Nigerian Journal of Medical Imaging and Radiation Therapy

ASSESSMENT OF PATIENTS' WAITING TIME IN PRIVATE DIAGNOSTIC IMAGING FACILITIES IN PORT HARCOURT

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ARTICLE INFO

Keywords:
Patients' waiting time, patients' satisfaction, queue, diagnostic imaging facility.

ABSTRACT

Background: The length of time patients wait in diagnostic facilities for services impacts negatively on use of the facilities. Keeping patients waiting unnecessarily can be a cause of stress for both the patient and the radiographer.

Aim: To assess patients' waiting time in private diagnostic facilities in Port Harcourt with a view to proposing an optimization model.

Method: The operating characteristics of two selected private diagnostic facilities in Port Harcourt were studied between January and April, 2019. Data were obtained from structured questionnaires served to 220 patients who attended these diagnostic facilities. Demographic characteristics of respondents, causes of delays in the facilities, implications of the delays, time of arrival at the facility and time of departure from the facility were surveyed. Tora optimization software was used to analyze the simulated queueing model.

Results: 70.5% of the respondents waited 60-120 minutes to get service, 24.5% waited 121-180 minutes. The mean waiting time was (105.43 ± 32.51) minutes. 47% of respondents were satisfied with the services and 45.5% would recommend the facility. The mean waiting time using the proposed M/M/3/GD/∞/∞ model was 26 minutes.

Conclusion: Increasing service channels and support staff would reduce patients' waiting time.

INTRODUCTION

Radiography plays a central role in modern medicine being a diagnostic tool of choice in diagnosing, treating and managing many kinds of ailment. Unlike other arms of the hospital that are designed to carter for specific kinds of illnesses, the radiology department provides services that are utilized by almost every patient [1]. In Nigeria, services provided at public health facilities are generally perceived, by members of the public, as being very poor [2]. Even health care providers have been generally dissatisfied with the perceived quality of care and have for many years used their professional associations to demand for increased governmentfunding of the health sector [2,3].

From purely clinical judgement, physicians now rely more on "Diagnostic facilities", which offer advanced, high tech test, with high sensitivity and specificity, giving accurate results. 'Diagnostics' is a financial and technology intensive industry with a

high demand for skilled manpower. Technological advances in diagnostic care is very rapid nowadays. The challenge for many Diagnostic setups is to balance satisfaction of patients and clinicians, which is the primary reason for its existence, with profit generation for maintaining the expensive set-up. In today's world, private diagnostic healthcare market is growing very fast and there is intense competition to grab a lion's share [4]. Moreover, Consumer of today's health care sector is very alert and aware about his rights and the standards of services he is going to pay for [5].

A patient is any recipient of health care services [6]. Patients spend substantial amount of time in the clinics and diagnostic facilities waiting for services to be delivered by physicians and other allied health professionals [7]. Waiting time in private diagnostic facilities could be defined as the time between when a patient present at the diagnostic department for an investigation, and the time the investigation is done and a report written on the outcome of the investigation.

Healthcare organizations that wish to deliver exceptional services must effectively manage their waiting time [7]. Patient waiting time is an important indicator of quality of services offered by diagnostic facilities and hospitals [8]. The amount of time a patient wait to be seen is one factor that affects utilization of healthcare services. Patients perceive long waiting times as a barrier to actually obtaining services [9]. Keeping patients waiting unnecessarily can be a cause of stress for both patient and doctor. Waiting time is a tangible aspect of practice that patients use to judge health personnel's ability, even more than their knowledge and skill. One of the factors that influence patient satisfaction is efficiency of services received [10]. Satisfied patients are more likely to comply with prescribed treatment and advice from the care givers; they are also more likely to return for additional care when necessary and may be more willing to pay for services thus, increasing revenue.[10] The degree to which health consumers are satisfied with the care received is strongly related to the quality of the waiting experience. Additionally, waiting time becomes a factor in retaining current users of the services [7]. Patient satisfaction has emerged as an increasingly important parameter in the assessment of quality of health care hence, healthcare facility performance can be best assessed by measuring the level of patient's satisfaction. A delighted patient will become a loyal 'apostle', telling others about his / her great experience, while Outraged one will certainly not return but, will propagate negative aspects of the healthcare provider in an emotional way [11].

A study revealed that the average waiting time in hospitals in Trinidad and Tobago was 2hours 40minutes. This prolong wait before consultation was reflected in the 48% of patients who were dissatisfied with hospital care for this reason [12]. The Institute of Medicine (IOM) recommends that, at least 90% of patients should be seen within 30 min of their scheduled appointment time [13]. Furthermore, the British Medical Association (BMA) has recommended that average duration of consultation in outpatient departments should be approximately 15 minutes per patient. This is, however, not the case in most developing countries, as several studies have shown that patients spend 2 to 4 hours in the outpatient departments before seeing the doctor [12,14]. A source of dissatisfaction with healthcare reported by patients is having to wait a long period of time in the clinic,[15] and several studies have documented the negative association between increased waiting time and patient satisfaction with primary care [16,17].

Not much work on patient waiting time in radiology or diagnostic imaging departments are reported in the literature. Worse still, works on patient waiting time in radiology or diagnostic imaging departments reported are studies carried out in government owned public facilities. In separate studies carried out in the radiology department of the University of Port Harcourt Teaching Hospital, Arimie [18] and Ogaji *et al* [19] reported mean patient waiting time of 1.04631 hours (or 63minutes) and 77 minutes respectively. Arimie [20] reported mean patient transit time (i.e. mean time from entering to leaving the facility including the waiting time) of 1.19604 hours (or 72 minutes). This reported times are at variance with Sobechukwu *et al*. [21], a similar study in the Radiology Department of another Teaching Hospital in Nigeria. Here, it was reported that the mean time spent from time of reporting to the reception to leaving the department was 2hrs. 40mins ± 1hr. 16mins. Chest cases spent the least time of 2hrs. 29mins ± 1hr. 9mins, while those that

came for extremities spent the longest time of 3hrs. 36mins ± 21mins.

It is established that the duration of waiting varies from country to country, and facility to facility. A number of factors account for this variation for example, number of service points available, diversity of the patient groups needing the service, diversity of the investigation mix, pattern of patients arrival and arrival times, number of service staff available, adequacy of the staff in terms of expertise, competence, experience, motivation, efficiency and effectiveness [20]. All processing steps except film assessment by radiographers significantly affects the length of time patients spend in a radiology department [21]. Considering the fact that the operational dynamics in public and private sectors are not the same and also that there is paucity of literature on studies of patient waiting time in private diagnostic facilities especially, in Port Harcourt, it is the aim of this study to assess patients' waiting time in private diagnostic facilities in Port Harcourt with a view to proposing a model for optimizing the patients' waiting time.

METHOD

The operating characteristics of two selected private diagnostic facilities in Port Harcourt were studied between January and April, 2019. These two diagnostic facilities were selected because they have full complements of the essential imaging modalities such as conventional radiography, contrast radiological studies, Magnetic Resonance Imaging (MRI), Computed Tomography (CT), Mammography and ultrasonography (USS), and they have high patronage of patients as they provide a wider range of diagnostic imaging services. The two facilities are assumed to account for well over 50% of all diagnostic imaging procedures done in private diagnostic imaging facilities in Port Harcourt.

Data were collected using structured questionnaires which surveyed demographic characteristics of respondents, the causes of delays in the facilities, implications of the delays, time of arrival at the facility and time of departure from the facility. The questionnaires were administered only to stable, conscious and ambulant patients who were willing to participate in the study. The decision to use these inclusion criteria was due to the fact that these facilities are detached from any hospital and seldom receive patients on stretcher and wheel chair. Each questionnaire served was retrieved from the patient at the point of exit from the facility after entering the departure time. A total of 220 questionnaires were administered to the patients who met the inclusion criteria and who gave their consent to participate in the study after ethical approval was obtained from ethical committee of the diagnostic facilities involved.

The proposed model

The sketch of operational layout of the two diagnostic imaging facilities studied are very similar and is shown in Figure 1.

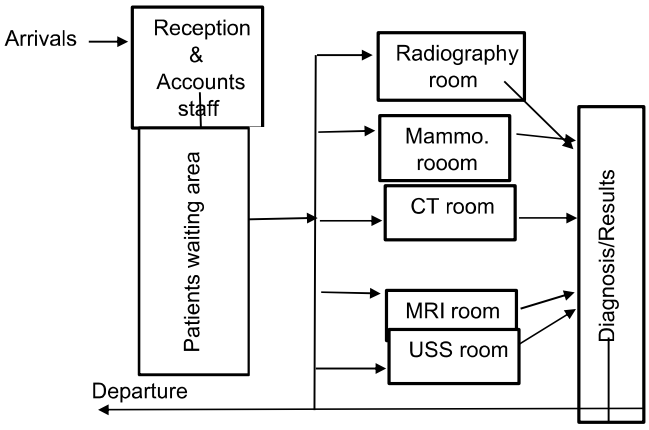

Figure 1: Operational layout chart of the diagnostic imaging facility.

It was observed that the facilities experience variable arrival rates of patients and also, variable service rates probably due to the investigation mix. Some investigations are complex and takes more time to complete while the less complex ones take less time to complete. Owing to the variable arrival and service rates, the probability distributions of both the arrivals and service times must be determined in order to successfully apply the queueing model.

Using simulation technique, the arrival and service rates of the facilities were found to follow a Poisson process (Poisson arrivals and exponential service times), the mean arrival and the mean service rates were determined. The arrival and service rates data were used to analyze the M/M/2/GD/∞/∞, M/M/3/GD/∞/∞ and M/M/4/GD/∞/∞ queueing models respectively, using Tora primer optimization software. One of the three models that optimizes the facilities operations was chosen and proposed for use. In the model, M represents "Markov" indicating that the number of arrivals and the number of completed services in a given time t, follow Poisson process which is a

continuous time Markov chains, the numerals 2, 3, 4 represents the number of service channels, GD refers to general queue discipline, and ∞/∞ stands for unlimited expected number of patients in the queue and an infinite size of population from which the patients are drawn [18].

RESULTS

It was observed that the two facilities studied have similar operating characteristics. 220 questionnaires were administered to the patients but, only 200 of the questionnaires were duly filled and returned, giving a return rate of 91%.

The respondents comprised of 50 males representing 25% and 150 females representing 75% of the total respondents. Table 1 shows the age distribution of the respondents. It is easy to see from the table that the modal age class is (20 – 30) years. The mean age of the participants is (35.61 ± 11.18) years.

Table 1: Age distribution of respondents (n=200)

Age (Years)	Number (n)	Percentage(%)
20-30	77	38.5
31-40	72	36.0
41-50	28	14.0
51-60	14	7.0
61-70	9	4.5
Total	200	100

Table 2 shows the amount of time the respondents spent in the facilities. Majority of the patients waited between 60 – 120 minutes to get service. The patient's mean waiting time was (105.43 ± 32.51) minutes.

Table 2: Assessment of patients' waiting time at the diagnostic facilities

Waiting time (Minutes)	Frequency	Percentage(%)
1 – 59 Minutes	6	3.0
60 – 120 Minutes	141	70.5
121 – 180 Minutes	49	24.5
181 – 240 Minutes	4	2.0

Table 3 gives the perceived causes of delays in the service system. Large number of patients to few radiographers given the services demanded accounted the most for the long waiting time. 42.5% (n=85) of the respondents attributed the long waiting time to a large patient population to a few radiographers' ratio.

Table 3: Factors affecting patients' waiting time

Perceived Causes of Long Waiting Time	Frequency	Percentage (%)
Long queue at the reception	48	24.0
Patient registration/payment	18	9.0
Large patients to radiographer ratio	85	42.5
Radiographer taking long to see a patient	17	8.5
Result collection	21	10.5
No response	11	5

Table 4 showed the patients' responses to whether they got satisfaction for services received in the facility. 47% of the patients said they were satisfied while 28.5% of them were not satisfied.

Table 4: Influence of long waiting time on patients' satisfaction

	Satisfied with services got			
Waiting Time (Min)	Yes	No	No Response	Fre quency
1 – 59 Minutes	6	0	0	6
60 – 120 Minutes	78	23	40	141
121 – 180 Minutes	10	30	9	49
181 – 240 Minutes	0	4	0	4
TOTAL	94 (47.0%)	57 (28.5%)	49 (24.5%)	200 (100.0%)

Table 5: Impact of long waiting time on propensity to recommend the diagnostic facility to loved ones

Waiting Time (Minutes)	Propensity to recommend the facility			
	Yes	No	No Response	Frequency
1 – 59 Minutes	6	0	0	6
60 – 120 Minutes	85	30	26	141
121 – 180 Minutes	0	26	23	49
181 – 240 Minutes	0	4	0	4
TOTAL	91	60	49	200
	(45.5%)	(30.0%)	(24.5%)	(100.0%)

Results of analysis of the queueing models tested is shown in table 6. The arrival rate, (λ) of patients to the facility was found to be 10.57 (≅ 11) patients/hour and the service rate, (1/μ) for 2, 3 and 4 service channels respectively, were found to be 0.18, 0.24 and 0.32 complete service/hour respectively. Using model 1 with two service channels, M/M/2/GD/∞/∞ the mean waiting time is 1.83 hours (≅ 110 minutes), the mean transit time (i.e. time in facility including time in queue and time in service) is 2.01 hours (≅ 121minutes) and the queue length is 20 patients. For the model, M/M/3/GD/∞/∞, the mean waiting time is 0.43 hours (≅ 26 minutes), the transit time is 0.68 hours (≅ 41 minutes) and the queue length is 5 patients. For M/M/4/GD/∞/∞ model, the mean waiting time is 0.37 hours (≅ 22 minutes), the transit time is 0.69 hours (≅ 41 minutes) and the queue length is 4 patients.

Table 6: Comparative analysis of the M/M/2/GD/∞/∞, M/M/3/GD/∞/∞ and M/M/4/GD/∞/∞ queueing models

Model	Arrival rate (λ)	Service time (μ)	Queue length (L_q)	Waiting time (w_q)	Transit time (w_s)	Facility utilization rate (ρ)
M/M/2/ GD/∞/∞	10.57	5.54	19.31	1.83	2.01	0.95 (95%)
M/M/3/ GD/∞/∞	10.57	4.10	4.56	0.43	0.68	0.86 (86%)
M/M/4/ GD/∞/∞	10.57	3.11	3.89	0.37	0.69	0.85 (85%)

DISCUSSION

In this study, the mean waiting time was (105.43 ± 32.51) minutes. This is rather high considering the fact that most patients who visit private hospitals/diagnostic facilities do so on account of getting prompt services and also, when compared with similar studies conducted in government owned radiology department in Port Harcourt [18, 19, 20] .The main causes of long queue and long waiting time was attributed to few radiographers giving care to a large number of patients, inadequate quality support staff at the reception and pay point, and efficiency of the radiographer (see Table 3). These findings agree with Ugwuanyi *et al*. [22]. A number of factor may be responsible for the radiographer's inefficiency. These include quality (i.e. knowledge, ability, personality and experience) of the radiographer, the investigation mix, job satisfaction, adequate remuneration and incentive packages as well as motivational goals of the radiographer. Aside investigation mix, all the other factors listed influences the radiographer's job performance. The presence or absence of these factors are indices that could be used to assess whether efficient and effective services to the patients would be guaranteed. It is common knowledge that not many private firms can adequately assure these provisions. High quality

staff are seldom employed by private health care facilities owing to high wage bills, and very skilled radiographers prefer to work in organizations that guarantees them better job prospects.

Other reasons for the long patient waiting time observed are the fact that only one staff was seen attending to the long queue of patients at the reception during the period of data collection in each of these facilities. The few radiographers on duty engaged in multiple tasks including counselling and guiding patients on the right investigation to do, conducting the investigations, explaining results of the tests to patients, etc. Due to manpower shortage, one radiographer is expected to shuttle between two or more service points (modalities). For example, one radiographer may be responsible for conducting the routine and contrast radiographic tests, mammography and ultrasound scanning or any other combination of studies in any one working day such that when one patient is in service, all others must wait irrespective of their investigation type.

Unnecessarily long queues and long patient waiting times have unpleasant implications on the healthcare facilities. 100% of patients who waited for more than two hours to get services expressed dissatisfaction with the quality of services received and therefore totally declined recommending the facilities to loved ones. This finding is consonant with the findings of Anderson *et al.*[23] and Kayode *et al.*[24] where majority of patients were dissatisfied with the quality of services received and, the major cause of dissatisfaction was long waiting time.

It is well-known that long queues and long waiting time, in any waiting-line system, discourages new arrivals from joining the queue and encourages reneging [20]. As a result, a more scientific approach to solving waiting line problem is proposed. Queueing theory is a very powerful method that has been used by many organizations including health care facilities to uncork chronic bottle necks in congested service rendering facilities. However, using Queueing theory entails balancing the cost of waiting against the cost of service. Optimum service level is obtained by minimizing combined costs or maximizing combined benefits. In order to achieve this, one would have to predict the operating characteristics (average number of patients waiting in queue, number of patients receiving service, service time, average waiting time, idle servers if any) of the system.

Queueing models are not monolithic. There are varieties of them to choose from but, the peculiar characteristics of the system being modelle, in the framework of Queueing theory, determines the choice of model. For the facilities studied, an M/M/3/GD/∞/∞ queueing model will suffice for efficient and effective medical imaging services. Although the M/M/4/GD/∞/∞ model appears better in terms of the operating characteristics, the improvement gained is very minimal to warrant hiring four radiographers for a job that can be efficiently and effectively handled by three radiographers. The conditions that determine queue length are probability distribution of arrival pattern/times, probability distribution of service times, number of serving channels and queue discipline [18, 20].

It is worthy of note that increasing the service channel may increase the running cost of the facility but, what to do is to weigh the facility running cost against the cost of long waiting time. Although the cost of long waiting time may be difficult to quantify, revenue is lost when patients renege on account of long queues and long waiting times. Goodwill may also be lost as patient who are dissatisfied with services received would not recommend the diagnostic facility to others and may even paint the facility black thus, discouraging patronage. To further improve the quality of services rendered and to reduce patient waiting time, the registration services could be computerized and the staff trained to make the best use of the systems though, the delays at the reception is partly as a result of patients needing explanation and guide regarding their test, patients negotiating/bargaining the price of the study and other logistics involved with payment for the prescribed investigations.

CONCLUSION

Like many other studies on waiting times in diagnostic health care facilities and outpatient departments reported in the literature, patients' waiting time, in this study, is high with an average of over 1hour 45 minutes. Very high patient to radiographer ratio, long service times and delays at the registration desk and pay point were the main factors responsible for the long patients' waiting time. Applying a scientific method of analysis to

the waiting-line problem will enable a more robust way of balancing the cost of waiting against the cost of service delivery especially, as creating more service channels, employing more radiographers and support staff appears to be the only way to ensure quick effective service delivery and to reduce patients' waiting time. We therefore, conclude that patients' waiting time in private diagnostic imaging facilities is high and employing more radiographers to cover the different diagnostic streams and improving capacity at the registration desk and pay point will go a long way to reducing patients' waiting time and improving service delivery.

RECOMMENDATION

We recommend another study that will fit actual data from the facilities to the proposed model.

Conflict of Interest-Nil

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