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RESEARCH ARTICLE

MODELLING THE LENGTH OF STAY OF PSYCHIATRIC PATIENTS AT ADAMAWA STATE SPECIALIST HOSPITAL YOLA, NIGERIA

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ABSTRACT

Applications of queuing theory enhance congestion assessment of in-patient facilities in hospitals and can improve significantly on the impact of quality healthcare as well as on patient satisfaction. This study examined the congestion situations which include the length of stay (LOS) for admissions and discharges of male and female in-patients at Psychiatric Unit of Specialist Hospital (PUSH), Yola. Data were obtained from a secondary source and analyzed with Easy Fit software, IBM-SPSS, TORA and MS-Excel. The M/M/1/N queuing model was adopted, because the bed space capacity is 17 for the male patients and 12 beds for female patients in the wards. The LOS analysis using Poisson regression revealed that the male patients are at a higher risk of LOS compared to the female patients. The results further show that, patients with drug-induced psychosis are at higher risk of LOS compared to others. The Queuing analysis indicates that the average number of male and female patients on admission including those about to be discharge is approximately 17 and 12 patients per week respectively, and average time male and female patients in the system on admission including discharged time is approximately 11 and 8 days respectively, which shows that bed facility in the hospital in male and female wards were always over stretched, and their traffic intensity on admission and discharge rates is 2 patient per week respectively, implying that 2 male and female patients are being turn away every week, due to limited number of beds available for in-patients. The management of PUSH Yola should provide more beds facilities for psychiatric patients so as to avoid congestion of in-patients, and also to improve the quality of service.

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INTRODUCTION

Healthcare systems in general and hospitals in particular, constitute a very important part of the service sector. Over the years, hospitals have become increasingly important in deploying medical and technical innovations to deliver more effective clinical treatments. In-patients care of the mentally ill people, though expensive and resource intensive is still the safest and most effective mode of treatment for patients adjudged unmanageable at home or in the community (Bobier, 2005). Seasonality in utilization of psychiatric facilities has been observed as far back as the 70s (Hare and Walter, 1978) and this observation has not changed till date as recent studies have found weekly variations in psychiatric admissions with a peak around summer or at the peak of local temperature in Britain (Singh *et al.,* 2007 and Shiloh *et al.,* 2005). Such audits of psychiatric services including hospital service indices like hospital utilization index or bed occupancy rates are not a popular research venture in Nigeria. It is possible that there are other place specific contextual variables that may explain any seasonal pattern of psychiatric admission that may be found in Nigeria. Hospital admission rates is an important outcome of ambulatory care in chronic conditions such as mental illness, asthma or diabetic where it is believed that hospitalization may be avoided by appropriate care. Emergency admission for mental illness, asthma or diabetic ketoacidosis may reflect both the standard of primary care and the quality of self-care by the patient. The latter may be related to the standard of care provided by health professionals. Psychiatric Unit of Specialist Hospital (PUSH) Yola was established since the year 1988 with 29 beds facility; 17 and 12 beds space for male and female wards respectively. Are these facilities adequate for psychiatric patients? Are the large numbers of psychiatric patients on our streets as a result of inadequate facilities at

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PUSH Yola? This work attempt to answer these questions and others. Hospital managers are always faced with the problems of scheduling the services and reducing the length of stay (LOS) for in-patient. The objective therefore is to model the length of stay (LOS) of Patients at Psychiatric Unit of Specialist Hospital (PUSH) Yola, in order to derive results as information that can improve service efficiency and effectiveness. The theory of queues or waiting line has its origin in the work of Erlang, (1909) as in Saaty (1978), he experimented on a probability dealing with the congestion of telephone traffic. During busy periods, intending callers experienced some delays because the operators were unable to handle the calls as rapidly as they were made. The original problem Erlang treated was the calculation of this delay for one operator, and by 1917 the results were extended to the case of several operators. Development in the field of telephone traffic continued largely along the lines initiated by Erlang, and the main publications were those of Molina (1927) and Fry (1928). It was not until the end of World War II that early work was extended to other general problems involving queues or waiting (Saaty, 1978).

Bejan (2007) explained that, queue is formed when patients/customers arrive at a service mechanism that is busy, and have to wait for service. Also, queuing theory is concerned with the design of appropriate service mechanisms to minimize these delays (length of stay) and reduce the congestion of the queue (waiting). He further explained that, in queuing theory, a queuing model is used to approximate a real queuing situation or system, so the queuing behaviour can be analyzed mathematically. His theory explains the analysis of some population count in healthcare and service systems. A queuing model of a system is an abstract representation whose purpose is to isolate those factors that relate to the system's ability to meet service demands whose occurrences and durations are random (Janos, 2010). In his work, Siya (2006), modeled the queuing system of the Antenatal ward of the Federal Medical Centre, Yola and made an effort to identify the queue model for analyzing queue characteristics, which he found that both Wednesday and Thursday respectively have high facility utilization of 92% and 95%, low service rates were observed, an average waiting time of 14 minutes and 33 minutes for both Wednesday and Thursday respectively.

He concluded that there is need for additional health workers as well as improving the existing health facilities so as to reduce the waiting list and recommended the use of modern technology in improving everyday operations in all wards at the hospital. Hassan (2010), studied the queuing situation of patients waiting to consult at Outpatient department Gal-Bose Hospital Yola, he observed that patients spent most of their time waiting for doctor's consultation at the Outpatient department (OPD) of Gal-Bose Hospital, Yola between the hours of 7.00am to 1.00pm due to variation in arrival and service time and he concluded that the queue observed in hospital is not real but artificial, and this may be due to specified period that the doctor used for service.

MATERIALS AND METHODS

The model considered in this study is the M/M/1/N for both admissions (arrivals) and discharge (service). Since nurses on duty work admits and discharge patients, a single server (male ward or female ward) is considered, and system capacity (bed space) is finite for both male and female wards. The assumptions are that;

- Input population is finite
- Arrival rate (admission rate) has a Poisson distribution
- Service time (discharge rate) is exponentially distributed with mean $1/\mu$ [$\lambda<\mu$]
- Patients admitted on the FCFS
- System capacity is finite (number of beds in male ward = 17 beds and female ward = 12 beds, and beds spaces are finite).

The procedure used in collecting the data were studying and filtering from the secondary source and was limited only to Psychiatric Unit of Specialist Hospital (PUSH) Yola. The Data collected into; name of patient, gender, age, patient's diagnosis, date of admission and discharge. Diagnosis was classified into two; Drug cases and others. The data were collected daily for the period of six (6) months, January to June of the year of this study, 2014.

The data obtained were analyzed to determine the following queuing characteristics of the system

- the probability P_i of i (number of admission or discharge) patient per week in the system;
- The mean admission rate of patient (arrival process);
- The mean discharge rate for both male and female patients (departure/service); and
- The expected length of stay (LOS) for each patient.

The Easy Fit was used to determine the probability distribution that best fit the data and TORA used to analyze the queuing parameters and MS-Excel helped in computations, and IBM-SPSS was used to evaluate the analysis for Poisson regression based on gender, age and nature of illness.
Poisson regression is similar to regular multiple regressions except that the dependent (Y) variable is an observed count that is assumed to follow the Poisson distribution. Thus, the possible values of Y are the nonnegative integers. It is assumed that large counts are rare. Hence, Poisson regression is similar to logistic regression, which also has a discrete response variable. However, the response is not limited to specific values as it is in logistic regression.

RESULTS AND DISCUSSION

Analysis of Admission Rate

Male Patients

The admission rate of male patient with parameter λ is obtained from the data,
the mean admission rate λ and its variance is obtained as follows:

Mean (λ) $=\lambda_m \approx 12.5$
Variance $= 67.8$

Female Patients: The admission rate of female patient with parameter λ is obtained from the data, the mean admission rate λ and its variance is obtained as follows:

Mean (λ) = λ_f ≈ 12.5

Variance = 49.4

Based on the above computations it was observed that, the data are over dispersed with respect to a Poisson distribution, for which the mean is not equal to the variance. Through the goodness of fit obtained using the Easy Fit analysis suggests that the Poisson distribution is the appropriate model for the data, thus we obtained admission rate based on the Poisson distribution model.

Analysis of Discharge Rate

Male Patients

The discharge rate $\frac{1}{\mu}$ for male patients was obtained using the data, the mean discharge rate $\frac{1}{\mu_m}$ for male patients and its variance is obtained as follows

Mean $(\frac{1}{\mu_m})=\frac{1}{\mu_m}\approx 10.70$

Variance = 114.04

Female Patients

The discharge rate $\frac{1}{\mu}$ for female patients was obtained using the data, the mean discharge rate $\frac{1}{\mu_f}$ for female patients and its variance is obtained as follows

Mean $(\frac{1}{\mu_f}) =\frac{1}{\mu_f}\approx 9.84$

Variance = 95.46

Computation of Queuing Model Parameters

The M/M/1/N model using queuing applications, for the discharge rate of male and female patients is computed as follows;

$P_o=\sum_{n=0}^{\infty}\left(\frac{(1-\rho)}{1-\rho^{N+1}}\right)$, where $\rho=\frac{\lambda}{\mu}$ ($\frac{\lambda}{\mu}>1$ is allowed) (1)

where,

N -System capacity (number of beds at PUSH Yola for both male and female)

ρ -Traffic intensity for both male and female patients ($\rho = \lambda_m/\mu_m$ and

λ_f/μ_f) respectively

Male patients

The male admission and discharge rates as earlier obtained are λ_{male} = 12.474 and μ_{male} = 10.734 were used to analyze the queuing parameters using TORA software package and the results are as follows;

Male Patient Scenario (1): (M/M/1): (GD/17/17);

- Average number of male patients on admission including those about to be discharged, L_s;

  L_s = 16.13946 ≈ 17 male patients per week

- Average number of male patients on admissions, L_q;

  L_q = 15.13946 ≈ 16 male patients per week

- Average time male patients spends in the system on admissions including discharge time, W_s);

  W_s = 1.50353= 10.52471 ≈ 11 days

- Average time male patients spends on admission, W_q;

  W_q = 1.41037= 9.87259 ≈ 10 days

- Traffic Intensity for male patients = 1.162061 ≈ 2 male in-patients per week

- Utilization factor (Traffic intensity), ρ
- The utilization factor (traffic intensity) is given as $\rho = \lambda/\mu$;

  ρ_m = $\frac{12.47403}{10.7344}$= 1.162061 or 116.21%

$\therefore \rho_m \approx$=2 male in-patients per week

In this case, the traffic intensity of male patients at PUSH, Yola was approximately 2 male in-patients per week, since ρ > 1 shows that the queue will continue to grow permanently. The above results revealed that, the expected number of male patients in the system is approximately 17 patients per week, while the expected length of stay spent on admission is approximately 11 days (i.e. more than one-week stay on admission). The implication of these results is that, the male ward is always occupied weekly. With the average weekly admission rate of 13 patients (λ_m = 13) and the average weekly discharge rate of 11 patients, this shows that, the ward is always full to capacity. The traffic intensity of male patients in the system is approximately 2 male patients per week, implying that 2 male patients are being turn away every week, due to the fact that, there is a limited number of beds available for male in-patients. Since $\lambda_m > \mu_m$, the geometric series will not converge, and the steady-state probabilities, p_n does not exist. These results make intuitive sense because the admission rate is larger than the discharge rate of male patients, which make queue length continue to increase and no steady state can be reached, that is, patients needing admission will continue to increase in the face of limited facilities.

Female patients

The female admission and discharge rates as earlier obtained are λ_{female} = 12.8296 and μ_{female} = 9.8370 were used to analyze the queuing parameters using TORA software package and the results are as follows

Female Patient Scenario (2): (M/M/1):(GD/12/12);

- Average number of female patients on admission including those about to be discharged, L_s;

  L_s = 11.23325 ≈ 12 female patients per week

- Average number of female patients on admissions, L_q;

  L_q = 10.23325 ≈ 11 female patients per week

- Average time female patients spends in the system on admissions including discharge time, W_s);

  W_s = 1.14194 = 7.99358 ≈ 8 days

- Average time female patients spends on admission, W_q;

  W_q = 1.04028 = 7.28196 ≈ 7 days

- Traffic Intensity for female patients = 1.3042 ≈ 2 female in-patients per week

- Utilization factor (Traffic intensity), ρ
- The utilization factor (traffic intensity) is given as $\rho = \lambda/\mu$;

$$\rho_f = \frac{12.8296}{9.8370} = 1.30422 \approx 130.422\%$$

$\therefore \rho_f \approx 2$ female in-patients per week

This revealed that, traffic intensity of female patients at PUSH Yola was approximately 2 patients per week. The value of $\rho > 1$ shows that the queue will continue to grow permanently. The above results show that, the expected number of female patients in the system is approximately 12 patients per week, while the expected length of stay spent on admission is approximately 8 days (i.e. more than a week stay on admission). The implication of these results is that, the female ward is always occupied weekly with the total number of 12 beds in the ward. The average weekly admission rate of 13 patients ($\lambda_f = 13$) and the average weekly discharge rate of 10 patients, this indicates that, the female ward is always full to capacity and the traffic intensity (utilization factor) of female patients in the system is approximately 2 patients per week, implying that 2 female patients are being turn away every week, due to the fact that, there is a limited number of beds available for in-patients. Since $\lambda_f > \mu_f$, the geometric series will not converge, and the steady-state probabilities, p_n will not exist. These results make intuitive sense because the weekly admission rate of female patients is larger than their discharge rate, which make queue length continue to grow permanently and no steady state can be reached. This show the comparative analysis of queuing characteristics for both scenarios (male and female patients) and for drug induced cases and non-drug induced cases.

Modelling the length of stay (LOS) using Poisson Regression

Poisson regression was used to model the LOS and provide Relative Risk (RR) on having a longer LOS between genders and type of illness. The LOS is considered as the dependant variable, while Nature of illness (Nillness), Age and Gender of Patients are the independent variables. We first consider the main effects model given by the generating class;

Design; Constant +Gender +Nillness

The goodness-of-fit tests reveal that the, interaction terms are not required, since $p > 0.05$.

The corresponding parameter estimates revealed that the male patients (Gender =1) are at a higher risk of exp(0.0652) = 1.919 of LOS compared to the female patients. The results further show that, drug addicted patients are also at risk of LOS compare to others. This shows that the addition of Age to the main effect model does not yield a better result; this model is with the generating class;

Design; constant +Gender +Age +Nillness

Whereas the corresponding parameter estimates shows that, Age, Gender and Nature of illness are relevant parameters in explaining the LOS of patients. Since this effect have high absolute Z-values. Interaction terms are included, yet the result shows lack of fit, this result is from the model with generating class;

Design; Constant +Gender +Age +Nillness +interaction terms

Thus, the parameter estimates still reveal and that

- The male patients are at the high risk of LOS compared to the female patients; and
- Patients with drug induced psychosis stay longer compared to other patients and that a one year increase in age may results in an increase of exp(0.051) = 1.05 or 5% in risk of having a longer LOS, that is older patients are more addicted compare to younger ones.

Summary

This study examined the congestion situations which include the length of stay (LOS) for admissions and discharges of male and female in-patients at Psychiatric Unit of Specialist Hospital (PUSH), Yola. Data were obtained from a secondary source and analyzed with Easy Fit, IBM-SPSS, TORA and MS-Excel software. The M/M/1/N queuing model was adopted, because the bed space capacity is 17 for the male patients and 12 beds for female patients in the wards. The LOS analysis using Poisson regression revealed that the male patients are at a higher risk of LOS compared to the female patients. The results further show that, patients with drug-induced psychosis are at higher risk of LOS compared to others. The Queuing analysis indicates that the average number of male and female patients on admission including those about to be discharge is approximately 17 and 12 patients per week respectively, and average time male and female patients in the system on admission including discharged time is approximately 11 and 8 days respectively, which shows that bed facility in the hospital in male and female wards were always over stretched, and their traffic intensity on admission and discharge rates is 2 patient per week respectively, implying that 2 male and female patients are being turn away every week, due to limited number of beds available for in-patients. This study revealed that there is need to create more space for patients in other to avoid overcrowding and turn down.

REFERENCES

Bejan, A., 2007. Modelareatimpului de orientareinsisteme de asteptare cu prioritaji, Paper of the PhD Thesis in Physical-Mathematical Sciences, Chisinau.

Bobier, C. and Warwick, M. 2005. Factors associated with readmissions to adolescent psychiatric care. *Aust NZL Psychiatry*, 39: 600-606.

Erlang, A. K. 1909. "The Theory of Probabilities and Telephone Conversations", Nyt Tidsskritf for Matematik B, vol.20, 1909.

Fry and Thornton, 1928. Application of the Queuing Theory.

Hare EH and Walter SD. (1978); Seasonal variation in admissions of psychiatric patients and its relation to seasonal variation in their births. *J. Epidemiol Community Health,* 32(1): 47–52.

Hassan and Musa 2010. Waiting Line Analysis for Patients Consulting Doctor, at Out-Patient Department (OPD) Gal-Bose Hospital, Yola. An Unpublished undergraduate Project work, Federal University of Technology, Yola.

Janos, S. 2010. Queuing Theory and its Application A Personal view. *8th International Conference on Applied Informatics* Volume 1 Pgs 9-30, Eger Hungary.

Molina, E. C. 1927. Application of the Queuing Theory, a published paper.

Saaty, T. L. 1978. Elements of Queuing Theory, McGraw-Hill, New York.

Shiloh, R., Shapira, A., Potchter, O., Hermesh, H., Popper, M., Weizman, A. 2005, Effects of Climate on Admission rates of Schizophrenia Patients to Psychiatric Hospitals. Eur Psychiatry; 20:61-64.

Singh, GP., Chavan, BS., Arun, P. and Sidana A. 2007, Seasonal Pattern of Psychiatry Service Utilization in a Tertiary Care Hospital. Indian J. Psychiatry; 49: 91-95.

Siya, K. and Timothy, 2006, Application of Queuing Model to the Antenatal Unit of the Federal Medical Centre, Yola an Unpublished M.Tech. Thesis, FUT-Yola.

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