

“APPLICATION OF QUEUING THEORY IN QUALITY MANAGEMENT PRACTICES IN MEDICAL SECTOR”

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ABSTRACT

The paper provides the description on medical sector organizations which emphasize on quality management for example reducing waiting lines, good medical services to patients within reasonable price and time; Applying queuing theory to reduce waiting lines, maintaining a continuous improvement program; Trained employees in hospitals on reducing delay time in services and low-cost services to patients need. Medical sectors are seen to be less effective, inefficient and inadequate. Generally, those organizations, which are aware about quality and upgrade the quality time to time, will obtain the highest consumer acceptance and support. The 'Quality Management', as it is referred to reduce waiting lines, medical costs. To improve efficiency, quality and performance. It also considers customer satisfaction which is also a major part of medical sector when several sources of variation represent. Analyzing medical processes for removing wastage of time, money and rework. Quality management led to significant reductions in waiting lines and medical costs. The use of quality-assurance strategies and statistical tools can be directly applied in medical sector organizations with improved quality of service providing and the results of care from the customer's point of view.

Application of Queuing Theory in Quality Management Practices in medical sector

A queue or waiting line is where customers wait before being served. In general, a queue is formed because the service to a patient may not be rendered immediately as the patient reaches the service facility. Queuing theory is a field of practical research because the line is often used when making business ideas about a fund that is required to provide a service. Ideas since then have seen the use of communications, commerce and engineering, computer and design of factories, shops, services and hospitals and project management.

The line model was developed to predict line length and duration. In computer science the suggestion line is grade-level research as a way to manage computer processes and objects. The line can be analyzed according to the source of each item in the line, how often the information arrives in the line, how long it should last or whether certain information should jump forward in line, how many widths can be formed and managed, and the rules by which data is tracked and segmented. The range held by a computer is sometimes considered to be bulk. Linearity checks everything in the queue for the queue to be provided, including the arrival process, service process, server number, number of system locations and "visitor" number (possibly people, data packets, buses, etc.). Real-life theory includes providing fast customer service, executing complete business shipping orders from are positron and designing communication (systems such as call centers. Queuing theory is used to improve efficient queue systems that reduce client downtime and increase the number of visitors that can be provided. Many consumers expect quality in the delivery of medical services. Everyone wants to get good results in a timely manner.

Role and Importance of Quality Management in Hospitals

The major role of quality management to insure and level of patient care and safety, how much time they spend on this and a strong commitment to quality and safety and your development. As a result of this significant growth which is also

reflected in the increase in public and international funding opportunities for both the private and public sectors to be allocated to the medical system. Hospitals and other medical sector association across the globe have been increasingly enforcing quality operation to reduce costs, upgrade effectively and give high quality case care. Some part and significance are as follows: Time spent by medical sector on quality and safety and its enhancement.

1. Indication status related to quality and safety and your development.
2. Impact of jobs on quality and safety and your development.
3. Co-operation and communication between staff.
4. Implementation of new styles and disposal of old bones.
5. Development of procurement skills, risk assessment.
6. Incident reporting and management, environmental assessment, follow up, and response, as well as patient data management.

Problems of Medical Sector

1. Avoidable harm to patients.
2. Wastage of time and money value
3. Lack of transparency
4. Neglect of rural population
5. Expensive medical services
6. Lack of medical research
7. Social inequality
8. Shortage of medical personnel

Review of Literature

Author	Title	Objectives	Research Gap	Findings
A. H. Nor Aziati, Nur Salsabilah Binti Hamdan(2018)	Application Queuing theory model and simulation to patient flow at The Outpatient Department	Determining the pending arrival arrangement and duration of the outpatient counter case service and demonstrating an appropriate linearization system using implementation method.	There is prescriptive guide that will stop the flow of emotions, though their effects can be reduced.	To better Understand linear theory and management service the members of medical centre of can take decisions that increase the satisfaction of all working groups without improving resources.
Daniel Jonathan Kagedan, Stephen B, Edg and Kazuaki Takabe (2021)	Behind the clock: elucidating factors contributing to longer clinic appointment duration and patient wait time	To identify an association of trainee involvement with increased appointment duration. Busier conventions (increased diurnal hassle volumes) and busy conventions with smaller specialist clinicians.	Many former studies compare time stamp case shadowing systems versus factual case inflow. The patient waiting time, no. Of cases and appointment time ar en't that important discovered.	High-volume conventions and trainee involvement protract roaming hassle. Adding APP backing changing work schedules, and assigning out-of-the-kind tracking to the untrained may reduce difficulties period.
Dr. K. L. Muruganantha Prasad1, D. Saraswathi2, Dr. R. Winson (2019)	The analysis of appointments stem to reduce outpatient waiting time at Trichy government hospital	To study the major causes of cases length of time for medical treatment in a patient and provide recommendations on a stylistic strategy to improve the appointment process.	Investigation on operations strategy in government hospitals has not been well developed, especially If it integrates an operational strategy with the current state of health care. Most of the activities have not been well developed, especially If it integrates an operational strategy with the current state of healthcare. Most of the activities that present	The study Shows each variable independently. Analysis was performed to confirm that the objectives of the waiting period do not reach the minimum level of service of the medical centre.

			courses do not focus much on the affairs of the medical institution Cost Containment capacity planning, or help scheduling. These variables are appointment system, case inflow, capacity and behavior of the physician.	
Georgina Glogovac, MD, Mark E Kennedy, BS, Maria R Weisgerber, Rafael Kakazu, MD And Brian M Grawe, MD(2019)	Wait times in Musculoskeletal Patients: what contributes to patient satisfaction	Determining how long a stay is associated with patient satisfaction once and for all. How selection factors relate to longevity and case satisfaction in orthopedic surgery.	Former studies assessing patient satisfaction in orthopedic conventions have concentrated on rates related to the croaker and the croaker case on rates related to the croaker And The croaker Case commerce.	The plant of that time is spent living room is important for orthopedic patient satisfaction clinic. Sitting times had badly predicted satisfaction.
Holly Chu, Robert A. Westbrook, Sarah Njue-Marendes Thomas P. Giordano And Bich N. Dang(2019)	The psychology of the waiting time Experience what clinics can do to Manage waiting experience for Patients: longitudinal qualitative study.	Testing contextual factors can shape how situations may respond to different waiting times. To find ethics providers and clinics that can take the initiative to promote good waiting and develop bad bones.	Letters during the wait do not show a correlation between long delays and severe case symptoms.	Our research highlights important steps cited circumstances such as possible to improve waiting time experience. These methods effective and have some interest clinics, where waiting is always inevitable
Michal Dorda, Dusan Teichmann, Vojtech Graf(2019)	Optimization Service Capacity Based On Queuing Theory	To minimize the total costs with respect to the number of repairmen. The cost function which considers the repairman costs and the production losses.	There Are Many Mathematical Models Of Queuing Systems That Have Been Developed, But Models For Optimization Of Service Capacity With	A Mathematical Model Of The Problem Presented; The Model Can Be Used For Optimization Of The Number Of There Pair Men With Respect To Costs Of The System

			Respect Of Cost Still lagging behind.	
Muhammad Ahmed Kalwar Sarmad Ali Khaskheli Muhammad Ali Khan Ali Arsalan Siddiqui Miskeen Ali Gopang (2018)	Comfortable waiting time of patients at OPD varying demographic.	To investigate the comfortable waiting time patients arriving at OPD.	There is no similar study is published which can talk over results statistically by concentrating the demographics of cases arriving at the OPDs of private hospital.	It was found that the comfortable waiting time male and female patient was same, the comfortable waiting time of cases belonging to different age groups was begin to be different.
Sarmad Ali Khaskheli, Hussain Bux Marri, Murlidhar Nebhwani, Muhammad Ali Khan, Muhammad Ahmed(2020)	Comparative study of Queuing systems of medical outpatient departments of two public hospitals	The purpose of this study was to compare the performance of physicians OPDs of two public sector hospitals.	The measurement of performance in medical sector has been done in previous studies, but in public sector the performance measures of corresponding queuing system is still lagging behind.	To enhance the Performance of existing line programs in outpatient departments (OPDs).The study found the optimum service level of medical OPDs of public hospitals using multi server line model. On the same time, the performance of both OPDs was also compared.
Vincent Le Elizabeth A. Wagar, Ron A. Phipps, Robert E. Del Guidice, Han Le, Lavinia P. Middleton (2020)	Improving patient experience of wait times and courtesy through electronic sign-in and notification in the Phlebotomy Clinic	Improving patients' sense of delay Times and respect in the phlebotomy clinic through an Authorization of electronic signage and announcement system, redesign of location and staff training.	Several studies Examine the relevance of the effect of Interventions on patient satisfaction points can be repeated. This Research can be used to model other forms of enhancing patient satisfaction and efficacy in a clinical set Preparation.	The interventions used demonstrated to accelerate case satisfaction in each step. Electronic signs and White boards bring precious facts to cases and staff

Research gap

On the basis of literature reviewed, it has been concluded that few studies were made on application of queuing theory in quality management practices where quality management is lacking behind due to lack of strategically management. So, the present paper will fill the gap by analyzing quality system, performance of employees and will suggest a model in the context of application of queuing theory in quality management practices.

Objectives of Study

The main objectives of the paper are as follows:

1. To learn the different quality assurance, find the organizational features that are important to those programs, use the features to create a variety of quality programs, and discuss the allegations of these types of health policy makers.
2. To analyze whether departments that work to improve quality management are actually aware or not about queuing system and some specific quality improvement designs.
3. To suggest a model to improve the quality management practices in public and private sector hospitals.

Hypothesis

Following are the main research hypotheses.

H01: There is no significant difference between queuing management strategies accredited by designated private and public hospitals.

Ha1: There is a significant difference between queuing management strategies accredited by designated private and public hospitals.

Research Methodology

Research Design

This paper is based on empirical study in nature and conducted on both primary and secondary sources of data gathered from various sources.

Data collection

Primary data was collected from the patients/customer through questionnaire by using Convenience Sampling Method and secondary data was gathered from various sources such as journal, books, websites etc

Data analysis and interpretation

In the present paper, for analyzing data, statistical tools (KMO and Bartlett's test of Sphericity, Exploratory Factor Analysis (EFA), Independent Sample T- Test have been used. The statistical tests have been performed at 5 percent level of significance and the interpretation of analyzed data has been written accordingly which explains the tabulated part for better understanding.

Results of Principal Component Analysis (PCA)

Principal Component Analysis (PCA) was applied to extract the latent factors of queuing management. The elements loadings were used to determine correlation between the named variables of the study. The loading factor near 1 shows a good correlation among the selected study variables, while the load near zero indicates a weak correlation. Features were also rounded up with use of Varimax with the Kaiser Normalization Rotation Method. The Principal component Analysis

(PCA) system used in the origin of the feature and only those elements, whose values were higher than 0.4, were translated.

The outcome of the Principal Component Analysis (PCA) on Queuing Management is as follows:

Result of KMO and Bartlett's Test

To quantify the validity of the feature analysis data, data validity was assessed on the basis of the outcome of Kaiser-Meyer-Olkin (KMO) ratings for sample acceptance and Bartlett (Homogeneity of Variance) Sphericity Assessment. The results in Tables 1 and 2 shows that the KMO rate of sample acceptance was 0.599. The data was therefore worth conducting a feature analysis in both cases. Similarly, Table 2 shows the results of Bartlett's Test of Sphericity (0.00). It was also significant ($p < .05$) that further revealed that the acceptable correlation was among the conditions for continued use of the exploratory factor analysis.

Table1: Results of KMO

KMO Measure of Sampling Adequacy	
	MSA
Overall	0.599
A	0.605
B	0.625
C	0.583
D	0.599
G	0.654
I	0.628
J	0.569
K	0.598
L	0.544

Table2: Results of Bartlett's Test

Bartlett's Test of Sphericity		
χ^2	D f	p
314	36	< .001

Outcome of Total Variance Explained for the queuing management

Table 3 depicts the total division of **Queuing Management**, three elements in the original result have an Eigen value over 1, and it considered for about **48.6** per cent of the practical variations considering responses of an arbitrary selection of selected respondents.

Table3: Total Variance Explained

Component	SS Loadings	% of Variance	Cumulative%
1	1.56	17.4	17.4

2	1.49	16.6	33.9
3	1.32	14.7	48.6

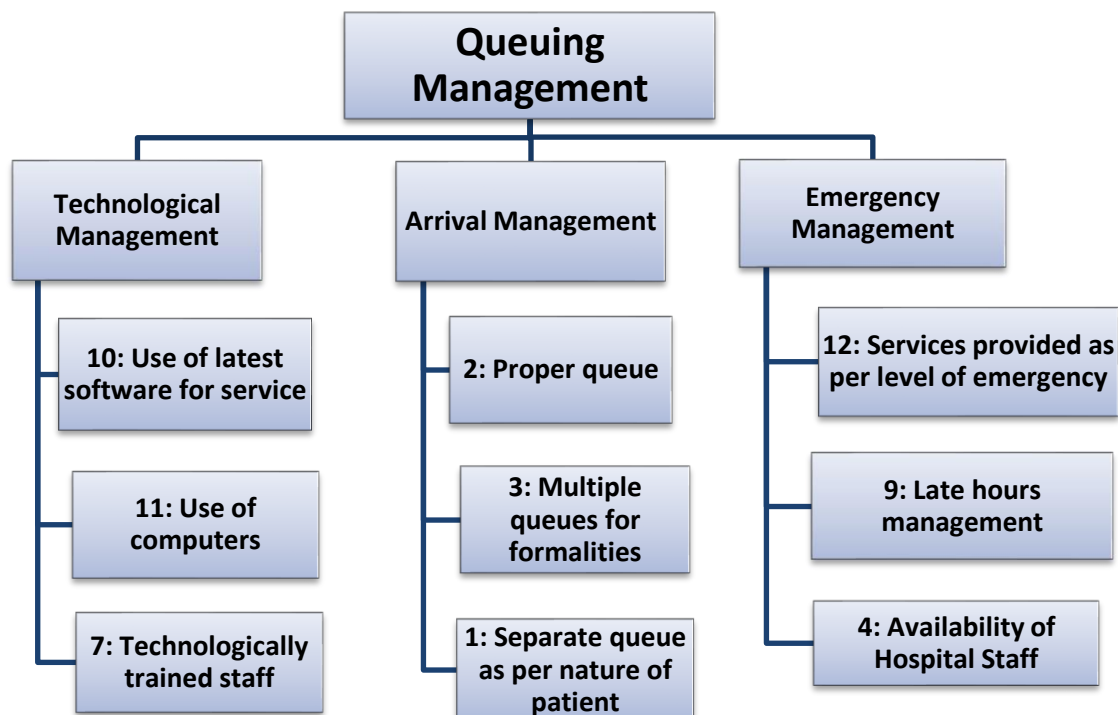
Extraction of latent factors of queuing management with the help of Rotated Component Matrix

Table 4: Results of Rotated Component Matrix

Component Loadings	Latent Components		
	1	2	3
10. Use of latest software for service	0.748		
11. Use of computers	0.666		
7. Technologically trained staff	0.643		
2. Proper queue		0.696	
3. Multiple queues for formalities		0.687	
1. Separate queue as per nature of patient		0.649	
12. Services provided as per level of emergency			0.704
9. Late hours management			0.597
4. Availability of hospital staff			0.563
Note. 'varimax' rotation was used			

Findings of EFA: In the present study, table 4 reveal the variable “Queuing Management Model” derived by applying Exploratory Factor Analysis (EFA). For the variable namely queuing management, three dimensions have been extracted. They were labeled as **Technological Management, Arrival Management and Emergency Management**.

Figure 1: Extracted dimensions of Technological changes and Student Performance using PCA technique



H01: There is no significant difference between queuing management strategies accredited by designated private and

public hospitals.

Ha1: There is a significant difference between queuing management strategies accredited by designated private and public hospitals.

For testing above hypothesis, Independent Sample t test has been applied on the three identified factors namely technological management, arrival management and emergency management extracted from Principal Component Analysis (PCA).

The results are as follows:

Table: Summary Statistics

Factors	Variable	N	Mean	Std. deviation
Technological Management	Public Hospital	300	2.578	0.894
	Private Hospital	300	2.191	0.789
Arrival Management	Public Hospital	300	1.997	0.706
	Private Hospital	300	1.799	0.702
Emergency Management	Public Hospital	300	2.167	0.634
	Private Hospital	300	2.609	0.780

Table: Results of t-test for two independent samples/Two-tailed test

Factor	Technological Management	Arrival Management	Emergency Management
Difference	0.387	0.198	-0.442
T (Observed value)	5.618	3.440	-7.619
t (Critical value)	1.964	1.964	1.964
DF	598	598	598
p-value (Two-tailed)	<0.0001	0.001	<0.0001
Alpha	0.05	0.05	0.05

Interpretation:

The calculated p-value is lesser than the significance level $\alpha=0.05$, the null hypothesis is H_0 is rejected for all the three identified factors of queuing management namely technological management, arrival management and emergency management, and accept the alternative hypothesis H_a1 . So, it can be found that there is a significant difference between queuing management strategy adopted by the selected private and public sector hospitals. Moreover, it is evident from the results of the arithmetic mean that the technological management and the arrival management is better in public hospital as mean value of public hospital is more. On the contrary, emergency management is better in private hospital as mean value of private hospital is more.

Limitations of the Study

1. Time spent on boards and managers, interaction and performance within quality and safety. This advertises in many parts of mythology and commentary on what directors should do by presenting what they really do.
2. The conditions and practices associated with good quality management and provide a model for presenting this clearly to directors taking into account their role in quality and safety.

3. It takes major trouble, time and energy to analyze a particular situation and crack the problem using the theory.

Conclusion

The conclusion of the study describes quality programs can be divided into three types of quality programs according to organizational feature standards: high, medium and low quality systems. An interesting result was that the characteristics of the feature were often the same in all aspects within the quality systems. It can be concluded that there are significant differences between the line management strategies adopted by selected private and public hospitals. Also, it is supposed from the results of the arithmetic mean that the technological management and the arrival management are better in public hospital as mean value of public hospital is more. On the contrary, emergency management is better in private hospital as mean value of private hospital is more. The model considerably suggests three factors namely technology management, arrival management and emergency management. Which are further classified in various suitable sub factors.

REFERENCES

1. **A.H. Nor Aziati, Nur Salsabilah Binti Hamdan,(2018),** *“Application Of Queuing Theory Model And Simulation To Patient Flow At The Outpatient Department”*.
2. **Daniel Jonathan Kagedan, Stephen B. Edg and Kazuaki Takabe (2021),** *“Behind the clock: elucidating factors contributing to longer clinic appointment duration and patient wait time*
3. **Dr.K.L.Muruganantha Prasad1, D. Saraswathi2 , Dr. R.Winson(2019),** *“The analysis of appointment system to reduce outpatient waiting time at trichy government hospital”*.
4. **Georgina Glogovac, MD , Mark E Kennedy, BS, Maria R Weisgerber, Rafael Kakazu, MD and Brian M Grawe, MD (2019),** *“Wait Times in Musculoskeletal Patients: What Contributes to Patient Satisfaction”*.
5. **Holly Chu, Robert A. Westbrook, Sarah Njue-Marendes, Thomas P. Giordano And Bich N. Dang (2019),** *“The Psychology Of The Wait Time Experience – What Clinics Can Do To Manage The Waiting Experience For Patients: A Longitudinal, Qualitative Study”*.
6. **Michal Dorda, Dusan Teichmann, Vojtech Graf (2019),** *“Optimisation of Service Capacity Based On Queueing Theory”*.
7. **Muhammad Ahmed Kalwar, Sarmad Ali Khaskheli, Muhammad Ali Khan* Ali Arsalan Siddiqui, Miskeen Ali Gopang (2018),** *“Comfortable Waiting Time Of Patients At The OPD With Varying Demographics”*.
8. **Sarmad Ali Khaskheli, Hussain Bux Marri, MurlidharNebhwani, Muhammad Ali Khan, Muhammad Ahmed (2020),** *“ Comparative Study of Queuing Systems of Medical Out Patient Departments of Two Public Hospitals”*.
9. **Vincent Le; Elizabeth A. Wagar, Ron A. Phipps,Robert E. Del Guidice, Han Le, Lavinia P. Middleton (2020),** *“Improving Patient Experience of Wait Times and Courtesy Through Electronic Sign-in and Notification in the Phlebotomy Clinic”*.