Optimizing Patient Flow and Resource Utilization in Out Patient Clinic: A Comparative Study of Nkawie Government Hospital and Aniwaa Health Center

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The study is a comprehensive evaluation to explore current systems and practice regarding the Patient Flow and resource utilization in an out-patient clinic in both a government and private owned hospitals in Ghana. Currently we are witnessing unprecedented queues in these hospitals. the general information was analyzed by a single-phase queuing system. Findings indicated that the estimated mean arrival rate and the waiting time at the OPD for the public hospital were 23 and 0.5 hours respectively, and 25 and 0.5 hours for private hospital and this is directly opposite queuing situations found in developed countries (Ortola, 1993).

INTRODUCTION

Out Patient Department (OPD) Services are one of the important aspect of Hospital Administration. OPD is the mirror of the hospital, which reflects the performance of the hospital being the first point of contact between the patient and the hospital staff. Ensuring high standard for medical treatment as well as other auxilliary services will be essential in preserving the efficacy of the current first line treatment for the patients who visit the various OPD centers in Ghanaian hospitals. Satisfaction refers to a state of pleasure or contentment with an action, event or service, especially one that was previously desired (Hornsby and Crouther, 2000). When applied to medical care, patient satisfaction can be considered in the context of patient's appraisal of their desires and expectations of health care. One of the factors that influence patient satisfaction is efficiency of services rendered to patients (Santillan, 2000). The " efficiency" of service refers to the promptness of the care given to patients, including issues like waiting time before consultation, duration of consultation, amount of time spent with the doctor, quick response to emergencies, quick dispensation of drugs, fast and accurate laboratory tests (Santillan, 2000).

Out-patient healthcare service as the term connotes is simply the provision of healthcare to patients at hospitals, polyclinics, doctor's offices etc where they are treated and released on the same day. Out-patient service has stood the test of time as a vital component in the delivery of healthcare in the Ashanti

Region. It registered one of the strongest growth areas in the industry. Average out-patient visits per member per year were between 1.40 and 1.50 in 2009 for Ashanti Region alone, as against a national average of 0.18 (Ministry of Health 2010).

Among the many challenges confronting the healthcare sector in a developing nation such as Ghana, out-patient healthcare service is in no way immune and has its own fair share of the challenges. Notwithstanding the successes and improvements chalked by the out-patient healthcare service in the nation, this part of the service continues to grapple with concerns such as inadequate funding, lack of qualified professionals and medical equipments, etc. Furthermore, there is still the wave of overcrowding due to longer waiting times in out-patient clinics and this has been a source of concern for health workers and policy makers (Coté, 1999). In Ghanaian healthcare, queues are characterized structures formed to maintain order and create a hold on time; capital and human contribution towards development and efficient performance of any hospital system usually rely on queues to coordinate the delivery of health care (Ministry of Health 2010).

Even though healthcare delivery systems in private hospitals are perceived to be better than that of government hospitals, majority of Ghanaians seem to rely often on government hospitals for healthcare services. This could probably be due to the higher cost of assessing private healthcare facilities, which in turn may be attributed to the low income level of many Ghanaians. The large number of patients patronizing government hospitals often results in overcrowding and longer waiting times in out-patient clinics. Longer waiting times have been reported to affect patient satisfaction and choice of hospitals (Nketiah-Amponsah and Hiemenz, 2009). Because of the growth in out-patient health care, the operational and planning activities associated with its delivery have been quite sensitive.

Consequently, there is a recognized need for more research in this area. To the best of the researchers' knowledge, there is currently no publication on optimizing patients flow in order to reduce waiting times in public hospitals in Ghana. Thus the main motivation for conducting this research was to come out with a suitable and appropriate system for the management of out-patient departments in various hospitals in Ghana. As a comparative study, the research sought to examine the patients' flow into consulting rooms at Nkawie General Hospital (government owned) and Aniwaa Medical Center (privately owned) and to determine the traffic intensity at both hospitals. Additionally, the average time spent by physicians on patients in consulting rooms at both hospitals would be estimated and finally, a system to reduce the length of waiting periods and average time spent in consulting rooms by patients in public hospitals would be proposed. The rest of the paper is organized as follows: Section 2 presents relevant literature review of Optimizing patient flow and resource utilization in outpatient clinics, to be followed by the research methodology in Section 3. Section 4 is a presentation of the results and discussion. Finally we conclude the paper by highlighting the findings, implications and potential recommendations in Sections 5 and 6.

LITERATURE REVIEW

Much healthcare research has been devoted to the occurrence of the length of time which patients have to wait in order to be given healthcare services (Appleby et al., 2005). After sometime, waiting lists were viewed (often implicitly) as arising from a “backlog” in the need for care (Harrison, 2000).

From his earlier research (Gross, 1992), established that management scientists view waiting as arising from the vibrant buffering or smoothing of demand. Queuing theory, which has been far and widely applied in areas such as the design of call centers (Koole and Mandelbaum, 2002) but which also has a long-recognized applicability to the healthcare. It is thus promising to think of waiting as a “time price” as opposed to a “money price” (Gravelle et. al. 2002)

Coté (1999) shows that similar to many hospital or in-patient applications, such as those described by Badri and Hollingsworth (1993), Blake et al. (1996), Cohen et al. (1980), and Hancock and Chan (1988), the movement and control of patients and the utilization of resources is also of paramount importance to the operations of outpatient clinics. Keller and Laughun (1973) formulated an objective function to study the effect of patient congestion on physician capacity. Cox et al. (1985) sought later to control patient

flow in order to ``optimize'' an appointment system for an outpatient clinic's operations. Rising (1977) formalized the outcome of earlier research to study how to allocate patient arrivals such that an outpatient facility's workload was balanced. Stafford and Agarwal (1979) introduced a demand function for health services based on classical economic theory of the firm in order to predict daily patient load as a function of the calling population.

With their recent research Bevan and Morton (2008) found that, the central idea of queuing theory is that variability in the waiting times arises from variability in the arrival process which is either unpredictable, or predictable but unmanageable (as happens in systems which experience "rush-hours"). According to Baurerle (2001), p represent system utilization and in queuing systems, it states that if $p < 1$, i.e. the number of arrivals is less than the number of potential departures and for that matter the system is stable (positive recurrent). If $p > 1$ the system is unstable (transient) and if $p = 1$ it is null recurrent.

Simple and compound waiting times are implicated in an attempt to access treatment through queues from the perspective of the patient (David, 2005). However, various methods have been adopted to reduce queues to the barest minimum in some hospitals. This has led to several techniques employed by health care facilities to queuing and its characteristics on queuing systems, service or server efficiency, service space and service point(s) provided (Kolobe, 2006).

According to Q-Matic (2009), Customer Flow Management process is central and it is only when this process has been fully understood, is it possible to design solutions that maximize the benefits for the service provider.

METHODOLOGY

Two main types of data will be used for this study, primary and secondary data. The primary data consisted of information gathered on long waiting times in the out-patients departments in both government and private hospitals in the country-Ghana. The selection of sample respondents from the two hospitals was based on their OPD (Out-patient Department) attendance. Available records from the two hospitals showed that, OPD attendance constitute an average of five hundred and eighty per day (580) for Nkawie Hospital and four hundred and eighty (480) for Aniwaa Medical Centre. Based on these figures, the sample size for the study was pegged at three hundred and twenty-four (324) which constitute sixty percent (60%) of the total average number of the OPD attendance and this, the researchers believe, is sufficient and adequate for the purpose of this study. Questionnaires administration, interviews as well as observation constituted the forms of data collection mechanisms. The data gathered was analyzed by applying the basic queuing theory formula for a single-phase, single-channel system to patients in both hospitals. Quantitative Methods (QM) software version 2.2 was also used for the analysis of the study.

RESULTS PRESENTATION, ANALYSIS AND DISCUSSION

The Flow of Patients into Consulting Rooms at Nkawie General Hospital and Aniwaa Medical Center

Concerning the flow of patients at the Nkawie and Aniwaa hospitals, the total average length of cases for the month of the study was estimated to be 5040 and 8991 patients respectively for the two hospitals. The mean arrival rate (λ) was determined by dividing the number of actual cases by the number of hours the hospital operates in a day for a month and this was:

$$\text{Nkawie } (\lambda) = \frac{5040}{(12 \text{ hours per day})} \times 30 = 23 \qquad (\lambda) = 5040/(12 \text{ hours per day x } 30) = 23 \qquad (1)$$

$$\text{Aniwaa } (\lambda) = \frac{8991}{(12 \text{ hours per day})} \times 30 = 25 \qquad 8991/ (12 \text{ hours per day x } 30) = 25 \qquad (2)$$

Therefore, patients arrive at an average rate of 23 and 25 per hour at the Nkawie and Aniwaa hospitals respectively.

Service rate (μ) was estimated using the average number of patients served per an hour period within which we took the sample cases. This was obtained after observing the patients right from the 'records'' section up to the time they obtain their drugs from the dispensary. Average time spent by the sample patient gave us the service rate for the two out patients departments under the discussion

The service rate **(μ)** at Nkawie General Hospital = 25 patients per hour (3)

The service rate **(μ)** at Aniwaa Medical Centre = 27 patients per hour (4)

From the data gathered the average time patients were:

Waiting in the entire OPD unit: $$Ws = \frac{1}{\mu} - \lambda \quad (5)$$

Waiting in the entire OPD unit of Aniwaa Hospital: $$Ws = \frac{1}{27} - 25$$

$$= 0.50$$

Waiting in the entire OPD unit of Nkawie Hospital: $$Ws = \frac{1}{25} - 23$$

$$= 0.50$$

From the data gathered, the waiting time in the entire OPD unit before the patient see the doctor is 0.5 of an hour or 30 minutes for both Aniwaa Medical Centre and Nkawie Government hospital. This shows that Aniwaa Medical Center has a better service rate than the Nkawie Government Hospital. This is due to the number of OPD cases they are able to serve within its operational time - 5040 patients for Nkawie Hospital and 8991 patients for Aniwaa Medical Center.

The number of patient flow into each of the hospital has resulted in more waiting time for the patients at the OPD units. From the data gathered, waiting at the OPD units at both Aniwaa and Nkawie hospitals was estimated to be 30 minutes. These consist of the wait period at records, revenue and vital signs checking sections. This is however, quite a substantial time to be wasted in these hospitals.

Concerning the Out-Patient Department (OPD) flow of patients at Nkawie and Aniwaa hospitals, patients arrive at an average rate of 23 and 25 per hour in the two hospitals respectively excluding the emergency wards and the patients who have appointments especially at Aniwaa Medical Centre where scheduling of appointments is practiced. The patients arriving at the OPD unit with Scheduled Appointments are not considered as part of the estimated waiting hours, even if they wait to see their medical doctors. Most of the cases at the out-patient unit were non-emergency cases and therefore we used Poisson distribution for arrival process in the study. After an extensive statistical analysis of the collected data, the service rates for the two hospitals were 25 and 27 patients per hour for Nkawie Hospital and Aniwaa Medical Centre respectively. Considering the time patients had to wait at the OPD unit, it was observed that both Nkawie hospital and Aniwaa Medical Centre had two consulting rooms each serving as their servers. This obviously created the long queues at the OPD units due to large number of arrival of patients. Both hospitals maintained only two servers because of the variability in the arrival process which is unpredictable or predictable yet unmanageable. These situations are consistent with the work of Morton and Bevan (2008) and Coté (1999).

The Traffic Intensity Within the OPD Unit at Nkawie and Aniwaa Hospital

Traffic intensity is a measure of the average occupancy of a server or resource during a specified period of time, normally a busy hour. From the above discussion, the volume of traffic in the OPD was

measured by the number of service requested per unit time and the time that a section in OPD satisfies each patient request and were recorded as follows (Table 1 and 2).

TABLE 1
WAITING LINE RESULTS FROM THE NKAWIE HOSPITAL

Parameter	Value	Parameter	Value	Minutes
Single-channel system		Average server utilization	0.9200	
Arrival rate(lambda)	23	Average number in the queue(Lq)	10.5800	
Service rate(mu)	25	Average number in the system(Ls)	11.5000	
		Average time in the queue(Wq)	0.4600	27.6000
		Average time in the system(Ws)	0.5000	30.0000

Source: Field Survey, 2013

TABLE 2
WAITING LINE RESULTS FROM ANIWAA MEDICAL CENTRE

Parameter	Value	Parameter	Value	Minutes
Single-channel system		Average server utilization	0.9259259	
Arrival rate(lambda)	25	Average number in the queue(Lq)	11.57407	
Service rate(mu)	27	Average number in the system(Ls)	12.5	
		Average time in the queue(Wq)	0.462963	27.7778
		Average time in the system(Ws)	0.5	30.0000

Source: Field Survey, 2012

The traffic intensity for both Nkawie and Aniwaa are all approaching one (1) indicating some amount of traffic in the system by the two hospitals. Figures recorded by the two hospitals-Nkawie and Aniwaa was 0.92. That is the average server utilization or the traffic intensity in the Public Hospital-Nkawie and that of the private Hospital-Aniwaa Medical Center in Ghana are all approaching null recurrent which is consistent to Coté (1999). This implied that the queue in OPD units will grow out of bound if nothing is done on the flow of the patients to these hospitals as well as the service rate of the hospitals. In other words, the figure 0.92 of both hospitals is approaching one (1) and if it is checked, very soon it will be more than one (1). This will increase the server traffic intensity, and operations at the units and planning activities at the OPD will all become complex and quite sensitive in its management (Coté, 1999). The ideal traffic intensity has to always fall well below one for the system to be stable or positive recurrent (Bauerle, 2001). This shows that there are a lot of inefficiencies in the operations at the OPD units in both hospitals that need immediate attention for smooth patients' flow.

Again from the data gathered, the average number of patient found in the queue at a time at Nkawie Hospital is eleven (11) patients as compared to the Aniwaa Medical Centre which on the average is twelve (12) patients at a time. With this average number in the queue, each patient at Nkawie Hospital spent an average of 27 minutes in all the queues that he/she joins at the hospital and 28 minutes at the Aniwaa Medical Center. But considering the total number of patients attending these two hospitals, Aniwaa Medical Centre is more operationally efficient than the Nkawie Hospital due to the less relative average time used to serve its patients.

To Determine the Average Time Spent by Patients in a Consulting Room at Nkawie General Hospital and Aniwaa Medical Center

The average time patients spent in the consulting room is

At Nkawie the service time $= \frac{1}{\mu} = \frac{1}{25}$ (6)

$\mu = 25$

therefore the average time spent in a consulting room

$= \frac{Lq}{\lambda} + \frac{1}{\mu} = \frac{10.6}{23} + \frac{1}{25} = 0.5 = 0.5$hours or 30 minutes. (7)

At Aniwaa the service time $= \frac{1}{\mu} = \frac{1}{27}$ (8)

$\mu = 27$

Therefore the average time patients spent in the consulting room is

$= \frac{Lq}{\lambda} + \frac{1}{\mu} = \frac{11.5}{25} + \frac{1}{27} = 0.49$ or 30 (9)

As at the time of the study, both hospitals had two (2) consulting rooms serving the entire patients. These consulting rooms are represented by **m** meaning the servers for the two hospitals. Therefore the Average server utilization for the two hospitals is 0.46. The figure also depicts the probability of how much a patient is likely to wait in the OPD Unit.

In all, it was observed, from the data gathered that the average time of patients waiting in line to be served are 27 minutes and 30 minutes for Nkawie hospital and Aniwaa medical centre consulting rooms respectively. The times could be detrimental for patients who do not have a stable condition.

Average time spent in the queue (Wq) is the proportion of the system's resources used by the traffic which arrives at the OPD unit. From the data gathered, the average time in the queue spent by patient in each of the section visited at the OPD unit at both Nkawie and Aniwaa hospitals was 0.46 hour. Therefore, a patient who visits records section, vital signs section, consulting room, and dispensary section will spend an average of 0.46 hour in each of these sections and the total time spent for these sections is 1.86 hours or 110.4 minutes. For the two hospitals, the value indicate the growth of queuing in the OPD operation system which is due to an increase in time the patients spent in the queue. Measures must be put in place to check these delays and provide efficient services. In general, a lower utilization corresponds to less queuing of patients and for that matter more efficient utilization of the system.

Service times are also often assumed to be random. The mean service rate is mu, and the expected service time is E(s) = 1/mu. Hence, when the OPD system capacities were measured, it was found that as the mμ increases, the system utilization for a given Patients arrival rate decreases. This means that, if the capacity of the OPD units increases, then the various sections within the OPD unit will be able to reduce the time used to serve patients who used the facility. It was also realized from the study that there are increases in waiting times especially at Nkawie General Hospital as a result of a fall in service capacity. It therefore rests on the Hospital Administrators to consider the trade-off between OPD capacity increase and the service delay, implying that they should weigh the cost of providing a given level of service against the potential cost of having patients wait as a result of having low capacity for the service provided as suggested by Mazumdar (2007).

Developing a System to Reduce the Length of Waiting Periods of Patients

From the observation made from the study, as a patient enters the hospital OPD, that patient has to either first join the queue leading to the records section or go straight to the records section when there is

no queue. The record section personnel determines if the patient ever receives the service at the hospital or not and if the former is true, they pull up the patient's card from their records and give to him/her. If the patient is visiting the hospital for the first time, the personnel at the records first creates patient's profile in the Hospital Information Database system before the patient is handed his or her new card. From records, the checking of vital signs before going to the consulting room is done. Patient then visit the revenue section and then to the dispensary. These procedures were disclosed by the patients of both hospitals and as a result of these paths it always resulted in long queues within the OPD units which is also consistent with the work of Stafford and Aggarwal (1979) that offering homogeneous service at stations aggregated clinic queuing.

This OPD queuing can be reduced or totally eliminated by the introduction of Q-matic system. Q-matic software is one of the systems that can be used to reduce the burden of control of manual processes and resources by creating a completely automated system (Thomas, 2009). Q-matic software had proved capable of reducing waiting times drastically to a tune of 70% of the waiting time.

Another important function of the Q-matic system that was discovered in this research is its ability to track patients throughout their visit to the Hospital. With the Q-matic solution, a system administrator sitting in his office can monitor the patient's movement through the OPD clinic. It basically tracks patients from the moment they enter till the time they leave using a single system and a single ticket. Again, the system is able to generate live management information which will enable the Hospital Administrators to take immediate measures if necessary. Administrators can see patient volumes at all times, real and calculated future waiting times for OPD, and consulting rooms. In addition, Administrators can see, in real time, any appointment, delay times as and when they happen. As soon as waiting times exceed the set limits, Administrators are alerted by the system and can act accordingly (Thomas 2009).

CONCLUSION

This study attempted to analyze actual operations of the two hospitals, Nkawie Government Hospital and Aniwaa Medical Centre which is fully private owned. From the study it was found out that Nkawie Government Hospital has longer waiting times compared to Aniwaa Medical Center. Even though the figures are the same for the waiting time but, based on the average number of OPD cases, Nkawie recorded 5040 cases whiles Aniwaa Medical Center recorded 8991. Again, Nkawie Government Hospital's traffic intensity as well as its utilization factor are the same as Aniwaa medical Center's which recorded 28.2% higher OPD cases. Despite both hospitals having their waiting times growing at an increasing rate that of Nkawie hospital is more severe than the Aniwaa Medical Center. This the researchers discovered was as a result of inefficiencies in the supervision of some of the services provided by the staff of Nkawie hospital. This confirms the perceived poor monitory and supervision of government institutions in Ghana (Lievens et. al., 2011).

RECOMMENDATIONS

Increasing the service rate of the OPD staff by way of introducing electronic based systems like Q-matic system for pre-registration, re-registration, and document reproduction functions of the patients coming to the Hospital will reduce cost and waiting times drastically in the both hospitals. The use of Q-matic system will help to speed up the patient flow as well as cutting down the cost of operation at the OPD unit. Increasing the number of personnel and rescheduling the work times of the staff of the OPD unit can help in reducing patients waiting in line drastically at the hospital. Introducing an appointment management system in both hospitals will also help in cutting down patients waiting in line.

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