Analysis of Right to Health Using Queueing Theory: A Critical Overview

Balveer Saini[1], Dr. Dharamender Singh[2], Dr. Kailash Chand Sharma[3]*
[1]Research Scholar, Department of Mathematics, MSJ Govt PG College, Bharatpur affiliated to Maharaja Surajmal Brij University, Bharatpur, Rajasthan, India.
[2]Assistant Professor, Department of Mathematics, MSJ Govt PG College, Bharatpur affiliated to Maharaja Surajmal Brij University, Bharatpur, Rajasthan, India.
[3]Principal (Retd.), Rajasthan Higher Education, India.
Email id: *veer.coiaf786@gmail.com[1], dharamender.singh6@gmail.com[2], ks.pragya@gmail.com[3]*
ORCID ID: *0009-0007-8818-0905*

Abstract

The Rajasthan Government has passed a "Right to Health Bill 2023" on March,21 and became the first state to enact a Right to Health Act. The bill gives every resident of the state the right to avail free Out Patient Department (OPD) services and in Patient Department (IPD) services at all public health facilities. The bill sparked massive protests from the medical community. In this article, we analysis the requirement of this bill and problems in implementation of RTH. Does this bill play a significant role to improve health care system at local level? We also discuss the practical situation of hospitals system capacity for these types of revolution. Here we use Queueing theory techniques for manpower planning in hospitals to improve efficiency of healthcare system. This is a theoretical article and provide decision support system for Policymakers and Public administration.

Keywords*: Right to health (RTH), Rajasthan Government, Doctor's Protest, Health Care System, Manpower planning, Queueing Theory.*

1. Introduction

The Right to Health Bill was tabled in the Rajasthan Vidhan Sabha in the year 2022, making it the first state to do so in India. It aims to make provisions for the security and satisfaction of equal rights to health and well-being for every individual. In simple words, if a patient is unable to pay the charges for emergency care, the government will pay the health service provider. The bill gives every resident of the state the right to avail free Out Patient Department (OPD) services and in Patient Department (IPD) services at all public health facilities. Additionally, similar healthcare services will be provided free of cost at select private facilities. Health Authorities are located at the state and district levels. These institutions will build and implement systems for public health emergencies and providing effective treatment. The bill guarantees 20 rights to the residents of the state and is based on Article 47 and the expanded definition of Article 21 of the Indian Constitution [1]. The legislation sparked massive protests from the medical community. The act was passed in the Rajasthan assembly among protests by healthcare professionals. To oppose the provisions of the act, the Indian Medical Association called for country wide protests and threatened to shut countrywide services [2]. All Rajasthan In-Service Doctors Association (ARISDA) has also called for shut down of healthcare services in the state [3]. The protestors have met with government opposition as police used water cannon and baton charge against the protestors [4,5]. The private healthcare sector had called the Act "draconian" and was apprehensive of the government's interference in their functioning after the enforcement of the law. Due to the doctor's protest to the introduction of the Bill, it was decided in the Vidhan Sabha that the

Bill be referred to a select committee of legislators to seek more inputs and to suggest amendments. A 16-member select committee was constituted, headed by the state's health minister. The protests finally being called off on April 4, after an agreement was reached, on the applicability of the law [6]. But does the private medical sector, which forms a huge segment of the healthcare sector in our country, need legislation? Should emergency care be provided to every resident in need of it at any hospital that is able to provide it? Should the Right to Life, enshrined our Constitution, also guarantee all citizens the Right to Health in India?

1.1 Why was the Act needed in Rajasthan?

Rajasthan has a population of around 80 million, and is the largest state in terms of geographical spread. Its health and economic indicators put it among the low-performing states in the country; therefore, the right to health Act is a policy of the governments' desire to expand access to quality healthcare without exorbitant costs to families. Even prior to legislating the Right to Health Care Act, the contemporaneous ruling party in Rajasthan have already launched a slew of schemes to improve access to medical care in the state, such as a scheme for free medicines, the chief minister's free treatment scheme, and health insurance through the Chiranjeevi scheme, which assures insured families of five persons up to ₹10 lakhs of medical coverage treatment at government and empanelled private hospitals. In the state budget 2023 announcement, the sum insured under the Chiranjeevi scheme has been enhanced to ₹25 lakhs from the financial year 2023–24 onwards [7]. Inspite of these provisions and schemes, residents of the state continued to bear around 60 percent of their health expenditure out of their pocket, as per the National Health Accounts 2018–19 released last year. As a consequence, families lost on their savings, nearly 7% of the country's population slid into poverty year (according the estimates of National Sample Survey Office), and many people do not seek medical attention or seek treatment when they are sick, which could cause more harm than good in the long run [8]. One of the reasons for this is that the public has not fully benefitted

from the schemes. Also, violations or failure to provide the services are not considered violations as these are not laws. The RTH Act imposes an obligation on the government to ensure health services as required for public, without causing any troubles.

1.2 What does the Right to Health Bill provide?

Right to health: Everyone has free access to indoor and outdoor care facilities, medicines, testing, and emergency care and treatment from all specialists without prior payment or police confirmation.

Additional rights for residents: A resident of Rajasthan will have certain additional rights to free treatment from all hospitals and free transportation, treatment, and road accidents' insurance coverage at all hospitals.

Duties of state government: According to the RTH model, the state government sets health standards and provide medical services for remote, geographic, or populated area. The government will also establish a human resource policy to ensure the equality of medical and health workers.

Health Authorities: The State Health Authority (SHA) and District Health Authority (DHA) will be formed as separate institutions at the state and district levels, respectively. These agencies will develop, implement, and monitor managing public health emergency response systems and provide effective medical service.

Grievance redressal: The Law set a mechanism to dealing with complaints, denial of services and violations of rights. A 24-hour support helpline and website will be created to address concerns. The Agencies including the Local Health Authority and the State Health Authority will be involved to solve the serious complaints.

1.3 Why were doctors opposing Rajasthan's Right to Health Bill? Were their protests justified?

The legislation sparked massive protests from the medical community. As the business advisory committee of the Vidhan Sabha announced the date of discussion and passage of the bill, doctors went up in arms to oppose its passage and demanded that

there be no right to health. They took out a massive protest march. As a result, medical care in the state has been disturbed, especially for those seeking care from private hospitals. The exact reasons why the doctors are agitating are not clear because the Act has little to do with the private sector. Their demands pertaining to the cost of treatment of patients in emergency wards of private hospitals, the refusal of representation of public representatives in health authorities, a single window grievance redressal, and membership of IMA representatives in the health authorities have been accommodated in the Act. The Act has also defined the emergencies as only those which could be related to accidents, snake bites and obstetrics. Private hospitals are required to provide only emergency care till it becomes possible to transfer patients to appropriate hospitals without any possibility of deterioration in their condition as shown in Figure 1. The Act also clearly mentions that the treatment cost would be borne by the government, if not paid by the patient as per the decided rates.

Figure 1 Doctors Protest in Jaipur against the RTH Bill / File Photo: India Today

At the same time, doctors' organizations staged vehement protests against the introduction of the Bill, it was decided in the Vidhan Sabha that the Bill be referred to a select committee of legislators to seek more inputs and to suggest amendments. A 16-member select committee was constituted, headed by the state's health minister. The committee held several rounds of discussions with representatives of doctors' organizations and accepted most of their demands:

- That if the patient does not pay, then the government would bear the cost of treatment done in emergency by any private hospital;
- That public representatives, civil society members and public health experts be removed from membership in the district and state health authorities, and be replaced by two representatives of the Indian Medical Association (IMA);
- That there should be only a single line of grievance redressal, and any person with a grievance must only complain in writing to the head of the institution to which the complaint pertains to.
- The district authority would be chaired by the district collector, and there would be two state authorities: one for logistics and the other for treatment protocols. The state authority for logistics would be headed by an Indian administrative services officer of the rank of secretary, the more important one on clinical protocols would be chaired by the vice chancellor of the Rajasthan University of Health Sciences.

1.4 Criticism

After accepting doctors' demands about 95% of the private hospitals are out from RTH, only Government funded nine medical colleges includes in this bill [1]. Then there is no significance of this RTH bill. Because, the current ruling party in Rajasthan already launched many schemes to improve access to medical care in the state, such as a scheme for free medicines, the chief minister's free treatment scheme, and health insurance through the Chiranjeevi scheme, which assures insured families of five persons up to ₹25 lakhs of medical coverage treatment at government and empanelled private hospitals. Therefore, the ruling party first should upgrade the local level healthcare system before implementing RTH [11-15]. They should increase number of hospitals, facilities in local hospital, doctors and paramedical staff. There is no significance of these type of bill without upgrade the local level healthcare system. The bill is accused of not appropriately defining the term

emergency. Here we provide Queueing theory application in manpower planning which provide us a strong base to upgrade healthcare system.

2. The Proposed Work

Queueing Theory Uses in Manpower Planning:
Queuing theory plays a significant role in healthcare sector. It provides useful data for decision making process in hospital manpower planning. Queuing theory principles allow healthcare administrators to calculate important performance measures, such as the average number of patients in the queue, average waiting time, and the utilization of healthcare resources. For this, we can use M/M/S: ∞/GD Queueing model to find out above measures and hospitals treatment capacity.

The {M/M/S: ∞/GD} Queueing model:
The {M/M/S: ∞/GD} Queueing model is a widely used queuing model in Healthcare sector. In this system, the patient arrival times follow a Poisson distribution, while random arrival and service time follow the exponential distribution and the number of servers is "S". System capacity is infinite and the service discipline is General Discipline. The

system can be in transient or in steady-state situation.

Notations:

λ = Mean arrival rate of Patients

μ = Mean service rate

ρ = Traffic intensity $\rho = \lambda/(\mu S)$

$P_n(t)$ = Transient state probability when n units are present in the system in time t.

P_n = Study state probability when n units are present in the system in time t,

$$\left[\lim_{t \to \infty} P_n(t) = P_n\right]$$

$E(L_S)$ = Expected number of Patients in the system.

$E(L_q)$ = Expected number of Patients in the Queue.

$E(W_S)$ = Expected waiting time per Patient in the system (with service time).

$E(W_q)$ = Expected waiting time per Patient in the queue (without service time).

Let E_n be the state of system i.e. n units are present in the system in time $t+\Delta t$ and $n \geq S$.

Then the probability of arrived patients or treated patients at time $t+\Delta t$

$$P_n(t+\Delta t) = P_n(t)\left[1 - (\lambda + S_\mu)\Delta t\right] + P_{n-1}(t)\left[\lambda \Delta t + o(\Delta t)^2\right] + P_{n+1}(t)\left[S_\mu \Delta t + o(\Delta t)^2\right] \tag{1}$$

The study state equations for M/M/S model are,

$$-\lambda P_0 + \mu P_1 = 0 \tag{2}$$

$$\lambda P_{n-1} - (\lambda + n\mu)P_n + (n+1)\mu P_{n+1} = 0; n \leq S-1 \tag{3}$$

$$\lambda P_{n-1} - (\lambda + S\mu)P_n + S\mu P_{n+1} = 0 \quad ; n \geq S \tag{4}$$

To solve study state equations, we get

$$P_0 = \cfrac{1}{\left[\sum_{n=0}^{S-1} \cfrac{(S\rho)^n}{\lfloor n} + \cfrac{(S\rho)^S}{(1-\rho)\lfloor S}\right]} \tag{5}$$

$$P_n = \left[\begin{array}{l} \cfrac{(n\rho)^n}{\lfloor n} P_0, 1 \leq n \leq S \\ \cfrac{S^S \rho^n}{\lfloor S} P_0, n \geq S \end{array}\right], \quad \text{Where} \quad \rho = \frac{\lambda}{\mu S} \tag{6}$$

From these equations (1) to (6), we can find out the probability of arrived patients or serviced patients at time $t+\Delta t$ in transient or in steady-state situation at the specified hospital. Further, we find out the key performance measures related to this queueing system, which are as follows:

(a) To find Expected number of Patients in the Queue

$$E(L_q) = \frac{\rho P_S}{(1-\rho)^2} \quad , \text{ where } P_S \text{ is given by eq. (6)} \tag{7}$$

(b) To find Expected number of Patients in the system

$$E(L_S) = \frac{\rho P_S}{(1-\rho)^2} + S\rho \tag{8}$$

(c) To find Expected waiting time per Patient in the system (with service time)

$$E(W_S) = \frac{\rho P_S}{\lambda(1-\rho)^2} + \frac{S\rho}{\lambda} \tag{9}$$

(d) To find Expected waiting time per Patient in the queue (without service time)

$$E(W_q) = \frac{\rho P_S}{\lambda(1-\rho)^2} \tag{10}$$

From these equations (7) to (10), we can calculate the average number of patients waiting and getting treatment at the same time, expected number of Patients in the system, expected waiting time per Patient in the system (with service time) and Expected waiting time per Patient in the queue (without service time). These calculations provide us the valuable data for decision support system in hospital manpower planning. No attempt is made here to develop the queueing model in details. The interested reader will find detailed discussion of above formulas in the works of Hiller and Lieberman [9].

Category	Required (R)	Sanctioned (S)	In Position (P)	Vacant (S-P)	Shortfall (R-P)
Female health workers/ANMs at SCs & PHCs	15,656	17,937	15,483	2,454	173
Total specialists at CHCs	2,464	1,555	525	1,030	1,939
Lab Technicians at PHCs & CHCs	2,749	3,186	2,149	1,037	600
Radiographers at CHCs	616	700	356	344	260
Pharmacists at PHCs & CHCs	2,749	2,360	1,198	1,162	1,551

Table 1 Lack of Health Workers in Rural Rajasthan as on March 31, 2022
Source: The Rural Health Statistics 2021-22

3. Capacity Analysis

Providing free and quality health services at all medical centers require human resources and infrastructure. The data shows that the state does not have sufficient such resources. This situation may affect the effective implementation of the RTH Statistics (2022) published by the Ministry of Health and Family Welfare noted that as on March 31, 2022 in Rajasthan has a shortage of 1,939 specialists at CHC's in rural areas [10].

4. Discussion

In this work, we analyse the structure of hospital system and suggest some ideas to improve and modify the service quality and hospital treatment capacity before implementing the RTH bill. For a meaningful public health policy, the following reforms should be done using above Queueing model and formulas by the Governments:

1. The Government should increase the service quality and hospital treatment capacity of Government hospitals at local level before applying these type of bills to avoid the above mentioned strike situation in medical sector

2. There is a need to observe the patients flow, and requirement of doctors using above Queueing model in local hospitals at block level and provide the sufficient paramedical staff, medical facilities and Doctors in hospitals, that will increase the service capacity and quality of treatment. As a result, it prevents the patients flow in City and District's level hospitals

3. Increase number of hospitals according to patients' flow. The infrastructure of hospital should contain all emergency facility

4. Form the required rule for Medical Protest Situation

5. **Medical Education**: Create reserve force of doctors for any emergency situations. For this, State should provide Medical Education as a mission on low fees and good quality to avoid shortage of doctors and medical staff in any emergency situation.

Conclusion

If the "Right to Health" Act implemented in its true spirit, it could improve access to free, high-quality medical care and healthcare. A healthy society, after all, is more productive and agile. But the Government of Rajasthan could not implement RTH Act in its true nature. The provision to provide free healthcare and emergency services to all residents of the state will lead to significant costs for the providers. The doctors and physicians who selflessly treated people during the pandemic and filled the institutional gap left by state services are now being treated as unequal stakeholders in public health in Rajasthan. On the other hand, the healthcare system of Rajasthan is not so good at local level. Therefore, to implement of the RTH Act is not so easy in Rajasthan. Also, there are many health schemes such as free medicines scheme, the chief minister's free treatment scheme, and health insurance through the Chiranjeevi schemes already present in state [16-18]. Therefore, the Government first should increase the facility at local level healthcare system before implementing RTH. They should increase number of hospitals, facilities in local hospital, doctors and paramedical staff. There is no significance of these type of bill without upgrade the local level healthcare system. In this article, we provided an overview of RTH Act with its critical analysis. The main work of this article is proposed queueing model, i.e. M/M/S queueing model. Here we provided key performance measures that will help in manpower planning. The key performance measures provide us a strong base to upgrade healthcare system. This research work provides a valuable support for decision making and corresponding future research.

Social Impact of the Proposed Work

The impact and utility of this Proposed work are as follows:

- This work is directly connected to common people and their health requirements and provides some useful modification in decision making process
- This work will analyze that how Queueing Theory offers valuable insights into resource allocation, wait time reduction, and overall efficiency enhancement in healthcare sectors
- This work will provide a base for decision support system with valuable data and methodology
- This work will provide optimization model of queueing with quality service guarantee in management
- This work will lead a valuable contribution in solving realistic problems and help to the policymakers and planners to make better decisions

Acknowledgement

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