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The Applications Of Waiting Line Management On The Operations Of Public Sector Organizations: The Kogi State Health Sector Experience (2009-2012)

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Abstract- *The study examines the application of waiting line management on the operations of public sector organizations, a study of some selected hospitals in Kogi State. The aim of this research is to examine the application of waiting line management on the operations of public sector organizations with particular reference to the Kogi State health sector using some selected hospitals. The study used a sample of 522 patients drawn from a population of 3,090 patients, using judgmental sampling techniques. The study employed a combination of primary data in the form of questionnaire, observation and secondary data to collect data from the patients of these hospitals covering a period of (2009 – 2012). The survey research method was used in the research. The study employed chi square and ANOVA to test the necessary hypotheses. To obtain the sample size for this study, Yaro Yameru's model of obtaining sample size was used. Other techniques used to analyze the data in this study include: queuing simulation and other queuing models. It has been observed that waiting line is one of the major problems confronting most of the public health sector, to the extent that a possible lost of life in the case of serious illness which call for emergency situation can even resulted. The study revealed among other things, that unnecessary waiting line if not properly managed has a lot of cost implications for the concerned individuals, organizations and the general public. Based on the findings and conclusions, the study recommends the outright use of the application of strategic waiting line management for both public and private hospitals in order to improve their efficiency and productivity.*

Keywords: *Queuing Theory; Queuing Discipline; Arrival Rate; Service Rate; Waiting Line, Capacity Utilization.*

1. INTRODUCTION

1.1 Background of the Study

Virtually everyday people face waiting line problems. As such, they spend much time waiting on one form of line or another. On the way to work in the morning, people wait in line to pay the toll and wait in line to park their cars. If it is public transportation, people wait for the bus. In the bank, people wait in line to cash their money or to make deposit. In the hospital, people wait to be attended to and get treated. In the school, students wait in line to do their registration. In the filling station, car owners and others wait to refuel their cars. Waiting lines are commonly found wherever customers arrive randomly for one service or the other. Because waiting line is inevitable, one may think that the only way out is by increasing the service capacity. One thing to note in waiting line is that, increasing the service capacity cannot in any way solve the problem but rather, when service capacity is increased, it leads to the server's idle time being increased even the more. Consequently, in designing service systems, the designer must weigh the cost of providing a given level of service capacity against the potential (implicit) cost of having customers wait for service. This planning and analysis of service capacity frequently lends itself to queuing theory, which is a mathematical approach to the analysis of waiting line.

One reason why queuing analysis is important is that customers regard waiting as a non-value added activity; and as a result, may tend to associate this with poor service quality, especially if the waiting is becoming too long. Due to the above, managers at all levels, whether in the private or public establishment, need to properly manage these waiting times to ensure not only that their operations are efficient, but also that their customers are not so negatively affected by the waiting such that they take their future business elsewhere particularly in the case of private establishment where their primary aim is to make profit. Hence, understanding how customer satisfaction can be increased for a given waiting time provides service managers with an opportunity for managing their operations more effectively.

1.2 Statement of the Problem

Waiting lines are commonly found wherever customers arrive randomly for services. Almost everyday much time is spent waiting on the line to receive one form of service

or the other. This problem of waiting line is even more serious in developing countries with particular reference to Nigeria where the service providers particularly in government owned establishments may at times feel they are doing their customers favour and as such, can go elsewhere if feels dissatisfied with their services. In line with the aforementioned, it is obvious that providing ever-faster service with the ultimate goal of having zero customer waiting time which has recently received managerial attention in advance countries has received less or no attention at all in the less developed or in the developing countries particularly in the Nigerian public sector (including Kogi State which is the focus of this study). First, in the more highly developed countries, where standard of living is rising, time becomes more valuable as a commodity and consequently, customers are less willing to wait for service. Secondly, organizations are becoming aware that how they treat their customers today significantly impacts on whether or not they will remain loyal customers tomorrow. It is based on the above general problem therefore, that the following specific problems seen as the managerial implications of waiting line for the proposed research study were drawn: (i) A possible loss of goodwill (ii) A possible reduction in customer satisfaction, (iii) The resulting congestion may disrupt other business operations and/or customers and (iv) A possible lost of life in the case of emergency situation.

The above research problems among others, call for this research work, with the hope of finding a lasting solution to the problem at hand-certainly, a home made solution to a home made problem.

1.3 Objectives of the Study

Consequent upon the above statement of the problem, the below research objectives are drawn starting from the general objective to specific objectives. In general, the objective of this research study is to ascertain the application of waiting line management on the operations of public sector organizations, with particular reference to Kogi State health sector. To achieve this stated general objective, the following specific objectives have been specified for the research study.

i. To find out if public hospitals are less efficient than the private hospital and vice versa.
ii. To determine the extent and cost implications of waiting line problems.

1.4 Research Hypotheses

Based on the above research problems and the subsequent research objectives, these research hypotheses were formulated:

1. H_0: Public hospitals are not less efficient than private hospitals.
   H_1: Public hospitals are less efficient than private hospitals.
2. H_0: Waiting line problems do not have cost implications.
   H_1: Waiting line problems have cost implications.

1.5 Scope of the Study

The research study is on the application of waiting line management on the operations of public sector organizations; the Kogi State health sector experience. Even at that, six hospitals were randomly selected across the state for use. These hospitals include; Federal Medical Centre, Lokoja, Okene General Hospital, Diagnostic and Reference Hospital Anyigba, Kabba General Hospital, Idah General Hospital and Ankpa General Hospital. The study covers the period between (2009 – 2012). Moreso, the categories of patients considered include; TB patients, accident patients and acute fever patients.

2. LITERATURE REVIEW AND THEORETICAL FRAMEWORK

2.1 Introduction

A conceptual framework focuses on the main dimensions to the studied, the factors or variables and the presumed relationship between them or in other words something that explains, either graphically or in narrative form, the main things to be studied. Sasser, et al (2004), stated that, by theoretical framework we refer to the conscious and deliberate decision that a researcher has made in terms of the theory or a combination of theories, which guide his research effort. From the foregoing therefore, the aim of this section would be in summary, to review the relevant major concept and also to review in summary, the main theory that would be used in the research study. The concept of providing or receiving services is inherent in today's specialized and interdependent world. If upon arrival, the service facilities are free the customers are provided services without delay or waiting. However, if the service facilities are not free, the customers either wait in a queue (waiting line) to receive their turn for service-or they get discouraged by seeing the length of the line and may decide not to join the line.

The word 'queue' or "queuing" is typically encountered in the academics or research field. Queuing theory is a mathematical study of waiting line (or queues). The theory enables mathematical analysis of several related processes, including arriving at the (back of the) queue, waiting in the queue (essentially a storage process), and being serviced by the server(s) at the front of the queue- Solomon (2007). Queuing theory is a quantitative (mathematical) approach to the analysis of system that involves waiting lines, or queues. The theory permits the derivation and calculation of several performance measures including the average waiting line in the queue or the system. Queuing theory is generally considered a branch of operations research because the results are often used when making business decision about the recourses needed to provide service. It is applicable in a wide variety of situations that may be encountered in healthcare, business, public service, etc. Gross et al (2009), states that queuing theory has a wide range of applications. Queuing networks according to Gross (2009), have been applied to reduce waiting times in hospitals and to analyze the performance of computational systems. The foundation of modern queuing theory is

based on the studies about automatic dialing equipment made in the early twentieth century by Danish telephone engineer A.K. Ealang. (Stevenson, 2000). Prior to World War II, very few attempts were made to apply queuing theory to business problems. Since that time, queuing theory has been applied to a wide range of problems. Waiting lines are usually the first encounter a customer will experience with an organization. Consequently, an unpleasant experience waiting in line often can have a negative effect on the rest of the customer's experience with a particular firm. How well managers address the waiting line issues is therefore critical to the long-term success of their firms.

2.2 Waiting Line Characteristics

Davis et al (2008) states that waiting line (or queuing) phenomenon consists essentially of six major components: (a) The source population; Arrivals at a service system may be drawn from either a finite or an infinite population. The formal refers to the limited size of the customer pool, which is the source that will use the service, and at times form a line. The later is the population that is sufficiently large in relation to service system that any change in the population size caused by subtractions or additions to the population (e.g., a customer needing service or a serviced customer returning to the population) does not significantly affect the system probabilities. Others include; (b) The way customers arrive at the service facility; (c) the physical line itself; (d) the way customers are selected from the line; (e) the characteristics of the service facility itself (such as, how the customers flow through the system and how much time it take to serve each customer; and (f) the condition of the customers when they exit the system (back to the source population or not?).

Below shows the framework for viewing waiting line situation:

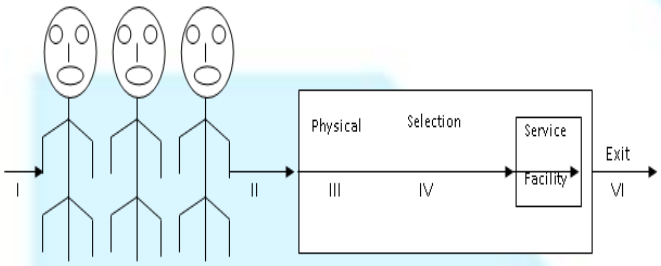

Figure 2.1: Framework for viewing waiting line situation.

Source: Stevenson, (2008: 832; Operations Management, publisher, McGraw Hill Irwin, New York, United State).

Stevenson (2000) states that waiting line system sometimes depends on queue discipline, which means the order in which customers are processed. All models of queuing namely; single channel, constant service time, multiple channel and exponential service time assume that service is provided on a first-come-first-serve basis, except the model of multiply priority service and exponential service time, where customers are processed according to some measure of importance. This is because, the waiting cost or penalty incurred is not the same for all customers. For examples, in a hospital emergency waiting room, a wide variety of injuries and illnesses may need treatment. Some may be minor, while others may be much more serious, even life-threatening. In this case, it would be more reasonable to treat the most serious cases first, letting the non-serious cases wait until all serious cases have been treated. Gomey (2005) states that in general, a queuing or waiting line problem arises whenever the demand for customer service cannot perfectly be matched by a set of well-defined service facilities. He said that the perfect match cannot be achieved because, in many situations, neither the arrival times (or arrival rate) of the customers nor the service times (or service rate) of the service facilities can be accurately predicted (i.e. both the customer arrivals and service times are random). Weiss et al (1989), in Sule et al (2010), has identified three main broad categories of models of queuing such as the descriptive queuing models, prescriptive queuing models, and the analytical queuing models. Most of the early works on queuing models were based on descriptive models which have tended to determine the effect of having two tollgates rather than three. Prescriptive queuing model, a fairly recent waiting line model, place emphasis on how the service facility can be properly controlled in order to improve the general waiting situation. Slack et al (1998) in Sule et al (2010) also supported the views of Weiss et al on the issue of classifying queuing model into three categories namely; descriptive, prescriptive and analytical models respectively. They further suggested the use of analytical queuing models other than the purely descriptive and prescriptive models. They opined that analytical queuing might be proper in certain instances especially where concerned is for predicting the behviour of units when the arrivals are in a random fashion. The analytical queuing models, they assert, have the capacity to help predict the steady state and behaviour of different types of queuing systems. The analytical systems or models are most useful for capacity management purposes. Perhaps one of the reasons why some tend to be less receptive to the application of analytical queuing models resides in the fact that these models portray a matrix of complicated mathematical formula (Bunday, 1996: Mason, 2003). The waiting lines management approach therefore involves refreshing the present server (or system) and making radical changes to brighten the organizations vision and bring radical improvements in critical measures of operations in terms of cost, quality of operations and results, capital, service and productivity (ie. Output). Also, customers (patients) satisfaction is identified as the main concentration of waiting line management approach. Global competition, customers satisfaction, environmental and governmental regulations suggest that dramatic changes are required by many organizations particularly the public sector establishments with particular reference to health sector in Kogi State for future success and economic growth, development and survival, as healthy citizens of a nation brings about a healthy nation.

2.3 Waiting Lines Management and Organizational Performance

An effective waiting lines management or queuing management can be seen as an aggressive idea on innovation or how to strategically manage the perceived waiting time, which is the amount of time customers believe they have waited before receiving service. This is because, studies have shown that perceived waiting time has a greater impact in determining customer satisfaction than does actual waiting time (Davis et al, 2003). Waiting lines management therefore focuses on improving the level of customers' satisfaction by managing the customers' perceived waiting time. Hence, managers need to properly manage these waiting times to ensure not only that their operations are efficient, but also that their customers are not so negatively affected by the waiting time such that they take their future businesses elsewhere. And in the case of the health sector which is the research area of interest, too much of waiting time particularly in the case of a patient who need urgent attention can worsen the health condition and even at times can lead to outright death. Understanding how customer (patient) satisfaction can be increased for a given waiting time provide service managers (doctor, nurses, etc) with an opportunity for managing their operations more effectively. This is because, organizations both manufacturing and service operations (i.e. in the case of healthcare services, etc) that provide outstanding service to their customers can achieve a competitive advantage in their operations and performance in today's highly competitive environment. It is a known fact that good service starts or begins when the customer (i.e. patient) first comes in contact with an organization and waits in some type of line or queue prior to being serviced. Factors such as friendliness and knowledge of workers, quality service delivery, meeting customers expectation etc, that are their initial encounter with an organization and which can significantly affect their overall satisfaction and perception about the organization is the primary focus of an effective waiting lines management which is the focus of the research study.

2.4 Importance of Effective Waiting Lines Management

Below among others, are the benefits derived from effective management of waiting lines, according to Davis et al (2003), Stevenson (2009), and Slack et al (1998).

a) It enables the use of analytical models (Slack et al, 1998)
b) It brings about better customer satisfactions (Davis et al, 2003)
c) It brings about efficiency of performance and operations (Stevenson, 2009).
d) It helps to enhance expectations of customers and serves as a standard tool used in operations management (Slack et al, 1998)
e) One reason that queuing analysis is important is that customers regard waiting as a non-value-added activity (Stevenson, 2009).

From the above waiting lines models discussed, the research study adopted the analytical queuing models by (Weiss et al, 1989) and (Slack et al 1998). The reason being that these models can be used to predict the behaviour of units when an arrival is random Moreso, the models have the capacity to help predict the steady state and behaviour of different types of queuing systems.

2.5 Waiting Lines Management and Productivity

According to Dedrick (2003), productivity is the foundation of economic prosperity, a prerequisite for national development and also an important indicator of organizational competitiveness. A country's measure of productivity shapes the political decisions of national governments and also affects management's decision within their organization. No nation in the world can attain the height of productivity required for her economc growth and development when her citizens are sick people without proper treatment when the need arises. This means that when the citizens of a nation are sick the nation indirectly would be a sick nation and when a nation is sick, such a nation whether directly or indirectly would produce a sick economy. This is one of the most dreaded negative effects of inefficient services that can result from waiting line problem, in the operations and management of the public health sector in Kogi State. The question that may arise at this juncture is, how can this waiting line problem result in such scenarios as sick nation, sick citizens, and sick economy"? and other questions that may arise at this point is; is it only the public health sector that render healthcare services?, would one (the patients) go to private hospital(s), if not giving the needed attention resulting from this so called waiting lines problem? The answer to the above questions in a single sentence is, how many families in Nigeria can even afford three (3) square meals in a day, how much more, going to a private hospital for treatment when sick? From the above, it is very clear that the level of a nation's productivity is measured by the health standard of her citizens, which can only be attain through efficient and effective management of this waiting line problem, among other factors.

3. METHODOLOGY

3.1 Introduction

Here, we shall consider the methods, procedures, and the system adopted by the researcher, in the collection of the necessary data and information for the research work.

Every stage of the research process made use of some kinds of sampling. This is so, because it becomes apparently impossible to include all the variables which might be relevant, to administer questionnaire and interview every one who might provide useful information or to use all the data collected in the final report.

3.2 Research Design

Survey research involves the collection of first-hand information and data from primary sources by the researcher, which could either be by observation or by

inquiry through the use of questionnaire and interviews (Esosa and Izedonmi, 2003). The research design used in this research study therefore is survey research as it best suits the purpose of the research work.

The stratified random sampling was also used. The stratified sampling technique became necessary as the researcher made an attempt to group the population into some definite characteristics and then select the sample by applying random selection techniques on each stratum.

3.3 Population of the Study

The population of this study encompasses all the patients with TB, those that had accident and those with acute fever of all kinds in the aforementioned six (6) hospitals in the state between (2000-2012). The breakdowns as well as the total figure from the six (6) randomly selected government hospitals across the state are represented in the table 3.3.1 as shown below:

TABLE 3.3.1 SHOW POPULATION OF THE STUDY

States	Patients Categories	Observed Figures (Patients)
Diagnostic and Reference Hospital, Anyigba.	TB Patients	150
	Accident patients	100
	Acute fever patients	200
General Hospital, Kabba	TB Patients	200
	Accident patients	150
	Acute fever patients	270
Federal Medical Centre, Lokoja	TB patients	100
	Accident patients	70
	Acute fever patients	300
General Hospital, Okene	TB patients	120
	Accident patients	80
	Acute fever patients	200
General Hospital, Idah	TB patients	180
	Accident patients	170
	Acute fever patients	300
General Hospital, Ankpa	TB Patients	130
	Acute fever patients	120
	Accident patients	250
Total		***3,090***

Source: Kogi State Health Management Board, (2009 – 2012).

3.4 Sample Size of the Study

Sample is a portion of the entire population of the study under investigation. Thus, from the population of the study, a research sample size was determined using the Yaro Yamenu's formula of:

$$n = \frac{N}{1+Ne^2}$$

Where:

n = sample size to be determined, N = population of the study and e = margin of error. Using the above formula, the researcher obtained approximately a sample size at 5% margin of error level of: 522 patients.

3.5 Sampling Techniques

The researcher used the stratified random sampling. The stratified sampling technique becomes necessary as the researcher made an attempt to group the population into some definite characteristics and then selected the sample by applying random selection techniques on each stratum. To this end, six (6) hospitals were randomly selected across the state. And from each of the selected hospital, the researcher randomly selected some categories of patients (i.e. TB, accident and acute fever).

3.6 Sources of Data Collection

The study involves collection of data from both primary and secondary sources. Primary data were collected through the use of structured questionnaire, which were administered through trained enumerators. Secondary data were collected from Kogi State Health Management Board (KSHMB), text books, journals, newspapers, internets.

3.7 Methods of Data Analysis

The researcher used both qualitative and quantitative methods of data analysis to establish the needed relationship between the effective management of waiting lines and the operations and, corporate performance of public sector organizations, with particular reference to the health sector in Kogi State. The researcher used the following statistical tools and queue models for data analysis. Chi-square, ANOVA, queue simulation, and other queue models such as average number of customers in the queue, utilization model and average time spent waiting for service and so on.

Instrument of Reliability Test

Ndiyo (2005) define reliability as the consistency between independent measurements of the same phenomenon. Reliability test was carried out to ensure that the instrument used gives similar or close results if the study to which the instrument is applied is replicated. Thus, the test re-tests method of affirming instrument reliability was employed for this study. It was computed by calculating the correlation coefficient between three distributions of test scores obtained at three different times on the same respondents.

The instrument (questionnaire) was administered to 30 respondents drawn from three hospitals in Kogi State (Idah, Anyigba and Lokoja). The correlation coefficient (r) of 0.85, 0.95 and 0.99 were obtained. Those figures

obtained indicated a high reliability and appropriateness of the research instrument.

4. DATA PRESENTATION AND ANALYSIS

This chapter deals with the presentation, analysis and interpretation of the various data collected. In this chapter therefore, the researcher attempted to analyse the responses from the questionnaire and interview questions. Also discussed in the chapter were the test of hypothesis, and the discussion of the research findings.

4.1 Data Presentation, Analysis and Interpretation

Data Presentation and Analysis (Empirical Results I) Using Queuing Models:

Table 4.1 (A): ***Hospital Data relating to the Number of servers, Mean Arrival Rate, Service Rate, and the average numbers being served respectively.***

S/No	Names of Hospitals	No of Servers	Mean Arrival/Hr	The Average No of Customers Being Served	Mean Service/Hr
1.	Federal Medical Centre, Lokoja Kogi State	6	25	0.962	26
2.	General Hospital Idah	12	24	0.96	25
3	General Hospital, Ankpa	10	20	0.95	21
4.	Diagnostic and References Hospital, Anyigba	8	18	0.95	19
5	General Hospital Kabba	15	30	0.94	32
6	Specialist Hospital Lokoja	10	20	0.19	22

Source: Field Survey, (2012).

Table 4.1B as shown below shows the calculated value of the data obtained from the hospitals earlier mentioned in table A above. In doing this, the researcher used the following models; Lq = the average number of customers waiting for service; Wq = the average time customers wait in line; L = average number of customers waiting for service, and utilization, (i.e, the percentage time each server is busy). The researcher's use of the aforementioned models of waiting line is based on the assumption that average arrival and the average service time follow the exponential distribution (Agburu, J.I, 2005).

TABLE 4.1 (B) SHOWS CALCULATED VALUE OF THE DATA OBTAINED FROM THE HOSPITALS AS IN TABLE 4.2.1

Hospitals' Name	Calculated values using queuing models				
	(A)	(B)	(C)	(D)	(E)
	Lq	Wq	P	Ls	Ws
Federal Medical Centre Lokoja	24.038	0.96	0.160	25	0.998
General Hospital Idah	23.04	0.96	0.08	24	1.00
General Hospital Ankpa	19.047	0.95	0.10	20	0.998
Diagnostic & Reference Hospital, Anyigba	17.05	0.95	0.12	18	1.003
General Hospital, Kabba	28.125	0.94	0.063	29	0.971
General Hospital, Okene	18.18	0.91	0.091	19	0.955

Source: Field Survey, (2012).

The above table (B) comprises of the analysis of responses from some of the respondents of both the staff and patients of the six (6) hospitals which were used as the case study of this research work. Using queuing models, the researcher computed the following for the various hospitals;

a) The average number of customers in the system (waiting and/or being served); This is represented by Ls.
b) The average time customers wait in line; this is represented as Wq.
c) The system utilization (i.e. the proportion or percentage time each server is busy); This is represented by P.
d) The average number of customers waiting for service; this is represented as Lq.
e) The average time customers spent in the system (waiting in line and service time), this is represented by Ws.

To arrive at the above table, the researcher used a Multiple-Server System because in all the above hospitals used as case study, they have more than one server (i.e. doctors) in the various consulting rooms who attended to these patients, each working independently to provide service to customers (patients) on arrivals. This model is based on the assumption of a poisson arrival rate and exponential service time, servers all work at the same average ratea nd the customers (patients) form a single waiting line (in order to maintain first-come, first-served processing), excluding emergency cases.

Hence, from table (A) we found out that the mean arrivals per hour for the six (6) hospitals range between 18 and 30 inclusive while the mean service per hour is relatively high, it ranges between 19 and 32 respectively. The Kabba

General Hospital seems to enjoy the most strategic location vis-à-vis other hospital. And even though it is located in the heart of Kabba, it has a mean arrival rate of 30 while the service rate is 32. Federal Medical Centre Lokoja is the next on board in terms of mean arrival and mean service rate per hour, which were 25 and 26 respectively. This could be attributed to the fact that its location is comparatively better than that of Diagnostic and Reference Hospital, Anyigba with the mean arrival and mean service rates of 18 and 19 respectively. On the whole, it was observed that Diagnostic and Reference Hospital, Anyigba which are located at the out sketch of the town enjoyed the least score in term of mean arrival and mean service rate per hour of 18 and 19 respectively. The study revealed that the Kabba General Hospital was the most efficient in terms of mean service rate per hour of 32, a staggering difference of 13 compared with DRH, Anyigba with a mean service rate per hour of 19.

Table (B) above as mentioned earlier was obtained using the various models of queue above for computation. From the table above, the computation of Lq shows that with the exception of Diagnostic and Reference Hospital, Anyigba and Ankpa General Hospitals, respectively, the number of patients in the queue had tended to range between 23 and 28 respectively. The average number of customers/patients waiting for service in the later hospitals when compared to the former hospitals is more. Moreso, the average time spent waiting for service as shown in the table was least for Okenne General Hospital, where a patient had to spend 0.91 hours (54 mins) waiting for service. Kabba General Hospital is next on the line where on the average, a patient have to spend at least 0.94 hours (56mins). DRH Anyigba and Ankpa General Hospitals recorded waiting time(s) of 0.95hrs (57mins) and .95 hrs (57mins) respectively. While lokoja Medical Centre and Idah General Hospital recorded on the average waiting time of 0.96 hours (59mins) respectively for service. Moreso, in terms of the average patient spent in the system (waiting in line and eventually served) Idah General Hospital and Diagnostic and Reference Hospital, Anyigba are less efficient, because on the average, patient spent 1.00 hours (1 hour) before he or she can be served in both cases as can be seen from the table above. Even in the other hospitals, inefficiency still persists as on the average, none in the case of these other hospitals a patient would spend less than 0.95 hours (i.e. 57 mins) before being attended to. As per average number of customers (patients) in the system (waiting and/or being served), Kabba General Hospital recorded the highest number of patients (i.e. 29 patients) in most cases. This followed by Federal Medical Centre Lokoja with 25 patients in the system at any particular point in time, excluding non-working days and non-working hours. Diagnostic Reference Hospital, Anyigba and Okenne General Hospital experienced the least patient on the average in the system with 18 and 19 patients respectively. Finally, is the computed values for input utilization (i.e. the proportion of time each doctor is busy). These computed values were generally very low. The highest utilization was recorded against Federal Medical Centre Lokoja where it stood at 0.160 (or 16%). The Ankpa General Hospital, Idah General Hospital, Diagnostic and Reference Hospital Anyigba, Kabba General Hospital and Okenne General Hospital recorded system utilization of: 8%, 10%, 12%, 6.3% and 9.1% each respectively. This implies prima facie that doctors were being underutilized in these hospitals. They hardly had enough time to settle down and work for these public health due to other commitments outside their primary place of work. The reason for this, from empirical study is not far fetched. Most of these doctors if not all, have their private hospital(s) where they spend most of their times for financial gratification, while abandoning their primary place of assignment. Thus, if utilization was defined as the percentage of capacity (other than human resources) employed, it would mean that the existing physical facilities are being under utilized in these hospitals.

Table 4.1(C): ***Showing Data Presentation and Analysis using Queuing Simulation to determine the estimated mean time between arrival, the estimated mean arrival, the estimated mean service, time the estimated mean customer waiting time, the estimated mean customer time spent in the system and the estimated mean service rate.***

In the course of this research work, the researcher as earlier stated classified the patients into three categories to be studied. That is, patients suffering from TB, those that had accident (i.e. accident patients) and those suffering from acute (various) forms of fever. In the course of our investigation, the following figures were obtained from the (six) 6 various hospitals across the state.

Hospital	Patients Categories	Observed Figures (Patients)
Diagnostic and Reference Hospital, Anyigba.	TB Patients Accident patients Acute fever patients	150 100 200
General Hospital Kabba	TB Patients Accident patients Acute fever patients	200 150 270
Kogi (Lokoja Federal Medical Centre)	TB patients Accident patients Acute fever patients	100 70 300
General Hospital, Okene GH	TB patients Accident patients Acute faver patients	120 80 200
General Hospital, Ankpa	TB Patients Acute fever patients Accident patients	130 120 250
General Hospital, Idah	TB Patients Acute fever patients Accident patients	180 173 300
		3,090

Source: Kogi State Health Management Board, (2009-2012).

The above three thousand and ninety (3,090) patients from the various hospitals as categorized above constitute the population of the study for the research work. From the above population, a sample size of five hundred and twenty two (522) patients was drawn using the Yaro Yamenu formula as earlier stated. This gave a figure of eighty-seven (87) patients approximately, for each of the hospital to be investigated Thus, from the sample of 522 patients that queued in these various hospitals at different period of time in the various hospitals waiting room, a time pattern of their arrivals and services at the waiting rooms were taken so as to simulate the arrival time, service time as well as the waiting time in order to determine whether the workforce of these hospitals are actually efficient or not in carrying out their responsibilities based on the data given in relation to customers arrival time pattern and their number of occurrence (i.e numbers of time customer visit the hospital) as well as the service time pattern vis-à-vis the number of occurrence. Also to be computed from the aforementioned are the random numbers (RN) for arrival time, random numbers for service time and the assumed time these hospitals on the average opens and start attending to patients. The computed figures are shown below in tables D, E, and F respectively.

Table 4.1(D): ***Empirical Results: Simulation of Arrival Time***

Arrival Time	**Probability**	**2-Digit no**	**Cum-probability**	**Arrival Random Number**	**Corresponding Time between Arrivals**	**Assumed Clock time at Arrival (8.00am)**
10	0.15	00-21	0.15	12	10	8.00
20	0.25	22-54	0.40	81	50	9.40
30	0.10	55-64	0.50	36	20	160
40	0.10	65-72	0.60	82	50	140
50	0.25	73-82	0.85	21	10	210
60	0.15	83-92	1.00	74	50	220
				90	60	270
				55	30	330
				79	50	360
				70	40	410
Total Arrival Time					370	450

Source: Field Survey, (2012).

From table D above, the estimated mean time between arrivals was 37 minutes per customer. This figure was obtained simply by dividing total time between arrivals by the members of customers. What this means is that, on the average, it takes 37 minutes for a patient to arrive at the hospital waiting room, meaning that if the server i.e. the doctor in question is determined and efficient in carrying out his or her responsibility, there would be no question of the system being overloaded. The finding from this simple analysis reveals that lack of commitment on the part of these hospitals management with particular reference to the doctors and nurses many at times brings about overload in the systems and as a result, patients have to wait even to the point of death before being attended to. Moreso, from table D above, it was discovered from the data analyzed that, the estimated mean arrival rate was 0.027 customers per minute on the average. This means that the number of customers that arrived at the waiting room per minute are not even large enough to be attended to as soon as possible that would have resulted in unnecessary queue. This has revealed that the doctors and nurses of these various hospitals are grossly inefficient due to lack of commitment, as most of them have their own private clinics where they prefer to spend most of their quality times for money.

Table 4.1 (E): *Simulating the Service time (Empirical Result)*

Service Time	Prob.	Cum Prob.	2-Digit No	Service RN	Corresponding Service Time	Close time at Service 9.00 pm
10	0.15	0.15	00-21	51	20	20
20	0.25	0.40	22-54	69	40	69
30	0.10	0.50	55-64	37	20	89
40	0.10	0.60	65-74	61	30	119
50	0.25	0.85	75-82	25	20	139
60	0.15	1.00	83-88	46	20	159
				59	30	189
				3	60	249
				36	60	309
				33	20	329
Total Service Time					340	

Source: Field Survey, (2012).

From the above table E above, estimated mean service time is 34 minutes per customer. This means that on the average it takes 34 minutes for a patient to be diagnosed of his or her illness by the doctors. This is however with particular reference to patients with either TB or acute fever. This means that patient(s) with serious or accident cases would have to spend more than that time (i.e 34 minutes). From the above analysis, it was also discovered that much time is spent on the average for a patient to be diagnosed of his or her illness particularly if it involves emergency where the patient need to be urgently diagnosed and administered drug on, so as to avoid the condition getting worse. One of the major findings from the above analysis so far is that, some patients whose condition are so critical can give – up (die) in the process of unnecessary time wastage on the part of these doctors and nurses. From table E above also, it was also discovered from our analysis that on the average, the estimated mean service rate (i.e. the number of patients treated) is 0.029 customer (patients). The number again appears to be very insignificant, which further suggests how inefficient these group of doctors and nurses can be.

Table 4.1(F): *Stimulation of Waiting Time (Empirical Results)*

Clock Time at Arrival (a)	Clock Time at Service (b)	Service Time (c)	Service Completion Time (d)	Waiting Time (e)
9.00	29	20	49	20
140	69	40	109	40
160	69	20	109	20
210	119	30	149	30
220	139	20	159	20
270	159	20	179	20
330	189	30	219	30
360	249	60	309	60
410	309	60	369	60
450	329	20	349	20
Total waiting time =				320

Source: Field Survey, (2012).

From table F above, the estimated mean customer waiting time is 32 minutes per customer on the average, this was obtained by dividing the total waiting time by the number of customers-while the estimated mean customer time spent in the system is 64 minutes per customer i.e. 1 hour and four minutes. This result, obtained by summing the total waiting time and total time spent in the waiting room of these various hospitals on the average is on the high side. One cannot imagine someone who is seriously ill and at times at the point of death to wait for about 1 hour 4 minutes before receiving the necessary treatment. This type of attitude is majorly display in African countries, particularly in Nigeria where human beings are not regarded as anything important, particularly if you are perceived to belong to the category of poor people. Thus, the computed estimated mean customer waiting time and that of the estimated mean customer time spent on the system respectively before being treated equally confirmed that most public hospitals in Kogi State are grossly inefficient due to the nonchalant attitude of these hospital workers (i.e. doctors and nurses).

Table 4.1 (G): Performance Evaluation on the Operations of the Kogi State Public Health Sector. (DATA PRESENTATION)

Hospital	Poor	Fair	Good	V. good	Outstanding	Total
Diagnostic and Reference Hospital, Anyigba.	30	16	20	15	6	87
Fed. Medical Centre Lokoja	35	21	15	12	4	87
General Hospital, Kabba	25	20	26	11	5	87
General Hospital, Idah	21	25	10	25	6	87
General Hospital, Okene	32	22	12	16	5	87
General Hospital, Ankpa	22	32	16	5	12	87
Total	165	136	99	84	38	522

Source: **Field Survey, (2012).**

Table 4.1 (H): ***Data Analysis and Interpretation (Test of Hypothesis I)***

S/NO	O	E	(O-E)	$(O-E)^2$	$\underline{(O-E)^2}$ E
1	30	27	3	9	0.333333
2	35	27	8	64	2.370370
3	25	27	-2	4	0.148148
4	21	27	-6	36	1.33333
5	32	27	5	25	0.9259259
6	22	27	-5	25	0.9259259
7	16	22	-6	36	1.6363636
8	21	22	-1	1	0.0454545
9	20	22	-2	4	0.18181818
10	25	22	3	9	0.409090909
11	22	22	0	0	0.0
12	32	22	10	100	4.545454
13	20	16	4	16	1.00
14	15	16	-1	1	0.0625

15	26	16	10	100	6.25
16	10	16	-6	36	2.25
17	12	16	-4	16	1
18	16	16	0	0	0.00
19	15	14	1	1	0.07142857
20	12	14	-2	4	0.285714285
21	11	14	-3	9	0.642857142
22	25	14	11	121	8.642857143
23	16	14	2	4	0.285714285
24	5	14	-9	18	5.785714286
25	6	6	0	0	0.00
26	4	6	-2	4	0.6666666
27	5	6	-1	2	0.1666666
28	6	6	0	0	0.00
29	5	6	-1	1	0.1666666
30	12	6	6	36	6.00
				∑ =	40.132

Source: **Field Survey, (2012).**

Table G above was obtained from respondents of the six (6) hospitals with a sample size of 522 patients. The essence of obtaining the data was to test the first hypothesis so as to verify the performance of these public health sector vis-à-vis their private counter parts, (i.e. to know whether the private hospitals are more efficient or the same as these public hospitals) bearing in mind that both of them suffers this waiting line problem. To test the hypothesis, the researcher used chi square test of homogeneity. The hypothesis was tested at 95% level of confidence- while the researcher used (C-1)(R-1) formula to obtain the degree of freedom. In the formula, C stands for column, while R stands for row. From table H, the calculated x^2 value is 42.132 (i.e. cal. Value = 42.132), while the table value of x^2 given that df = 5 x 4 = 20 is tabα value .05 = 31.410. As a decision rule, since the calculated value = 42.132 is > table value = 31.410, we reject the H_0 that public hospitals are not less efficient than private hospitals, and conclude that private hospitals are more efficient than public hospitals even though, they will all experience waiting line problems.

Table 4.1 (I) and 4.10 (J): ***Data Presentation***

To test the second hypothesis the respondents were categorized according to the type of sicknesses earlier stated above (i.e. TB, Acute Fever, and Accident Patients). To achieve our objective, questionnaires were administered to the 522 patients from the different hospitals and at the conclusion of the researcher's investigation, the following mixed results which eventually constituted the data used to test the second hypothesis were obtained based on the question below;

Table 4.1 (G): Did you think that there are any cost implications associated with waiting line problem?

Respondents	**Responses Yes**	**Responses No**
T.B	75	25
Acute Fever	80	90
Accident Victims	100	152
Total	255	267

Source: Field Survey, (2012).

Table 4.1 (H): ***Using ANOVA for Data Analysis, Test of Hypothesis and Interpretation***

	Sum of square	**Degree of Freedom**	**Mean square**	**F – ratio**
Factor	24	1	24	87.67
Error	8416	4	2104	
Total	*8440*	*5*		

Source: Field Survey, (2012).

From table H above, the cal F-ratio value was 87.67. In order to obtain the tab F-ratio value, the researcher used α= 0.05 as level of significance; while the degree of freedom for the numerator and denominator form table J are 1 and 4 respectively. Therefore, the critical value for F-ratio from F-ratio table was 7.71. From the above analysis, it was revealed that F calα 87.67 > F tab value 7.71, we therefore reject the H0 that unnecessary waiting line problem do not have cost implication and accept the H1, that unnecessary waiting line if not properly managed has a lot of cost implication for the concerned individual(s) and the general public.

4.2 Discussion of Results

From table (A) in the research findings, it was revealed that the mean arrivals per hour for the six (6) hospitals ranged between 18 and 30 inclusive while the mean service per hour is relatively high, it ranges between 19 and 32 respectively.

The Kabba general hospital seems to enjoy the most strategic location vis-à-vis other hospitals and even though it is located in the heart of Kabba town, it has a mean arrival rate of 30, while the service rate is 32 patients per hour.

Federal medical centre Lokoja is the next in terms of mean arrival and mean service rate per hour which were 25 and 26 respectively. This could be attributed to the fact that its location is comparatively better than that of Diagnostic and References Hospitals, Anyigba, with a mean arrival and mean service rates of 18 and 19 respectively. On the whole, it was discovered that the Diagnostic and References hospital, Anyigba which is located at the out sketch of the town enjoyed the least score in terms of mean arrival and mean service rates per hour of 18 and 19 respectively.

The study revealed that the Kabba general hospital was the most efficient in terms of mean service rate per hour of 32 patients, a staggering difference of 13 patients when compared with Diagnostic and Reference hospital, Anyigba with a mean service rate per hour of 19 patients.

Table (B) above revealed that from the computation of the average number of customers (Patients) waiting for service (LF) with the exception of Diagnostic and Reference Hospital, Anyigba, Okene general hospital and Ankpa general hospitals respectively, the number of patients in the queue had tended to range between 23 and 28 respectively. The average number of customers (patients) waiting for service in the later hospitals when compared to the former hospitals is more. Moreso, the average time spent waiting for service as shown in table (B) above was least for Okene general hospital, where a patients had to spend 0.91 hours (54 minutes) waiting for service, before being attended to. Kabba general hospital is next on the line, where on the average, a patient have to spend at least .94 hours (56 minutes). Diagnostic and Reference Hospital Anyigba and Ankpa general hospital recorded waiting times of .95 hours (57 minutes) each respectively while Lokoja Federal Medical Centre and Idah general hospital recorded on the average waiting times of .96 hours (58 minutes) respectively for service.

In terms of the average time a patient spent in the system (waiting in the line and eventually getting served), Idah general hospital and the Diagnostic and Reference Hospital, Anyigba are less efficient, because on the average, a patient would spent not less than 1 hour before he or she can be served in both cases as can be seen from table (B) above.

It was also discovered that even in the other hospitals, inefficiency still persist on the average becausein all the hospitals, there is none where a patient would spend less than .96 (57 minutes) before being attended to.

As per the average number of patients in the system (waiting and/or being served), Kabba general hospital recorded the highest number of patients of about 29 in most cases, followed by federal medical centre Lokoja, with 25 patients at any particular point in time. Anyigba Diagnostic and Reference hospital and Okene general hospital experienced the least patients on the average in the system with 18 and 19 patients respectively. From the research finding, it was discovered that the proportion of time each doctor is busy attending to their patients is very low. From the finding, it was also revealed that the highest utilization was recorded against federal medical centre, Lokoja where it was about 0.160 (or 16%) while Ankpa, Idah, Diagnostic and Reference, Anyigba, Kabba and Okene general hospitals recorded system utilization of 8%, 10%, 12%, 6.3% and 9.1% respectively.

This implies prima facie that doctors are being under utilized in these hospitals. Research revealed that these doctors hardly have enough time to settle down and work for these pubic hospitals, as a result of other outside commitments which is not part of their primary assignment in their place of work. The reason for these actions as revealed by empirical study is that, most of these doctors if not all, have their own private clinics, where they spent most of their quality times, for financial gratification, which by profession is against the ethics of medical practitioners.

The research revealed that if utilization was defined as the percentage of capacity (other than human resources) employed, then, it would mean that the existing physical facilities are being under utilized in these public hospitals.

Result from simulation of arrival time shows that on the average, it takes 37 minutes for a patient to arrive at the hospital waiting room, if such a patient is within the town where any of these hospitals is located. This means that if the server (i.e. doctor in question) is determined and efficient in carrying out his or her responsibility, there would be no question of the system being overloaded. The finding from this analysis reveals that lack of commitment on the part of these hospitals management particularly the doctors and the nurses many at times brings about the so called overload in the systems, and as such, patients have to wait even to the point of death before being attended to.

From table D, it was observed that the mean arrival rate was estimated to be 0.27 customers per minute

on the average. What this analysis revealed is that customers who arrived at the waiting room per minute on the average are not even large enough to be attended to as soon as possible, but yet unnecessary waiting line prevails. This result further revealed that the doctors and nurses of these various hospitals are grossly inefficient due to their lack of commitment, as most of them have their own private clinics where they prefer to spend most of their quality times for money.

From the first tested hypothesis, in table H, the calculated x^2 value is 42.132 (i.e. Calα = 42.132) at 95% level of confidence. While the table value of x^2 given that, df = 5 x 4 = 20 is (tabα .05 = 31.410). As a decision rule, since calα = 42.132 is > tabα = 31.410, we reject the Ho that public hospitals are not less efficient than private hospitals, and conclude that private hospitals are more efficient than public hospitals even though, they all experience waiting line problems.

From the second hypothesis tested, using ANOVA in table J, the Calα F–ratio value was 87.67, at 5% level of significance, while the critical value for F-ratio from the F-ratio table was 7.71. This analysis revealed that F-calα = 87.67 > F-tabα 7.71. Therefore, the H0 was rejected that unnecessary waiting line problem do not have cost implications and accept the H_1 that unnecessary waiting line if not properly managed has a lot of cost implications for both the patients, the organization (hospital) and the general public.

5. SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

5.1 Summary of Findings

The findings of this study include:

(1) That unnecessary waiting line has cost implications both on the organization and the general public.
(2) That management of private hospitals are more committed to their work as far as the Kogi State health sector is concerned and as such, more efficient in their operations.
(3) That strategic waiting line management approach such as commitment to one's duty, doing the right thing at the right time, among other factors can help to improve on the operations of the public health sector like their private health sector counterpart.
(4) Also revealed from the study is that effective waiting lines management study can bring about efficiency in the operations and corporate performance of the Kogi State health sector.
(5) Also discovered from the study was that most of the public health workers (i.e doctors) have their own private clinics where they prefer to spend most of their times thereby ignoring their primary assignment.

5.2 Conclusion

Based on the following findings above, the following conclusions are made.

(1) The Kogi State health sector management may not have realized at the moment the need for them to adopt a strategic waiting line management approach. This stems from the fact that they are yet to discover the need for its use.
(2) There is the need for effective usage of waiting line management to significantly improve the operations and performance requirement in the public hospitals.
(3) Waiting line management even where it is being practice in the public hospitals in Kogi State is still very much characterized with queue indiscipline.

5.3 Recommendations

From the aforementioned discussion, the research has profile the following suggestions;

(1) The Kogi State health sector among other things, need to integrate all kinds of strategic waiting line management into the main stream of their operations to maximally experience a positive impact on their performance. The current lack of commitment on the part of the management of these public hospitals as revealed by this study, would translate in serious problems in the future if proper waiting line management strategy is not put in place.
(2) Both state and federal government should make efforts to improve the condition of services of the health personnel so as to bring about more commitment on the job. The efforts so far made had not yielded any significant positive results
(3) The management of these hospitals and the Kogi State government should be aware that without good health, no nation can think of growth and development. This is because a nation with sick citizens indirectly is a sick nation and as such should put in place all necessary strategies in their operations to ensure effective waiting line management.
(4) Government both state and federal needs to improve on the service facilities in these hospitals. In the light of this, it might be pertinent to recommend that more modern, sophisticated equipments and facilities including modern computerized blood pressure pumps, weight check slabs, laboratory test equipments, etc should be provided to enhance productivity. Such would also assist to reduce drastically the time patients spend on the average waiting to be served.
(5) There should also be dynamic and efficient mechanisms by management of these hospitals seek for optimal system utilizations. There should be some optimal number of hours that a given doctor should work. The tendency to over- labour an input (human resources inclusive) should be eliminated so as to motivate the workers to increase their efficiency and productivity in their operations.

(6) Both doctors and nurses as well as other auxiliary workers of these hospitals can be sent on training not only within Nigeria, but abroad so as to learn new things and how things are done there. This would in no small measure increase efficiency and the resultant effect is nothing but increase in productivity and efficiency.

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