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Determination of emergency department patient utilization and staffing at the University of the Philippines-Philippine General Hospital (UP-PGH)

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Abstract: **Objective:** In developing staffing plans for emergency departments (EDs), a multifaceted approach must be considered without compromising quality of care, patient safety and personnel satisfaction. This study aims to determine the temporal trend of patient attendance and staffing in a major tertiary hospital ED to assist in establishing an optimal staffing pattern.

Methods: A 1-year retrospective ED census review of adult patients at the University of the Philippines-Philippine General Hospital (UP-PGH) was undertaken. One-way analysis of variance (ANOVA) with post hoc Fisher-Hayter pairwise comparisons were utilized to determine if the ED consults and admissions were significantly ($P < 0.05$) associated with the month of the year and day of the week.

Results: A total 43,632 consults at the UP-PGH ED, averaging of 3,636 per month or 121 per day, were seen in 2019. Results indicated statistically significant differences between monthly [$F(11,353) = 16.45; P < 0.0001$] and between daily means [$F(6,358) = 4.19; P = 0.0004$]. The most number of consults occur during August, September, October and November while admissions were highest during April and October. It was busiest during Mondays and afternoon shifts (1400-2200 hours) with majority arriving as urgent in acuity. Mortality was also highest during the afternoon shifts.

Conclusion: The temporal variations in patient visits and acuity described in our study can be used as a template for workforce scheduling and resource allocation to meet the demands in the provision of care at the ED.

Keywords: Emergency Department; Patient Volume; Temporal Variation; UP-PGH

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1. Introduction

For many years now, one of the main problems challenging emergency departments (EDs) has been how to determine appropriate and optimal staffing. The ED has always been the most unpredictable unit in any hospital worldwide. There are times that the patient influx can be overwhelming especially during the peak hours; and there are instances that the workload is manageable, manpower and resources-wise. Optimal staffing is crucial in providing the best care to the growing number of diverse patients and to assure workforce' satisfaction at the ED. Inadequate staffing levels in hospitals has been linked to excess mortality, poor patient experiences and overcrowding (1-3). 2016 centers for disease control and prevention (CDC) survey of ED visits reported that there has been a total of 61.2% rise in ED volume over the past 20 years. An estimated 6.4% increase in ED attendance was noted from 136.9 million in 2015 to 145.6 million in 2016 (4). This same trend was seen in Taiwan during a 12-year period with a greater surge of 40% annually in ED volume from

1995-2006 (5).

Large patient volumes and overcapacity lead to congestion and problems in manpower which will inevitably compromise delivery of healthcare. Sufficient medical health workers with appropriate skills to meet patient needs and other clinical demands must be ensured. With an exceedingly changing acuity and quantity of patient at the ED, establishing an appropriate level of staffing that will provide the highest quality of care possible is also necessary (3). At an organizational level, high patient consults will translate to longer length of stay that is associated to increase in-hospital occupancy with more critically ill admissions to the wards and to the intensive care unit (ICU) beyond what is anticipated in these units (6,7). This will result to an imbalance of clinical volume and medical personnel providing adequate care even at the ED where most of the patients are initially seen and assessed. Administrators then are compelled to match the various patient needs with staffing that will conform to cost-efficient operation, provide patient satisfaction and re-

duce risk of medical errors (7). But as workload increases, direct and indirect patient care also expand affecting non-clinical personal time (8) which causes over exhaustion and burnout among hospital health care workers. Staffing at the ED is definitely a challenging task as workload is highly unpredictable and needs a high degree of flexibility and interaction between different units in the hospital. It is the aim of this study to determine the temporal variation and trend of patient volume through a comprehensive one-year census analysis and present medical staffing available at the University of the Philippines-Philippine General Hospital (UP-PGH) ED. This will provide preliminary basis for the appropriate future workforce and resource allocation to improve daily operations and quality of care delivery in a major tertiary hospital.

2. Methods

2.1. Study design and population

A 12-month retrospective census analysis of patients aged 19 years and above at the UP-PGH ED from 1st January to 31th December 2019 was done. ED records were reviewed and abstracted information include: number of patients consulting per day and month; number of admissions per day and month; patient acuity; number of mortality and number of ED staff every 8-hour shift for nurses and 12-hour shift for doctors. Patient acuity refers to how ill the patient was on arrival, their increased risk of clinical deterioration and how time consuming was the care they needed (9), accordingly patient acuity was classified using a 3-level triage system (10): (i) emergent– those with life threatening cases requiring immediate and rapid treatment, (ii) urgent– those with significant medical problems that could be life threatening, and (iii) non-urgent– those with stable conditions and considered as non-medical emergencies (11). Nursing time shift refers to the generally followed local time shifts: morning (0600-1400 hours), afternoon (1400-2200 hours) and night (2200-0600 hours); while the 12-hour doctor shift refers to morning (0700-1900 hours) and night (1900-0700 hours) shift within a 24-hour time frame.

2.2. Statistical analysis

All collected quantitative data were encoded in a Microsoft Excel spreadsheet and statistical analysis was performed using Stata Version 12 for Windows. One-way analysis of variance (ANOVA) was carried out to compare the monthly and daily census means of ED consults and admissions. Those found to be statistically significant in the omnibus ANOVA were subjected to post hoc Fisher-Hayter Pairwise comparisons to determine if the ED consults and admissions were significantly ($P < 0.05$) associated with the month of the year and day of the week.

The study was exempted from ethical review by the UP Manila-Review Ethics Board (UPM-REB 2019-349-01) as it did not involve more than minimal risks or harms entailing only data collected for institutional quality assurance.

3. Results

During the one-year census review, there were 43,632 consults at the UP-PGH ED with an average of 3,636 per month or 121 per day. Admissions during this time period averaged at 34.2 per day or 28% (12,329) of all consults; detailed patient volume per month is summarized in table 1. The months of August, October and November registered the most number of consults with over 4,000 patients while the months of January, March and April have the highest admissions. The lowest daily average consults were seen in the months of January and February with 95.6 and 95.8 respectively, and the lowest daily average admission of 13.8 was reported in November. It was during Mondays and Fridays that ED saw the highest number of visits with an average 547 and 552 patients per day respectively, while Saturdays had the lowest average at 492 patients followed by Sunday and Wednesday both having an average of 495 consults (Figure 1).

A one-way ANOVA was performed to compare the census means of ED consultations and the omnibus ANOVA results (Table 2) indicated statistically significant differences between monthly [$F(11,353) = 16.45$; $P < 0.0001$] and between daily means [$F(6,358) = 4.19$; $P = 0.0004$]. Fisher-Hayter post hoc test carried out for pairwise comparisons showed that on the average, ED consults for the of August, September, October and November months (studentized range critical value (0.05, 11,353) = 4.58) were greater compared to the rest of the months of 2019. Consultations every Monday (studentized range critical value (0.05, 6,358) = 4.05) was, on the average, greater than every Thursday, Saturday and Sunday.

Similar ANOVA (Table 3) and post hoc pairwise comparison done for admissions showed statistically significant differences between monthly [$F(11,353) = 2.23$; $P = 0.0125$] and between daily means [$F(6,358) = 14.48$; $P < 0.0001$].

On the average, ED admissions for the months of April and October (studentized range critical value (0.05, 11,353) = 4.58) were greater than the census for the month of December. The weekend (Saturday and Sunday) average admissions (studentized range critical value (0.05, 6,358) = 4.05) were lower than the census during weekdays (Mondays to Friday) with Monday being additionally higher than Thursday admissions.

The 8-hour shift census revealed that the midday or afternoon shift (1400-2200 hours) had the most number of consultations for the whole year while the night shift (2200-0600 hours) had the least patient number (Figure 2).

As for the mortality census, the months of September and October recorded the highest daily average per shift at 5.8 and 5.6 respectively while the afternoon shift had the greatest daily average at 36. Moreover, November only had a fifth of the mortality count of September and October (Table 4).

Patients with urgent triage acuity accounted for majority of consults in all the three 8-hour shifts (Figure 3) and represented 47% of the overall annual statistics. Patients were classified as urgent if they were hemodynamically stable on arrival, evaluation and care were required within 2 hours

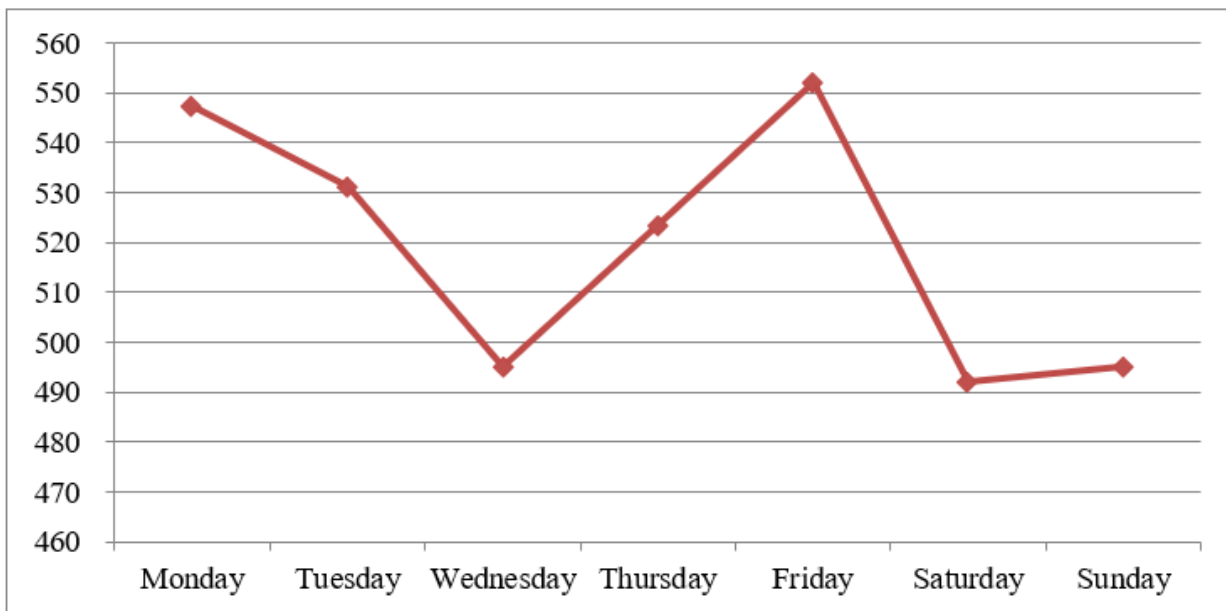


Figure 1 Average number of ED consults per day of the week from Jan-Dec 2019

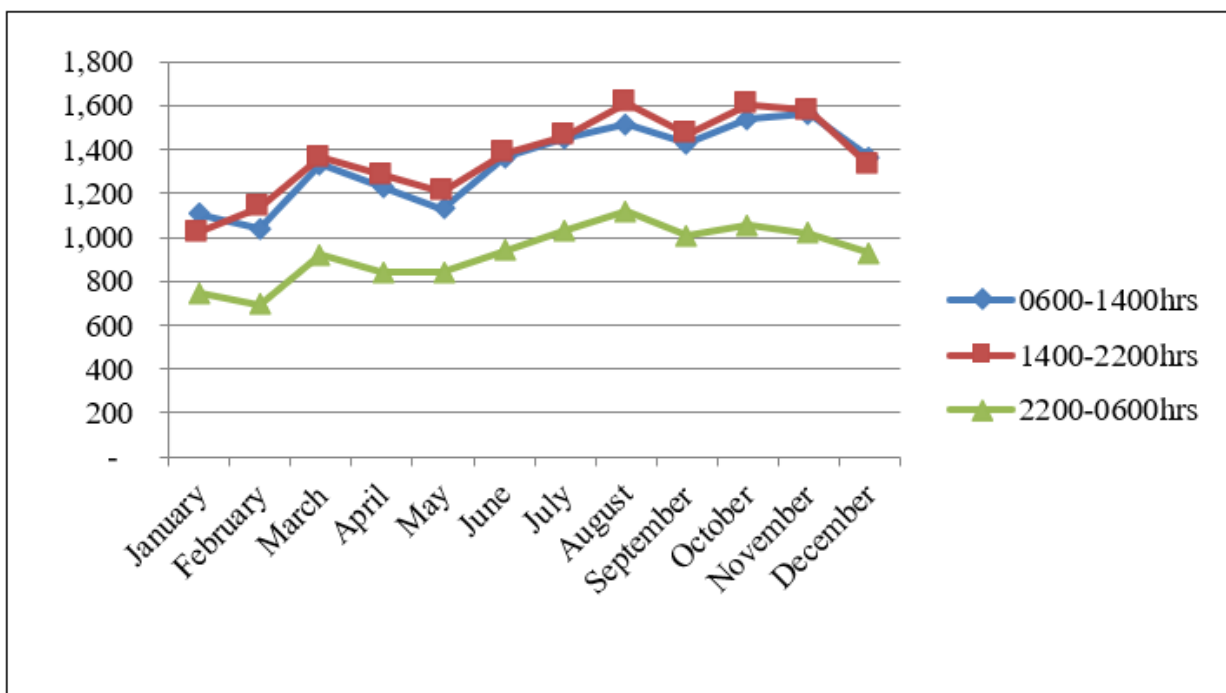


Figure 2 Number of ED consults per 8-hour shift from Jan-Dec 2019

and generally, their condition will not cause loss of life or limb if not treated immediately. In contrast, the non-urgent patients or those considered as non-medical emergencies mostly came in the morning (0600-1400 hours) and afternoon (1400-2200 hours) shifts and they registered the next highest overall ED visits at 29%.

The average number of doctors posted at the ED is 4 during the 12-hour morning shift and 3 during the 12-hour night shift mostly composed of emergency medicine residents and

a surgeon-on-duty (Table 5). The nursing staff complement, on the other hand, averages 13.2 per shift the entire year of 2019 (Table 6).

4. Discussion

This study presents the preliminary data on the temporal variability, different demand patterns and immediate staff allocation in a 1,500-bed state-owned tertiary, training hospital serving more than 690,000 patients per year. The annual ED

Table 1 Monthly ED consults and admissions with average per day, 2019

Month	Consults N	Average consults per day	Admissions N	Average admissions per day
January	2,869	95.6	1,236	41.2
February	2,874	95.8	979	32.6
March	3,620	120.7	1,215	40.5
April	3,359	112.0	1,359	45.3
May	3,173	105.8	1,092	36.4
June	3,685	122.8	969	32.3
July	3,937	131.2	1,016	33.9
August	4,247	141.6	1,010	33.7
September	3,901	130.0	907	30.2
October	4,192	139.7	1,105	36.8
November	4,157	138.6	414	13.8
December	3,618	120.6	1,027	34.2
Total	43,632	121.2	12,329	34.2
Average/month	3,636		1,027.42	

Table 2 Comparison of the mean ED consults by month and day, 2019

Month	Mean	Standard deviation	P-value ^a
January	103.6	14.9	
February	95.8	10.5	
March	100.3	12.5	
April	97.9	13.9	
May	97.9	14.8	
June	103.2	14.6	<0.0001*
July	103.5	12.1	
August	117.4	14.3	
September	123.7	13.1	
October	121.9	15.0	
November	124.0	10.6	
December	101.2	24.9	
Day			
Monday	115.3	18.7	
Tuesday	109.2	19.5	
Wednesday	108.2	17.7	
Thursday	105.2	14.5	0.0004*
Friday	111.4	13.8	
Saturday	102.0	16.1	
Sunday	101.9	20.4	

^a: one-way ANOVA; *: P-value<0.05 was statistically significant

attendance comprised of 55% medical cases and 37% trauma patients. Emergency medicine (EM) residents, supervised by board-certified EM specialists, man the ED with workforce augmentation mostly coming from the departments of surgery and internal medicine. The EM physicians are tasks to triage and administer acute care to all adult patients except those with obstetric or gynecologic complaints. In-depth analysis of patient census is important to determine the overall volume of patients and capacity fluctuations by day of the week, month of the year and time shift of the day. Optimal staffing is central to having a well-oiled and functioning operation in any department at the hospital or facility particularly in the acute care setting. Understaffing undermines patient and health worker safety causing unmatched clinical load and exhausted workforce while overstaffing, on the

contrary, reflects inappropriate resource allocation and inequitable manpower distribution.

A higher number of consults at the ED was significantly associated with the months of August, September, October and November which coincide with the rainy season in a tropical country like the Philippines (12). This is when diseases related to increase rainfall, flooding and low ambient temperature result to an uptick in ED visits. Admissions, however, were statistically more during the months of April and October compared to December. These findings were similar to a local study by Jimenez et al. (11) showing higher ED consultations at the latter part of the year (September-December), albeit reported in a private tertiary hospital. This was attributed to the occurrence of respiratory illnesses associated with the rainy season, maximization of health card

Table 3 Comparison of the mean ED admissions by month and day, 2019

Month	Mean	Standard deviation	P-value ^a
January	34.5	7.0	
February	34.4	6.6	
March	36.2	8.0	
April	37.4	7.2	
May	35.5	6.9	
June	34.9	8.4	<0.0125*
July	36.6	6.3	
August	36.6	5.9	
September	37.0	7.2	
October	38.9	7.3	
November	34.4	5.9	
December	31.2	10.4	
Day			
Monday	40.1	8.9	
Tuesday	38.1	7.5	
Wednesday	36.5	6.3	
Thursday	35.9	5.0	0.0001*
Friday	37.3	6.1	
Saturday	30.5	5.5	
Sunday	31.0	7.3	

^a: one-way ANOVA; *: P-value<0.05 was statistically significant

Table 4 Actual and average number of ED mortality per 8-hour shift from Jan-Dec 2019

Month	0600-1400 hours N	1400-2200 hours N	2200-0600 hours N	Total	Average/shift/day
January	27	22	17	66	2.2
February	28	31	23	82	2.7
March	20	28	22	70	2.3
April	25	34	30	89	3.0
May	30	36	42	108	3.6
June	30	29	28	87	2.9
July	44	43	38	125	4.2
August	44	48	35	127	4.2
September	58	62	54	174	5.8
October	56	56	55	167	5.6
November	9	10	14	33	1.1
December	35	27	27	89	3.0
Total	406	426	385	1217	
Average/month	34	36	32	101	

Table 5 Average number of doctors posted at the ED per 12-hour shift from Jan- Dec 2019

Month	12- hour morning shift N	12-hour afternoon shift N
January	5	3
February	4	6
March	4	3
April	4	3
May	4	3
June	4	3
July	4	3
August	5	3
September	5	3
October	5	3
November	5	3
December	4	3
Average/shift	4	3

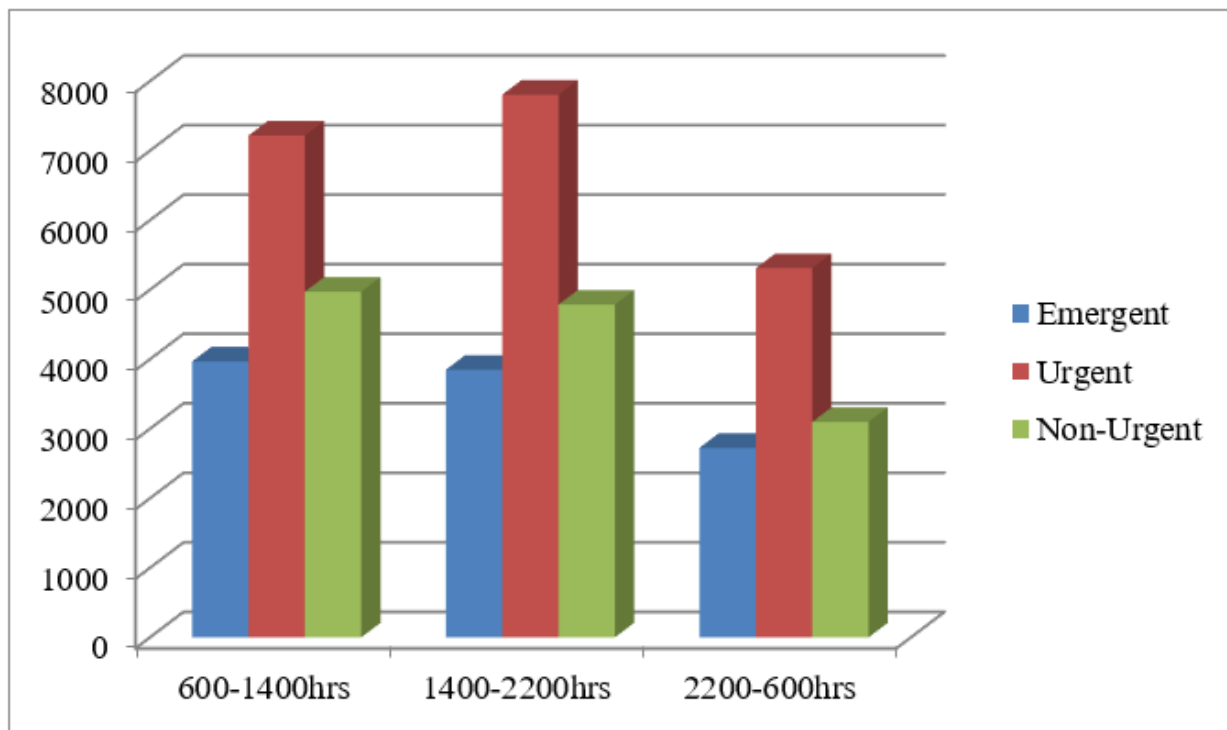


Figure 3 Emergency department patient acuity per 8-hour shift from Jan-Dec 2019

Table 6 Number of nurses posted at the ED per 8-hour shift from Jan-Dec 2019

Month	0600-1400 hours N	1400-2200 hours N	2200-0600 hours N
January	13	13	13
February	12	12	12
March	13	13	13
April	13	13	13
May	13	13	13
June	13	13	13
July	13	13	13
August	13	13	13
September	13	13	13
October	13	13	13
November	13	13	13
December	13	13	13
Average/shift	13.2	13.2	13.2

subscription to its ceiling benefit at the last quarter of the year and due to the unavailability of primary healthcare facilities during these months marked with holidays and festivities. Several studies have shown variable outcomes on the effects of seasonal patterns in ED visits which were mostly ascribed to the weather differences. In the United States, cold weather, and by extension the cold season brings lower number of patient arrivals (13) that was consistent with the trend reported by Sun et al. (14) in Singapore. Patients were fewest during the months of November and December which can be considered as the counterpart winter season in Southeast Asia. However, an investigation on the effects of season and weather conditions in the ED volume at

Montgomery County, Ohio showed that winter had the highest number of ED attendance (13). This season was comparable to the rainy season with low temperature in the eastern hemisphere. While admissions demonstrated a different pattern, being significantly higher during April and October, the severity of cases during these months could be the reason. The daily average temperature during April in the Philippines, which is considered a summer month, ranges from 28.8°C to as high as 33.7°C (15). Food and water-borne diseases coupled by heat-related illness are common during this time of the year (16). Moreover, people are mostly on vacation during summertime which is why a visit to the ED may suggest that the patient is very ill necessitating admission.

On the other hand, October having more consults will most likely result to a higher number of admissions. Influenza and other respiratory diseases were also notably common during this time. Although the actual chief complaints and admission diagnoses were not part of the data collected in this study, explanation for the results can be extrapolated from the trends in the previously cited literature on the effect of temporal variability in ED volume (11,13,14).

By far, the result of the weekday patient volume that was highest during Mondays was consistent with various studies (11,13,14,17). A phenomenon known as “Monday syndrome” has been mentioned in several literature to loosely mean as an increase in demand of healthcare services during Mondays, causing reallocation of resources to accommodate the uneven clinical load during this day of the week (18). Monday also has been the busiest day of the week at the UP-PGH ED with the highest consultation and admission census. Although Fridays have a comparable number of visits as Mondays, this was however not statistically correlated. Numerous reasons have been mentioned for the “Monday syndrome” which was perceived to be multifactorial (18): occupational disease, workaholic breakdown, injury-related and general practitioners sending more patients to the ED after their weekend rest. In the local context, this can also be due to the return of Filipinos from weekend breaks when they usually defer going to the ED. Weekends are considered vacation and family time which are both strongly based on social and cultural practices. In the systematic review by Wargon using linear regression models, the day of the week (Monday) was consistently the best predictor and had the strongest effect in forecasting ED attendance among all temporal factors considered (19). Trends of the weekday patient consults in this census audit showed that the numbers dipped from Monday to mid-week (Wednesday) when it was lowest and registered another peak on Friday. Saturdays and Sundays also had the least number of admissions owing to the low ED visits at this time. A possible explanation for the peak in consults during Fridays was the delay in ED check-up during weekdays due to tight work schedule. The tendency was to wait for the end of the week to have a perceived minor illness to be seen before taking a weekend hiatus. More commonly, ED consults during Fridays are due to the end-of-workweek social gatherings with officemates or friends resulting to binge eating, alcohol drinking and other risky vices. The urgent (47%) and non-urgent patients (29%) accounted for the majority of ED arrivals. Although these cases do not require immediate care and attention as the emergent patients, they almost always take more bed space and time in the department as they necessitate more diagnostics and laboratory work-ups to reach a definitive disposition. The non-urgent patients are particularly taxing because they are usually non-medical emergencies consuming more staff time and resources at the ED. These results were in agreement with the findings of Sun et al. (14) in a regional general hospital in Singapore with P2 (equivalent to urgent acuity) and

P3 (equivalent to non-urgent acuity) accounting for 92% of total daily attendance. The busiest work period was from the morning (0600-1400 hours) until the afternoon shift (1400-2200 hours); but most of the urgent and non-urgent consults, and mortality were registered during the midday shift. These have significant consequences on how manpower and resources allocation should be planned particularly that the number of doctors and the nurse's work shift assignments remain constant throughout the day, week and month of the year.

Recognizing the historical staffing patterns and knowing the patient volume trend on arrivals, admissions and mortality will help hospital managers stay ahead of the expected patient surges within the day, week or season. This review also intended to provide a guide in adjusting staffing patterns in an extremely demanding and busy department such as the ED to a level that is responsive to the variations in volume and acuity. To reduce the widely known effects of “Monday syndrome” in ED visits and surge of patients during the afternoon shift, provisions to increase medical, paramedical and ancillary staff including supply during this day and time must be considered. A three-year analysis of ED records at the St. Louis County Hospital showed that the peak patient load happens at 1100 hours and at 1900 hours (20). Adding a supplementary overlapping 8-hour mid-shift to coincide with the peak of patient volume at 1100-1900 hours made staffing “fat” with contingency personnel cushioning off the potential overcapacity so that quality of care, safety and patient experience will not be compromised. This additional shift during the midday patient surge can be a feasible strategy to maintain an efficient staff working at the ED. A mechanistic decline in productivity over the course of a duty-shift was also noted among emergency physicians. The rapid accrual of new patients at the start of work will be followed by a gradual slowdown in the rate of seeing patients at the latter part of the day. This was partly due to the filing up of tasks like following-up diagnostics and referrals done on patients managed early on coupled by the physical and cognitive fatigue ED doctors experience as the day progresses due to the non-aligned normal circadian rhythms catching up on their efficiency (21). Scheduling and timing of non-essential administrative and non-clinical activities e.g., meetings, training, workshops, seminars etc. should be avoided on Mondays and afternoon shifts. To prevent over exhaustion among staff, careful planning of their posting must be taken with due attention given to equitable rotation of shift timing, day and month assignments.

5. Limitations

Although, this preliminary census review has partly provided stakeholders an understanding of the temporal variability of ED visits and overall demand patterns, it has some limitations. Simplistic as it may seem, the others factors affecting ED attendance were not gathered in this study. These include actual number of workforce available whether medical

or not; interaction with other departments e.g., specialty departments, laboratory, radiology, administrative units; availability of in-patient beds; the financial constraints of patients; budgetary restrictions on government hospitals on hiring staff, provision of resources and other logistical requirements for ED operations. The actual seasonal variation during the time period of the study was not described in detail but rather only the known weather and seasonal patterns as reported by the accredited national weather agency was taken as the frame of reference. Furthermore, since this is a secondary data review, accuracy and completeness were dependent on the available ED census sources. The size and length of review, however, obviate possible minor errors in reporting causing no major difference or impact on the results. Lastly, generalizability of results may not apply to other hospitals in other parts of the country of different service capability and catchment area.

6. Conclusion

The degree of overcrowding at the ED in recent years introduces a number of challenges to hospitals and its management. Improving the ED staffing, that is optimal and responsive, is one approach to address this problem. An analysis of ED census for a period of 12 months at UP-PGH showed that the most number of patient consults significantly occur during the months of August, September, October and November and admissions during April and October. It was busiest during Mondays and afternoon shifts (1400-2200 hours) with majority of patients arriving at the triage classified as urgent in acuity. It was also during the afternoon shift (1400-2200 hours) when mortality was highest. The temporal ED patterns and variations described can be utilized as guides in adjusting manpower scheduling and resource allocation to match projected inflated attendance and higher patient acuity.

7. Declarations

7.1. Acknowledgement

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7.2. Authors' contribution

Both authors contributed to the conceptualization and design of the study, data collection, analysis and writing of the final manuscript. Both also approved the final report.

7.3. Conflict of interest

The authors declare no conflicts of interest.

7.4. Funding

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