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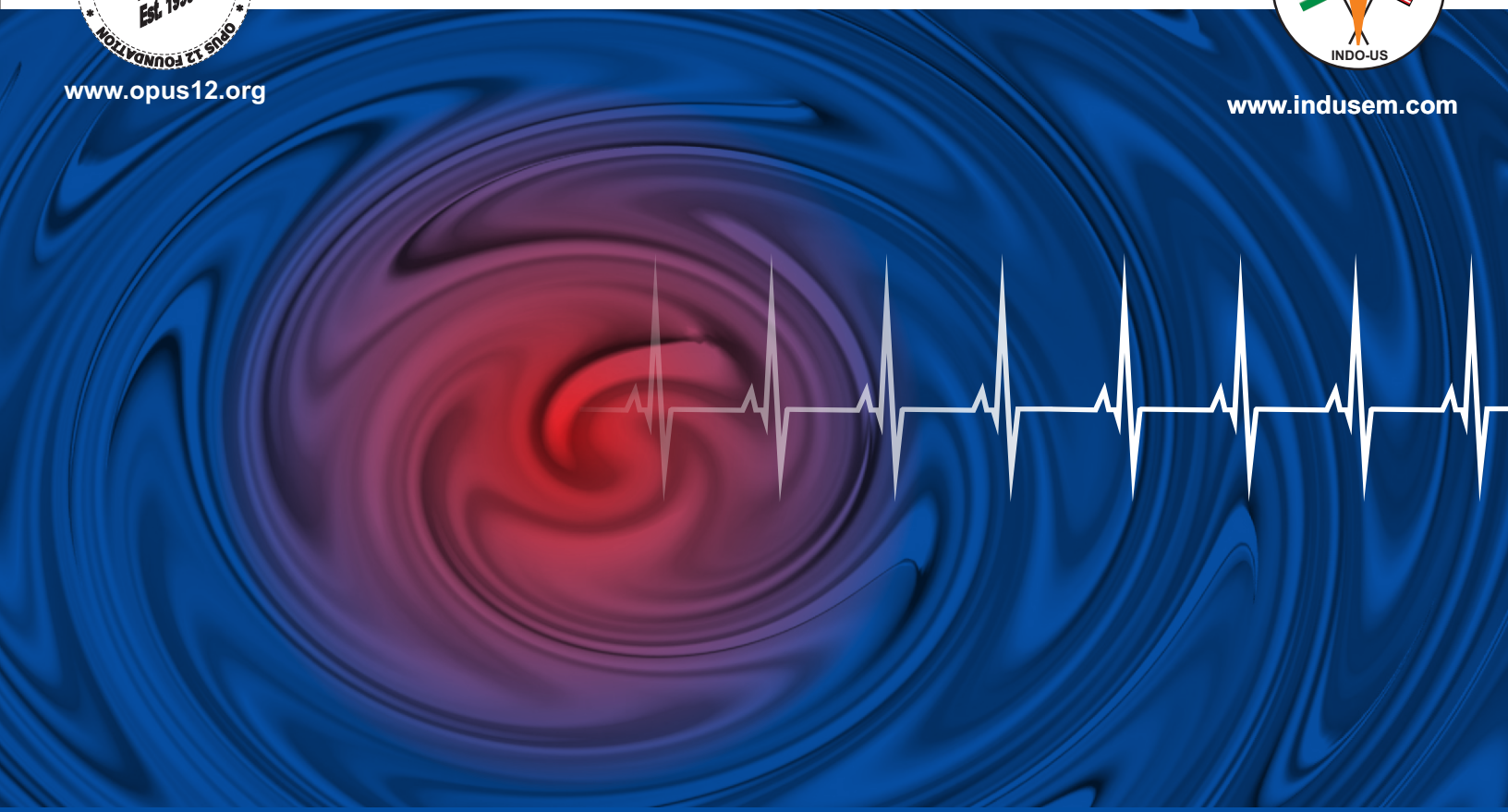

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Original Article

Arrival time pattern and waiting time distribution of patients in the emergency outpatient department of a tertiary level health care institution of North India

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ABSTRACT

Background: Emergency Department (ED) of tertiary health care institute in India is mostly overcrowded, over utilized and inappropriately staffed. The challenges of overcrowded EDs and ill-managed patient flow and admission processes result in excessively long waits for patients. **Aim:** The objective of the present study was to analyze the patient flow system by assessing the arrival and waiting time distribution of patients in an Emergency out Patient Department (EOPD). **Materials and Methods:** This short cross-sectional descriptive study was conducted in the EOPD of a Tertiary level health care Institution in North India in the month of May, 2011. The data was obtained from 591 patients, who were present in the EOPD during the month of May, 2011. The waiting time, inter arrival time between two consecutive patients were calculated in addition to the daily census data (discharge rate, admission rate and transfer out rates etc.) of the emergency. **Results:** Arrival time pattern of patients in the EOPD was highly stochastic with the peak arrival hours to be "9.00-12.00 h" in which around 26.3% patients arrived in the EOPD. The primary waiting areas of patients included patients "under observation" (29.6%); "waiting for routine diagnostic tests" (16.4%) and "waiting for discharge" (14.6%). Around 71% patients were waiting due to reasons within emergency complex. **Conclusion:** The patient flow of the ED could only be addressed by multifaceted, multidisciplinary and hospital wide approach.

Key Words: Emergency department, inter arrival gap, overcrowding, patient flow, waiting time

INTRODUCTION

The Emergency Department (ED) is known to be one of the most congested units in any hospital that faces greater pressure in terms of patient load and health care resources as compared to other departments of the health care system. Studies across various countries reported that quality of care decreases when the ED is overcrowded.[1] Overcrowding can result in delayed treatment, long patient waiting time and stay, overburdened working staff, patient elopement, high medical error rate, low productivity and poor patient outcomes.[2]

Overcrowding is often seen as a by-product of improper patient flow.[3] An efficient patient flow system serves critical patient quickly minimizing unnecessary delay in treatment. On the other hand, an inefficient patient flow leads to the problem of long and outstanding queues. Efficient patient flow depends on reduced waiting time and smooth outflow of patients. A patient arriving in the ED encounters repeated waits as he/she progresses in different stages, which may last for hours or even days.

Waiting time has been often cited as the most important cause of patients' dissatisfaction in the ED. Cooke cited reduction of "waits" as the most important area for improvement in ED.[4] Delays in the process have been associated with adverse outcome and increased violence in EDs. Waiting time in turn

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depends on multiple factors including volume of patients and workload on existing staff. If the outflow of patients from ED (either by means of transfer out or by discharge) is obstructed, this upstream bottleneck will also cause delays in the treatment.

The present study was conducted to assess the patient flow system by assessing the arrival time pattern and waiting time distribution of patient in the ED of a tertiary health care institute of India. By understanding flow trends, hospital administrators can streamline processes to minimize wait times, improve efficiency, reduce overcrowding in the Emergency out Patient Department (EOPD) and in turn improve patients' satisfaction.

MATERIALS AND METHODS

It was a short term cross sectional descriptive study conducted in May, 2011 in ED of a tertiary level medical, research and health care institution of North India. The institute caters to medical care needs of around 370 million populations of 7 states of India. In 2010-11, the institute catered to a yearly load of around 16,57,200 out-patients and 64,969 inpatients, whereas the ED of the Institute attended to 52,894 out-patients and 32,563 inpatients.[5]

A data collection tool to gather the required information was developed and pilot tested. During the study period, the investigator was stationed in the ED from 8.00 to 18.00 h. The data regarding waiting time (the length of time, when patient is waiting idle in the ED for delivery of the service, he requires) and Inter-arrival Gap (time gap between arrivals of two consecutive patients in the ED) distribution was collected. However, the data regarding arrival time (the time that the patient is first recognized, as requesting service in the ED) was obtained from the emergency records. The investigator approached patients/attendants presented in the EOPD during the data collection hours and asked them about their background characteristics and time of entry in the EOPD. They were further asked to document the waiting period for a service by asking a question "for what service the patient is waiting for and from how much time?" The consent for undertaking the study was obtained from in-charge, ED of the institute. The data was analyzed using the statistical package for the social sciences version 16.

RESULTS

The ED Block of the institute had a treatment area of approximately 23,088 square feet, which included 2 halls for patients with medical emergencies known as Emergency Medical OPD and one hall for patients with surgical emergencies known as Emergency Surgical OPD. The ED has one main entrance for patients and two more inlets from within the hospital, one from the main Hospital and one from advance trauma center. There is a cabin for enquiry adjoining main entrance where two receptionists along with one Assistant Public Relation Officer respond to the queries of the patients 24 × 7, along with other assigned works. There is a registration counter manned by one medical record technician, who register the patients, issued the gate passes to the patients' attendants and mark "no payment stamp" on the recommendation form of patients after checking their eligibility. A fee clerk receives the hospital charges in a cabin adjoining to the registration counter. The fee counter runs from 8.00 to 20.00, after which that the collection of fees is done on the registration counter. There is a radiology room; attendant's waiting hall, laboratories, chemist shop, blood bank, toilets (male and female) and Senior Medical Officers (SMO's) room [Figure 1].

The overall signage system was not adequate to guide the patients and their relatives. Patients have to be brought on the trolley for a checkup in the ED. There was no designated parking space for the vehicles of patients or staff who came to ED. A Deputy Medical Superintendent assisted by five SMO look after the ED services. At present, four posts of SMO were lying vacant and only one SMO (Ad-hoc) was in a position. The administration of the emergency complex was looked after by the SMO, such as dealing with medico-legal cases, providing poor free services to deserving patients and supply life-saving medicines and consumable items to the poor patients and supervise patient management in case of a disaster. In the EOPD, medical staff works in 3 shifts/day viz. from 8.00-14.00 h, 14.00-20.00 h and 20.00-8.00 h.

It was observed that majority (70%) of the patients who visited the EOPD was male and around 28% were in the age group of 45-59 years followed by 24.7% patients from the age group of 15 to 29 years. Majority (85%) of the patients who arrived in EOPD were in the conscious state of mind and around 64% were referred from other health care facility before coming to EOPD [Table 1].

Arrival time pattern of patients showed that around 26.3% patients came during the 9.00-12.00 h. Peak hour of the

Figure 1: Ground floor plan of emergency block of study institute in north India. A: Hall A Emergency Medical Out Patient Department (EMOPD); B: Hall B EMOPD; C: Emergency Surgical Out Patient Department; D: Waiting hall; E: Chemist shop; F: Laboratory; G: Ultrasonography room; H: X-ray room; I: Reception; J: Corridors; K: Waiting area for patients

presentation was 10.01-11.00 with 11% of the total presentations. The maximum inter-arrival gap (46 min) was observed during 6.01-7.00 h [Figure 2].

It was observed that maximum patients (29.6%) were waiting "under observation" after preliminary diagnosis by the physician and their median waiting time was 16 h. The next highest category of patients (16.4%) was those who were waiting for "diagnostics tests and their results" with the median waiting time as 1 h. The number of patients, who had completed the treatment process and waiting for doctors decision regarding discharge from EOPD was also substantial (14.6%) with the median waiting time of 2 h. Maximum median waiting time (38 h) was recorded for patients waiting for their turn for operative procedure after the decision to operate. It was observed that waiting of around 71% of patients in EOPD was attributed to factors within ED itself, whereas waiting of 26% patients was attributed to the reasons outside ED but within hospital [Figure 3].

Table 1: Background characteristics of study population

Variable	Number (*N* = 591)	Percentage
Age group (in years)		
0-14	31	5.2
15-29	146	24.7
30-44	125	21.2
45-59	165	27.9
60-74	97	16.4
>75	27	4.6
Gender		
Male	415	70.2
Female	176	29.8
Current place of residence		
Punjab	213	36.0
Chandigarh	114	19.3
Haryana	101	17.1
Himachal Pradesh	89	15.1
Uttar Pradesh	43	7.3
Other states	31	5.2
Health state		
Conscious	502	84.9
Unconscious	82	13.9
Semi-conscious	7	1.2
Referral status		
Health facility referred	377	63.8
Self-referred	214	36.2

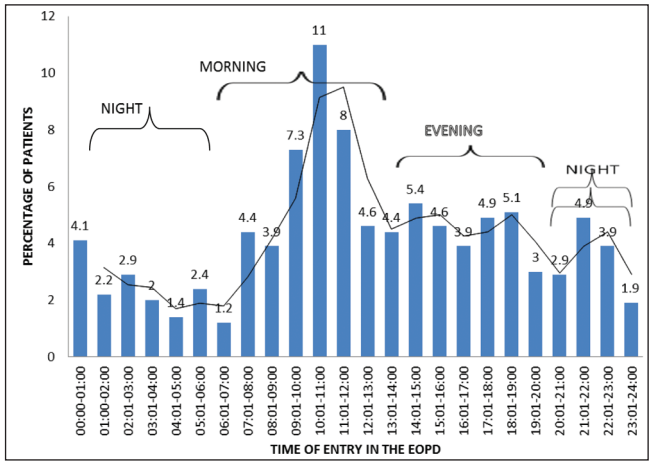

Figure 2: Arrival time pattern of patients in the emergency out patient department of study institute

DISCUSSION

With a steep increase in life-style diseases and road traffic accidents, the demand for emergency medical health care has been increasing. However, resource constraints in terms of scarce health manpower lead to overcrowding in hospitals, which in turn compromises the quality of care. However, much of this overcrowding is due to erratic and irregular patient flow. Most of the tertiary care hospitals of the India are facing problem with patient flow system. Such problem is even more apparent in ED, which are mostly overcrowded, over-utilized, inappropriately staffed and often lack coordination of care. Overcrowded EDs and poorly managed patient flow results in excessively long waits for patients, increase in the risk of inappropriate care and poor quality of services.[3]

There has been a steady rise in ED attendance in the institute over the years both in absolute terms as well as daily averages. Increasing rise of patients in EDs of hospitals is a commonly occurring trend globally. This is in conformity with an another study, conducted in a ED of a tertiary care hospital in New Delhi in 2003, which concluded that during the last 3-4 years there had been a steady rise in the ED attendance, both in absolute terms as well as daily averages.[6]

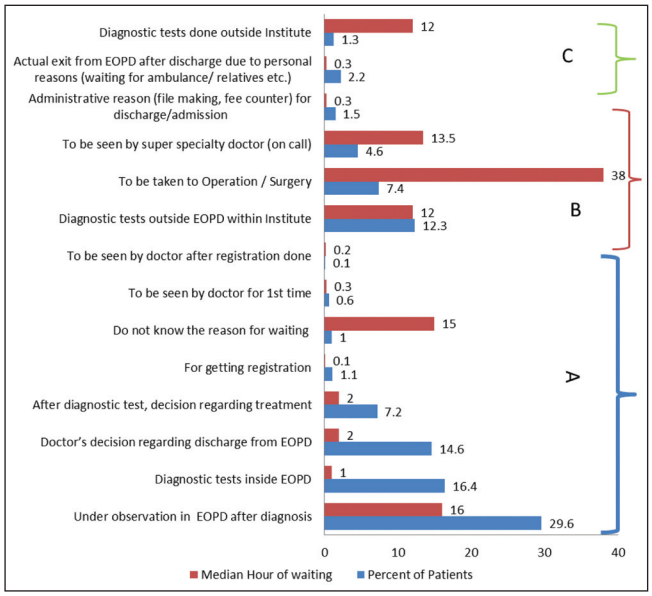

Figure 3: Waiting time distribution of patients for various services in the Emergency Out Patient Department of study institute; A: Waiting time attributed to reasons within the Emergency Department (ED) complex; B: Waiting time attributed to reasons outside the ED but within hospital; C: Waiting time attributed to reasons outside hospital

The higher use of the ED in the tertiary care hospitals can also be attributed to many reasons such as increase in the illness and chronic diseases, changes in demographic and epidemiological trends of diseases, increase in acute injuries, changes in people's perception about emergency need for health problems, better quality of health services rendered and growing population etc. This is supported by the data on accidental deaths, which had shown a rapidly increasing trend during the decade 2000-2010.[7] Moreover, the patient's preference toward a tertiary care institute was also documented in a study earlier done in the same institute wherein more than two-third patients were satisfied with hospital services and wish to avail them over secondary level care.[8] The provision of low cost tertiary level care treatment in study institute compared with the catastrophic cost of treatment in private hospitals might be a reason for choosing health care service in the Institute. Lack of tertiary care hospitals of such repute in neighboring states also lead to high rush of referral cases in the institute.

At present, EOPD of study institute was looking after around 154 patients at a time, which was around 5 times of its original capacity. To accommodate this heavy load of patients, additional patients were put on patient trolleys. As per the guidelines of Australasian College of Emergency Medicine,[9] the area of ED under study was adequate only for around 29,000 yearly patient load against present 53,000. Due to shortage of space, even the corridors of the EOPD were full with patients on trolleys with a very little space left for movement. Another study conducted in the same institute backs up this finding that patients were being treated in the non-treatment areas of the EOPD.[10] Kulstad *et al.* in their study had also concluded that frequency of medication errors in ED increased with the crowding in ED.[2] A study by Goel *et al.* in same study institute also suggested that heavy load of patients and attendants in the non-treatment areas of EDs may be a potential source of transmission of deadly infections.[10] Other studies have concluded that plague infection spread rapidly through infected patient to other patients in an overcrowded emergency ward of a tertiary care institute.[11,12]

The maximum patients in ED in our study from neurosurgery department are indicative of the fact that accidents mostly on road are increasing the volume of patients in ED. Chan *et al.* in their study concluded that total census of major patients in ED is major reason behind wait in ED.[11] The present study revealed that majority of the patients using the ED services were males. These results were easy to attribute to our culture where males are more exposed to hazards due to outdoor nature of their work as opposed to females.

A little less than one-third of the patients who visited the ED were from the productive age group of 15-29 years closely followed by age group of 45-59 years. Somewhat similar using pattern were shown in an another study carried out in Barbados which shows that around 36% who used the ED services were from the age group of 21 to 45 years and around 26% were above 50 years of age.[12] Increase in the number of vehicles in Chandigarh and its neighboring states resulting in steep upward trend in the number of road accidents might lead to increase in admission of males of the productive age group.[7]

The patients' arrival time pattern in present study was highly random. The peak arrival hours were at "9.00-12.00 h" in which around one fourth of the patients arrived in the EOPD. The finding in the present study were in consonance with another study done in a tertiary care hospital of Barbados, where only 10% of daily census entered in the ED during night.[12] Another study done in Turkey also showed that the ED visit during the night had decreased substantially when compare to day time visits.[13] The results of another study conducted in Saudi Arabia are contrary to this finding in which around 46% patients attended emergency during night.[14] The reason for low arrival of patient in ED during night time in the study, can be attributed to the fact that public transport facility are shut down after 21.00 h and hefty charges are made by the private taxi operators at night. Moreover, since no "on call" ambulance is provided by study institute, arranging one's own vehicle might not be an easier option in the night. Moreover most of the patients arriving in ED of study institute belong to lower strata of society who prefer to wait until morning rather than taking the patient to the hospital during night time.

Even though there was highly random arrival patterns observed in the study, yet surprisingly, the staffing pattern was somewhat similar for all 24 h spans. This might be seen as an obstruction to smooth flow of patient in ED. Overloading of patient due to high arrival rate in peak hours and inappropriate staffing pattern may result in clogging of patients. The guidelines adopted by American Academy of Emergency Medicine states that 1 physician is required per 2.5 patients/hour and the nurse, patient ratio should not exceed 1:3.[15] Whereas, in the EOPD of the study institute, around 10-11 resident doctors and 12-14 nurses cater to the average daily load of around 150 patients, which is much lower than the requirements. The volume of patients attending an ED was observed to be a major determinant of the waiting time, if resources are fixed. The resources in the department need to be matched to the workload on an hour by hour basis, despite the inherent variation in the workload.

Our study depicts that the factors influencing the patient flow do not lie solely in ED, although waiting of at least three fourths of all the patients can be explained by the reasons lying in the ED complex itself. Similar to our study, Schull and Shanks cited unavailability of alternative levels of care in the community, delay in diagnostics and patients held in ED awaiting admission are the main causes of wait in ED.[16]

Derlet and Richards in their study concluded that the most important cause of ED overcrowding was insufficient inpatient capacity for ED patients, who required hospital admission.[17] A study done in China[18] and Taiwan,[19] also confirmed this trend. Unavailability of inpatient beds not only delay those requiring bed but create a log jam effect, leading to unavailability of space and consequently delay of other patients who can be discharged from the ED. Due to un-specified "observation area" in EOPD in study area, most of the "under observation" patient had to stay on trolleys in the corridors of the EOPD. Chauhan *et al.* in their study also suggested formulating a strong admission

and discharging policy in the ED to regulate the patient turn out rate.[3]

Fast decisions on life-and-death cases are critical in ED. As a result, doctors face great pressures to over test and over treat. The fear of missing something often leads to extra blood tests and imaging scans. In the ED complex of the study institute, only routine diagnostic tests (X-ray, Hematology, Biochemistry, ultrasonography and Echocardiogram) were performed whereas patients have to visit the concerned departments for specific tests. This finding is supported by the fact that around 12.3% patients in the EOPD were found waiting for specialized tests with the median waiting time of 12 h. In the EOPD, the blood samples for laboratory test were taken by already overworked resident doctors. This adds in the additional waiting for sample collection. Another study done on the ED of study institute has also observed extreme rush in laboratories present within the premises of ED.[3] Other studies have also shown similar trend wherein, unnecessary tests conducted in laboratory complex increases the rush of non-patients.[20] Cooke also concluded that waiting for results of tests was one of the four commonest reasons for patient waiting in the ED.[4]

Consultation is a common and important aspect in the functioning of ED. A review on consultants in ED of tertiary hospitals had suggested that average response time of consultants ranges from 30 to 45 min, depending on the current needs of the patient.[21] In our study, median time for waiting for consultant was much higher than was recommended. This might be due to high proportion of junior resident doctors in the ED, higher rush of patients needed super specialty consultations and lack of Standard Operating Procedures for consultations. There is ample evidence that lack of timely consultation and coordination in emergency team is a leading cause of ED overcrowding and poor case management.[22]

In our study, a small fraction (1%) of patients were not aware about their reason of wait which can be possibly sketched by the fact that people feel hesitant in enquiring about the treatment from their care givers. Frank *et al.* has also concluded that insufficient information provided on waiting time, was a cause of people's perception of waiting time being extended.[23]

Limitations of the study

One of the main limitations of the study is small sample size and short duration of study. For the services availed by the patients in the absence of investigator, the investigator had to rely on the statement of the patients/attendants for time taken during the service. There might be a possibility of recall bias, where patient may forget about certain type of service rendered. There was a possibility of some incorrect data provided by patients or over exaggeration of waiting time.

Recommendations

To tackle the random inflow of patients, it was recommended that experienced staffing in the ED should be matched with temporal arrival pattern of patients. Further, benchmark should be formulated for various services (waiting time, service time) with annual audit mechanism. A laboratory technician should be posted in EOPD area for blood sample collection to ease out the already overworked resident doctors. The communication with patients in ED should be improved, where waiting is inevitable, health education and promotion should be introduced.

CONCLUSION

Based on the above study it can be concluded that identifying operational factors that influence patient flow in ED help hospital administration to device suitable strategy for improvements in the functioning of ED.

Summary

1. **Why is this topic important?**
   The policy makers faces a challenge of overcrowded Emergency Departments (EDs) and an ill-managed patient flow in tertiary care institutes, especially in developing countries, which result in excessively long waits for patients. Through this study, we tried to analyze the patient flow system by assessing the arrival and waiting time distribution of patients in the Emergency Out Patient Department (EOPD). This study will inform the hospital administrators and policy makers in effectively design a system so as to reduce waiting times and hence overcrowding in ED. This will in-turn benefit the patient by increasing their satisfaction rate.

2. **What does this study attempt to show?**
   This study attempted to understand patient flow in emergency department. The waiting times at different service stations in EOPD has been analysed. The paper provides insight to some of operational factors and solutions, which are easily replicated across other countries.

3. **What are the key findings?**
   i. Arrival time pattern of patients in the EOPD was highly random with peak hour of presentation was 10.01-11.00 with 11% of the total presentations
   ii. The primary waiting areas of patients included patients "under observation" (29.6%); "waiting for routine diagnostic tests" (16.4%) and waiting "for discharge" (14.6%). Around 71% patients were waiting due to reasons within Emergency Complex.

4. **How is patient care impacted?**
   Overcrowding resulting from poor patient flow and excess waits can result in delayed treatment, long patient waiting time and stay, overburdened working staff, patient elopement, high medical error rate, low throughput and poor patient outcomes.

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