiday group compared to the regular day group (27% versus 12%,  $p = 0.0125$ ). Outcome data is shown in Table III. Simple logistic regression was done and showed the following variables to be associated with in-hospital mortality: age, male sex, high risk TIMI score, duration of symptoms,  $EF < 40\%$ , development of re-infarction, severe CHF, service / charity ward admission, and a weekend/holiday admission. Multivariate analysis identified a weekend admission, severe CHF, and a ward admission to be significant independent predictors of survival status (Table IV). The odds of dying among those who were admitted on a weekend/holiday is 7.69 times more likely compared to those who were not admitted on a weekend/holiday, controlling for the effect of CHF, and location; and this was statistically significant ( $p = 0.006$ ). Severe CHF increased the odds of dying by 26.4 times, compared to those without it.

### Secondary Outcomes: Re-Infarction and Heart Failure

Re-infarction occurred in 20.3% of the weekend/holiday admission group compared to 12.1% of those who were admitted on a regular day. This was not statistically significant ( $p = 0.15$ ). Simple logistic regression showed that a weekend/holiday admission was associated with development of re-infarction, but not in the multiple regression analysis.

Severe CHF occurred in 33.9% of the weekend/holiday admission group compared to 36.2% of the regular day admission group, and this was not statistically significant. Regression analysis did not identify a weekend/holiday admission as an associated factor with development of severe CHF.

## Discussion

Our study shows that a weekend/holiday admission was an independent predictor for mortality among patients with acute coronary syndrome (or 7.69,  $p = 0.006$ ), controlling for the effect of severe CHF and a ward admission. This demonstrates the existence of the weekend effect in our setting.

Increased mortality in weekend/holiday admissions have been documented in other settings. Cram et al.<sup>1</sup> was among the first to show the weekend effect in a large population of about four (4) million patients who consulted the emergency departments of several California hospitals. Notable in his findings is the significantly increased adjusted odds for death (or 1.03) in patients with ovarian cancer, duodenal ulcers, and in those with cardiovascular symptoms. Kostis et al.<sup>7</sup> showed unequivocally that a weekend admission was associated with increased 30-day mortality among ACS patients. Furthermore, they showed that this effect persisted for a year. Becker et al.<sup>5</sup> also found that among elderly patients with acute myocardial infarction, a weekend hospitalization was associated with an elevated mortality for a year. These studies consistently identified that on weekends, ACS patients were less likely to have access to primary intensive treatment such as PCI, a finding also attested to by Cubeddu et al.<sup>9</sup> Al-lawati et al.<sup>2</sup> also observed a similar reduction in the access and rates of angiography during weekends in the Gulf states, but there was no mortality difference. Other populations also failed to demonstrate the weekend effect among ACS patients.<sup>2-4,8,13</sup>

To look for factors that could explain this observed weekend effect in our setting, we examined patient-related characteristics and general management among those who were admitted on a weekend/holiday and on a regular day. We noted for any fundamental difference in baseline characteristics between the groups. We have shown that our week-day/holiday cohort is generally similar with our regular day cohort. The groups were similar in terms of comorbidities; diagnosis; and presence of high-risk features by TIMI score, cardiac enzymes, and low ejection fraction, as indicators of severity. Three variables stood out, however, as significant differentiating characteristics: a history of previous revascularization, duration of symptoms prior to consult and admission, and > one day delay in consult.

**Table II. Management Characteristics**

| Variables                                   | Total<br>(n=175) | Weekend/Holiday<br>(n=59) | Regular Day<br>(n=116) | p-value |
|---------------------------------------------|------------------|---------------------------|------------------------|---------|
| Echocardiography                            |                  |                           |                        |         |
| Done                                        | 72 (41.14)       | 27 (45.76)                | 45 (38.79)             | 0.3758  |
| Not Done                                    | 103 (58.86)      | 32 (54.24)                | 71 (61.21)             |         |
| Delay to Echocardiography (n=72)<br>in days | 5 ± 10           | 7 ± 14                    | 5 ± 7                  | 0.2720  |
| Type of Admission                           |                  |                           |                        |         |
| Pay                                         | 47 (26.86)       | 13 (22.03)                | 34 (29.31)             | 0.3046  |
| Service                                     | 128 (73.14)      | 46 (77.97)                | 82 (70.69)             |         |
| Location of Admission                       |                  |                           |                        |         |
| ICU                                         | 48 (27.43)       | 17 (28.81)                | 31 (26.72)             | 0.7696  |
| Ward                                        | 127 (72.57)      | 42 (71.19)                | 85 (73.28)             |         |
| Management                                  |                  |                           |                        |         |
| Beta blockers                               | 147 (84.00)      | 48 (81.36)                | 99 (85.34)             | 0.4962  |
| Antiplatelet                                | 158 (90.29)      | 51 (86.44)                | 107 (92.24)            | 0.2206  |
| ACEI/ARB                                    | 157 (89.71)      | 51 (86.44)                | 106 (91.38)            | 0.3093  |
| Statin                                      | 164 (93.71)      | 55 (93.22)                | 109 (93.97)            | 0.8477  |
| Nitrates                                    | 107 (61.14)      | 37 (62.71)                | 70 (60.34)             | 0.7614  |
| Revascularization                           |                  |                           |                        |         |
| Early Revascularization via PCI             | 20 (11.43)       | 3 (5.08)                  | 17 (14.66)             | 0.0600  |
| CABG                                        | 4 (2.29)         | 1 (1.69)                  | 3 (2.59)               | 0.7092  |
| Thrombolysis                                | 31 (17.71)       | 9 (15.25)                 | 22 (18.97)             | 0.5433  |

\*ICU-intensive care unit, BB-beta blocker, ACEI-angiotensin converting enzyme inhibitor, ARB-angiotensin receptor blocker, PCI-primary coronary intervention, CABG-coronary artery bypass graft

**Table III. Incidence of Primary and Secondary Outcomes**

| Variables                    | Total<br>(n=175) | Weekend/Holiday<br>(n=59) | Regular Day<br>(n=116) | p-value |
|------------------------------|------------------|---------------------------|------------------------|---------|
| <b>In-Hospital Mortality</b> | 30 (17.14)       | 16 (27.12)                | 14 (12.07)             | 0.0125  |
| <b>Severe CHF</b>            | 62 (35.43)       | 20 (33.90)                | 42 (36.21)             | 0.7628  |
| <b>Re-infarction</b>         | 26 (14.86)       | 12 (20.34)                | 14 (12.07)             | 0.1459  |

**Table IV. Multiple Logistic Regression: Mortality**

| Variables              | Odds Ratio            | p-value |
|------------------------|-----------------------|---------|
| <b>Severe CHF</b>      | 26.36 (4.41 – 157.64) | <0.001  |
| <b>Weekend/Holiday</b> | 7.69 (1.78 – 33.30)   | 0.006   |
| <b>Location: Ward</b>  | 0.18 (0.05 – 0.69)    | 0.012   |

A higher proportion of patients in the regular day group had previous revascularization. This might be related to a more aggressive health-seeking behavior among these patients, given their history. These patients, when they experience angina, could now have been more mindful of any symptom, lowering their threshold for consultation, even on regular days.

As mentioned, patients in the weekend/holiday cohort delayed their consult more and experienced longer duration of symptoms prior to seeking consult, compared to those admitted on a regular day. This is a significant finding. This could be a possible mechanism for the observed weekend effect in our study. It is a recognized fact that the greatest delay in the management of ACS lies in the patient's decision to call for help.<sup>14</sup> Given that the prognosis of ACS heavily depends on prompt treatment, a delay in consult and admission could result to a worse outcome. This finding was not demonstrated in our cited studies. A recurring limitation in these studies is the absence of data on symptom duration prior to admission, and the absence of severity data on presentation.<sup>4,7</sup> In our study, we have presented both data. Another important thing to consider for this delay in seeking prompt medical care is whether other socio-demographic factors play into this decision, such as job or work tasks and/or family responsibilities during weekdays that preclude patients from consulting.

General management was likewise similar between those in the weekend/holiday cohort and those in the regular day cohort. Optimal medical management was observed in both groups, and this was consistent with the observation of Alcover et al.<sup>12</sup> that compliance to guideline-recommended medications was very high among ACS patients in PGH. The rate of PCI, however, remains low. As previously mentioned, less access and use of PCI during the weekends has been proposed as a possible contributing factor to the weekend effect.<sup>5,7</sup> In our study, we could not determine if the availability and access to PCI was different between the groups due to its low utilization. Alcover et al. shared the same observation and surmised that low utilization of this therapeutic procedure could be related to the financial limitations of the generally indigent patient populace of PGH, which is a government-run tertiary-level charity hospital. Even so, the cohorts were still similar in this regard. The observed weekend effect in our study, therefore, could not be attributed to management variables.

Foreign literature points to reduced staffing during the weekends, both in terms of quantity and of expertise, as possibly contributing to the weekend effect.<sup>1, 2, 4, 7</sup> The mechanism could be related to the efficiency of delivery of care, and to close clinical supervision by senior doctors and staff, especially in managing complex cases. Cram et al.<sup>1</sup> tested the hypothesis that a teaching hospital would

have a smaller, if any, weekend effect, because of the relatively constant level of staffing by residents and fellows. Instead, they found that the weekend effect was larger in major teaching hospitals than in the non-teaching hospitals. They concluded that the weekend effect may reflect more than just physician availability, but may be a composite of reduced staff during weekends and reduced availability of procedures. This hypothesis remains to be demonstrated, however, in all these studies<sup>8</sup>. In our study, we have no information from the database on whether the level of staffing during weekends/holidays differed significantly from regular days, and whether a difference would result to adverse outcomes. Still, the similarity in the management of our cohorts makes the contribution of a reduced level of staffing to the weekend effect, if any, less potent.

Contrary to the moderately higher mortality observed for weekend heart failure admissions in another study by Horwich et al.,<sup>15</sup> our study showed that a weekend admission was not associated with heart failure or re-infarction. Severe heart failure occurred in 35% and re-infarction in 15%, which was not different between groups – this probably implies that the management given to both groups were similar. Improvement in the care for patients with heart failure or ACS, may it be on a weekday or a weekend, may account for this negligible association.

### Limitations and Recommendations

Our study has several limitations. A major limitation of our study is the design. Our data was obtained from a single-institution, prospectively collected database of a previous study, which investigated and was powered to detect an entirely different outcome. The exclusion criteria, in particular, were very specific. This may affect the applicability of our findings to other ACS patients, who would not meet the set criteria.

As mentioned, we did not have data on actual reduction in number of hospital staff and availability of facilities during the weekends, so we were not able to explore these factors. So far, we are not aware of any local study showing a reduced level of staffing during weekends/holidays, and linking this to outcomes.

Another important information we did not have was the reasons for delays in consult. Other specific ACS quality-of-care indicators such as the time interval between admission and being seen by a physician or the cardiologist, the door-to-ECG time, door-to-needle time, and proportion of time would also be valuable to further explain our finding. We also had very few PCI done in our institution, hence, we believe we did not have enough power to detect whether PCI, or the lack of it, contributed to the outcomes of our cohorts.

A major strength of our study is that we were able to address some of the limitations encountered in the past. Perennial limitations cited were lack of data with regards symptom duration and severity of illness of participants. Here, we were able to provide such data. We also showed that the management of ACS patients in PGH is generally optimal and constant throughout the week.

We recommend a bigger and prospective study to continue exploring the factors of the weekend effect in our setting, especially on the reasons for delays in consult.

## Conclusion

For patients with ACS, a weekend/holiday admission was associated with increased in-hospital mortality compared to those who were admitted on a regular day, despite similar baseline patient and general management characteristics in both groups. Due to the inherent limitations of a case-cohort study, the factors for this finding were not clearly established. One possible reason, however, would be the longer duration of symptoms prior to admission and the delay in consult among those who were admitted on a weekend/holiday. There is a need to further explore the factors that contribute to this "weekend effect" in our setting by a prospective trial.

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