

Research of reasonable Ophthalmic Hospital Bed Arrangement Problem based on the Mathematical Model

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Abstract.

How to reasonably arrange the limited beds in hospital to reduce patient queuing time as much as possible, and make full use of the resources have important significance to improve the quality of hospital services and reduce hospital operating costs. Optimize beds management based on queuing theory is the main technical solutions. A series of model are established in this paper according to the actual needs in a hospital in ophthalmic hospital bed distribution, and its integrated on a system platform thus to make it easy to use.

1. Research background

In recent years, as China's economy has been rapid development, people's material life level increased significantly, put forward a higher demand on medical health level, so as to promote the development of the medical service market, all kinds of medical services appear constantly. However, "a doctor" difficulty and high cost has become a universal social problems at the same time, for this purpose, the country launched a health care system reform, with the deepening of the reform, all kinds of medical resources integration, and the new social resources into continuously, make health medical market competition is becoming increasingly fierce. In the fierce competition environment, the values of hospital personnel also profound changes have taken place, the service consciousness, enterprising consciousness, competition consciousness, efficiency consciousness, the consciousness of cost accounting has significantly enhanced. [1]Relaxed at the same time, the reform of medical qualification tuen nucleus, the emergence of a variety of civilian battalion hospital and foreign hospitals to public hospital brought great pressure of market competition.

High quality medical and health level is the important embodiment of social progress and civilization is an important part of social and economic development in our country. At present, the medical and health work in the face of development opportunities in health care reform at the same time, also faces great challenge. These significant changes to the medical and health work two requirements are put forward. On the one hand, economic development put forward higher request to health work, on the other hand is constantly improve the people's material life level of health work put forward higher requirements. Medical institutions are facing the economic question is: how will the limited medical resources distribution. Therefore, must carry on the scientific planning of the limited resources; ensure the reasonable and efficient allocation of medical resources. Is to maximize the use of the limited resources of hospital medical institutions managers must face the problem and thinking.

Hospital is a complex system, provide patients from various services, such as registration, admission, operation when the existing demand exceeds its capability of providing the service of existing, queuing phenomenon will occur, due to the time of arrival of the patients and the time needed for patients with the diagnosis and treatment of randomness, controllable, queue is almost inevitable. When insufficient beds, patients often appear in line with a long time, make its satisfaction levels drop, it will bring bad influence on hospital and society. [2] But the hospital blindly increases the beds, and will cause unnecessary idle, form resource waste, which hospital managers also strive to avoid. So how do you on the limited beds, reasonable arrangement of be in hospital, reduce patient queuing time as possible, and make full use of the resources, improve the service quality, reduce service costs, for hospital JinYuanQi planning has the very vital significance. From the perspective of industrial engineering, bed allocation of hospital service is "key process", is the basis of hospital work. On hospital bed distribution can help:

- (1) Reduce the queue waiting time and total time in the hospital patients;
- (2) Reasonable planning: long / short-term plan, talents introduce and equipment update, drug purchase;
- (3) To improve the efficiency of resource utilization, and maximize benefits with the existing constraints;
- (4) Overall balance hospital and the doctor's load;
- (5) Improvement of the utilization efficiency of doctors working hours;
- (6) To arrange overtime or paid leave,
- (7) Service quality in a controllable state;
- (8) Management exceptions: enhance the ability of respond to emergencies;
- (9) Scientific decision: reduce the decision risk;
- (10) People-centric, arouses the enthusiasm of the medical staff, and improves hospital management level.

2. Queuing system and related theoretical basis

2.1 Basic theory of queuing system

The basic theory research of queuing system can be traced back to 1910, then call queuing traffic theory, the famous telephone engineer el lang inspired by statistical thermodynamics equilibrium theory, in solving the questions about the design of automatic telephone, he through telephone statistical equilibrium model is established, and launched a set of recursive equation of state, and then deduced the famous el lang phone loss formula.

Queuing phenomenon is a very common phenomenon. [3] People and things must wait and wait in line as to receive a service. Some queued to tangible, such as waiting in the canteen dozen rice line by a group of students, train station queuing romantic wait in line waiting for the train; There are some invisible line, for example, message queuing, the line of information into the computer center waiting to be processed, telephone switchboard received a telephone call signal wait in line. Because the customer arrival interval time and service time distribution is random. Therefore, the phenomenon of queuing normally is inevitable.

Queuing phenomenon is what people don't want to appear the phenomenon, this is because the people queuing at least illustrate the waste of time; Supplies of line means the backlog of goods. But the queuing phenomenon cannot be completely disappearing, this is a random phenomenon. The root of the cause of queuing phenomenon is due to the customer arrival time interval is random and system to provide customers with service time also is random.

2.2 Content of the queuing theory research

Queuing Theory (Queuing and found) is also called the Theory of stochastic service system, the main research system random accumulation and dispersion phenomenon and the mathematical Theory of stochastic service system work process and method, also is to solve the above problems and the development of a discipline.

Feature is the basis of queuing theory of randomness. The core of the queuing theory is described system, the main index of probabilistic, generally divided into the following three categories:

1) Sexual problems were

Sexual problems is a core problem in queuing theory research, it studies the law of all kinds of queuing system (probability), and sexual problems were also the foundation of the other two types of problems. Sexual problems were mainly includes three parts: the queuing system of the expected number of customers, the captain, customers from entering the queuing system to accept service of average waiting time, and busy period distribution, including the transient and steady state two kinds of situations.

(2) Statistical inference problem

Queuing system of statistical inference is to have developed the theoretical results of practical application, to a queuing system, the running through relevant statistical data, observation index, the mathematical statistics theory to data processing, and then deduce the queuing system of some indicators, in order to study the problems of queuing system, optimize the queuing system, and grasp regularity and characteristics of the queuing system. [4]Therefore, to grasp the method of statistical inference queuing system is very necessary for research.

(3) Optimization problem

Optimization problem of queuing system mainly includes two aspects: one is to not existing queuing system, the design rules in line, called a static optimal design. The other one is on the existing system optimization design, called dynamic optimization design. Optimization design or queuing system should be considered services and line up the interests of its customers, by controlling the related indexes within a reasonable range, pursue to the optimization of the whole system. Mastery and queuing theory, learning to enterprises or service agencies to provide ideas queuing system optimization design and improve the operation process, is ultimately to get the best economic benefits and social benefits.

2.3 Composition and characteristics of queuing system

Queuing system usually arrive by the customer, and customer service system to leave this three parts, the basic process description as shown in figure 2-1.

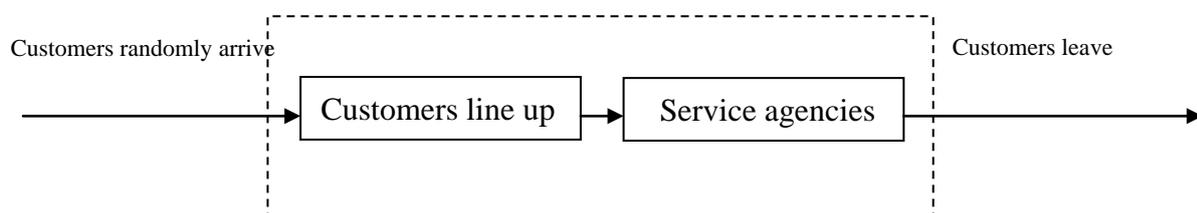


Figure 1. The general model of queuing system

All need to service object are known as the customers, to provide customers with services of people or objects called the waiter. Service system is made up of customers and waiters. If a service system service organization is small, when it cannot meet the needs of the wait for customer service, the service system will generate a crowded phenomenon and results in the decrease of the quality of service. Therefore, from the customer's point of view, service is the bigger the better, however, if the

service is too large, set by the service mechanism of manpower and material resources spending will increase accordingly, which leads to the waste of resources. [5]Therefore queuing model research purpose is in the customer's needs and trade-offs between decision-making service scales, reaches a certain balance between them. General queuing process consists of three parts, one is the input process, the second is queuing rules, and three is the service process.

3. Evaluation index system of ophthalmic hospital bed

Bed is one of the important of health resources; the hospital sickbed usage can actually reflect the hospital quality and management efficiency. So reasonable analysis of hospital bed utilization to improve hospital economic benefits improve the ward management pattern, mining the potential of the hospital, enhance the service ability and so on has the very vital significance. According to the actual situation of the eye hospital, this article considers the interests both hospital and patients, select the average bed days, sickbed utilization rate, sickbed turnover, average queue length, average waiting time and average wait after admission procedures, such as time evaluation index. And thus defined through the capacity and the degree of fair evaluation index, in order to apply optimization model is established.

3.1 Object of study

In this paper, with an eye hospital beds reasonable allocation problem as the research object, the hospital has 79 sickbeds; eye surgery is mainly in five categories: cataract (eyes), retinal disease, cataract, glaucoma and trauma.

Cataract surgery is simple, and there is no emergency. Such patients preoperative preparation time for only 1 ~ 2 days, so the patient needs only a brief assignment beds, and can advance booking first, low priority.

Trauma type with cataract eye surgery is different, generally belong to emergency, patients of sickbed demand is very urgent, need immediate arrangement free bed in the hospital, the highest priority.

Other eye disease is complicated, is different, for this kind of disease, the arrangement of the hospital is usually the operation time and cataract surgery time stagger, and most do not belong to the emergency, so when modeling the eye disease is not considering the emergency.

Current the in-patient department is for all the emergency patients in accordance with the FCFS (First last come, First serve) rule arrangement in hospital, the cataract patients with other non-emergency patients considered at the same time, make some critically ill patients can not be timely distribution beds, patients often complain, not only reduce the hospital economic benefit and also greatly influenced the image of the hospital.

3.2 Build evaluation index

Considering bed allocation model of reasonable evaluation index system, to the beds distribution model can be evaluated. For this, will be the role for the analysis of the problem, first of all, from the perspective of the role of the hospital, the hospital is mainly concerned with the utilization of hospital beds, in order to produce a higher economic efficiency, so the hospital want bed average working days in a cycle, sickbed utilization rate and the higher the turnover of the bed, the better, finally to determine the indicators for hospital bed efficiency [58]; If from the point of the role of the patient, the patient is mainly the pursuit of a better satisfaction, this kind of satisfaction mainly includes: queue length as short as possible, waiting time as short as possible, at the same time also hope to have better fairness. Therefore, when bed allocation model is set up the evaluation index system will consider the above the interests of the two roles.

3.2.1 Principle to build evaluation index

Hospital staff equipped with, the distribution of the medical technology and equipment and economic, etc., are determined according to the number of hospital beds, bed allocation model is a key problem in hospital queue system, thus to set a reasonable evaluation index to evaluate the bed allocation model. Therefore, points to the hospital and patients respectively the two roles to establish hospital bed distribution model of evaluation index system, comprehensive evaluation of hospital bed distribution model, which can increase the benefit of the hospital and patient satisfaction. Principle is: the bed allocation model of design mainly taking patient as the center, scientific use of hospital resources rationally, improve the sickbed utilization rate and patients' satisfaction.

3.2.2 Build evaluation index

Evaluation factors mainly include: failed to timely adjust the unreasonable distribution of bed; For a long time had not repaired the bed; Late reports of spare beds; The influence of seasonal factors on the sickbed demand; The influence of disease of sickbed demand; Patients' gender on the sickbed demand of ah, etc. Therefore, should be from two angles to analysis to determine the reasonable evaluation index system. First of all, from the perspective of the role of the hospital, the hospital mainly concerned about the hospital resource utilization, so as to produce a higher economic efficiency, so the hospital hope in a cycle, sickbed utilization rate and average hospital bed days sickbed turnover is higher, the better.

Summary

Queuing model and the fuzzy comprehensive evaluation mathematics model is set up, which make abstract problems that arrange bed expressed in mathematical language, effectively overcome the shortcomings of traditional evaluation. Using MATLAB to do data analysis and curve fitting of the number of admission and discharge, it is clear and intuitive. Statistical data obtained by questionnaires and four indicators weight, overall satisfaction, fully considering the social result, so it is reasonable. Although the national health policy has certain influence to the model, on the whole the model has certain rationality, applicability.

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