Research paper on use of operation research in Healthcare

Akarshita Agarwal, Amogh Vikram, Ananya Mathur ,
Arushee Dhawan, Saumil Sharma
Submitted to- Medha Mone Godase

I.   INTRODUCTION

OR is a method of analysis that helps management in making decisions. OR covers several qualitative and mathematical models to create effective solutions for overcoming challenges in the development and implementation of health policies. This is especially helpful in situations where the burden of disease is high, but the healthcare system is weak, and resources are limited.

The whole objective of having OR in healthcare is to find interventions, make strong strategies, improve effectiveness, assess the workability of interventions in specific population groups or settings, and advocate policy change. It can lead to a better health system in terms of 4A's – accessibility, affordability, availability, acceptability.

Several factors like rise in healthcare expenditures force growing pressures to improve efficiency in the healthcare industry, operations research can be effectively used for this aim.

The models which we are focusing on in this paper are Queuing model and simulation model
The queuing system improves resource allocation and lowers patient wait times before seeing a doctor. The use of the principle of the queuing principle in the construction of a model is that it provides effective performance measures of service structures in hospitals. The frequency and pattern of arrivals,
availability of medical services on time, and the preferred mode of transportation and the availability of information technology are factors that affect the performance of an appointment system.
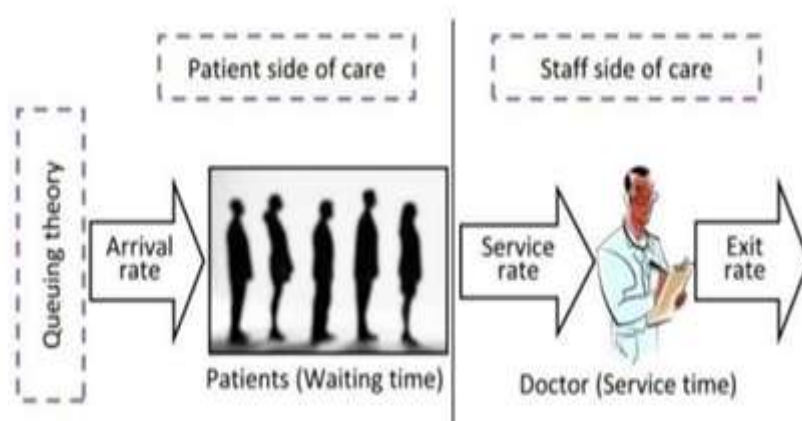

Figure 2 General flow chart of Queue system in hospitals

A linear data structure, or more specifically, a sequential collection is an example of queuing. Queue is used in operations research to store and hold diverse entities such as data, objects, people, and events to be handled later on the computer.

In the literature, researchers have used a combination of operations research and simulation to decrease complexities and increase patient flow. This combination method aids in the identification of various crucial elements that influence patient flow in hospitals, as well as the optimization of bed use by eliminating bed blocking. The flow patterns are first analysed using queuing networks, and then the flow is maximised using discrete event simulation. After that, bed reallocation can be done via queuing network analysis. The model uses simulation to maximise flow and predict waiting times; specifically, the ARENA simulation tool was used in this study. The restriction is that a big simulation model must be evaluated before it can be validated with real-world data. This may necessitate a lengthy warm-up process, which is inconvenient.

whereas Simulation is especially effective when there are large uncertainties in a problem that require stochastic analysis. It's also a great model for doing what-if analyses. Simulation is commonly used to analyse a system's performance under normal and abnormal conditions, to evaluate alternative techniques to discover the best solution, and to aid decision-making.

Real-life application of simulation technique

Cancer screening modelling has been the most widely used of all DES screening models. It's worth noting that breast cancer screening is the most common sort of cancer modelling, accounting for half of all cancer models. The cost and health consequences of various mammographic follow-up regimens, alternate breast cancer screening programs, and routine performance were investigated using DES.

II. LITERATURE REVIEW IN THE IMPLEMENTATION OF HEALTHCARE

Communication among the various specialties in the system was improved by the introduction of a bed management system. As a result, patient flow increased. To make the programme functional, researchers used a combination of operation and research and simulation to reduce the complexities and optimise the patient flow. This combined approach helps in identifying several Before the use of Operation and

research in healthcare, the increase in chronic diseases in the environment leads to the need for better disease prevention, diagnostic, treatment planning, and proactive care. Patients were very concerned for healthcare safety and traceability. For that reason, the recent development of advanced medical technologies makes the systems approach much possible. The availability of health-related data continues to increase, enabling better disease prevention, diagnosis and the operation of the health system. Nowadays, OR and Industrial Engineering conferences often have very popular sessions in healthcare such as surgery planning/scheduling, nurse rostering, bed allocation, emergency department analysis, ambulance location/dispatching, and so on.

The required number of beds to meet the demand is a repetitive problem in bed management. According to that, hospital capacity planning is a well-researched problem in healthcare. Several practices should be followed to find a solution to this problem based on different concepts. Oliveira et al. utilized a data mining tool to identify data about patient management to provide decision-makers with critical information to aid their decisions. OR is well-established in India and is a key component of global and local tuberculosis (TB) control agendas. India is responsible for a quarter of the global TB burden and new cases. The use of operation and research in India was first done in the tuberculosis care division, in collaboration with the Central TB Division, Ministry of Health & Family Welfare, Government of India, International Union Against Tuberculosis and Lung Disease (The Union) organized an Operational Research (OR) Dissemination workshop with technical, implementing and funding partners in August 2013.

Recently, Tortorella et al. By adopting different methods, coordinating and communicating to increase the bed replacement time, check the bed management in detail. A key factor affecting patient flow in hospitals or balancing bed occupancy by reducing bed congestion.

The research papers that we took reference from discussed the situation of healthcare without OR and how significantly it affected the current modern approach. It emphasizes the quality and inventory control problems that were faced in hospitals.

Because of Increasing health expenditures in the world, healthcare research is a very hot topic. Gorunescu et al. took a broader approach,

using queuing theory to illustrate patient flow in order to develop a method for improving hospital resource utilisation. They used the M/PH/c queue, in which M stands for Poisson arrivals, PH stands for service distribution (i.e. phase-type), and c stands for bed count. The study provides a way to determine the optimal number of beds by giving patients an adequate level of discharges.The finding suggested that a level of 10-15% bed vacancy is important to maintain administration productivity.

To manage the supply and demand for inpatient services across the system, Lovett et al reported an innovative approach that integrates multiple services into a single patient flow management centre. This process helps improve communication, coordination and accountability. It's worth noting that, while researchers are looking into various bed management practises, there are so many other models that deserve to be discussed.

III. ANALYSIS AND FINDING ON THE EXPLORATION OF OUR TOPIC

Based on our research, as mentioned in literature, see our perspective or is that it has played a very crucial role in the progress of modern health. The entire goal of having or in medical assistance is to find interventions, make strong strategies and improve efficacy. Since the investigation into operations makes use of advanced analytical methods, such as simulation, queue, optimization, etc., provides a better understanding of complex systems and, therefore, helps in the decision-making process.

Use of techniques as the queue proved to be useful for managing the patient's flow that reduces waiting time, but also further alleviates the bed assignment process to patients. With the increasing availability of medical data or can now be used to understand diseases and ensure disease prevention. Our research document focuses on the prevention and treatment of tuberculosis. This article mentions the use of mining techniques for the prevention of TB. India is the largest load creator of the TB cases which has implemented techniques to reduce the load.

The need to or to examine the most recent areas that have been added to the revised tuberculosis control program (RNTCP), such as the TB Drug Resistant TB, TB HIV and Pediatric TB, has been emphasized in socio- cultural and economic factors. A wide range of problems has been highlighted during this national level meeting, given the range and depth of the experts present. New trends in medicine will provide opportunities for the development and application of ISE

methods, in the areas of patient behavior, natural history of diseases and medical interventions.

Furthermore, paying attention to these common decision-making problems, requests are also considered a wide range of other applications for the approach proposed in this study.

IV. CONCLUSION, LIMITATIONS AND RECOMMENDATIONS

Different types of literature have been reviewed to define medical care problems and address them with the application of Or. These use different optimization techniques in different areas of the sector.

Bed administration is a complex theme in the health system. However, current literature has addressed the problem from more perspectives. Here, several ways have been designed to resolve bed management using queuing and simulation techniques in OR.

While the review is limited to the administration of the bed, queuing and simulation, there are many other documented examples to resolve the management of beds with different techniques. Therefore, there is a lot of research, and it is fine to mention that a successful bed management strategy is complex and should be judiciously managed. Administration and staff must be educated more, and consciousness is needed to use different software for the administration of the bed. The research must continue in this sector to determine the best practices for the management of beds.

The application of business research has greatly improved the treatment of medical patients. Of all the areas of operations research that provide medical services, this area is possibly the fastest growing area. These models/techniques form the basis for artificial intelligence, management information systems, and decision support systems. However, doctors manage to use expert systems or other DSS models for diagnosis or treatment. Of course, when others are in research mode, there may be a reason to adopt certain innovations. The purpose of current and future research is to examine this clinical process in order to understand the dynamics of adoption and dissemination. As knowledge increases, knowledge systems based on operations research become more useful for general practitioners.

The increasing capacity and installation of health systems in hospitals and healthcare practices are increasingly possible to collect and organize the data necessary to create and implement OR methodologies.

However, surgical experts are needed to

help develop these systems to determine the appropriate data and develop processes for collecting and using that data to advance the methodology. Sometimes, the process of conducting research in a medical institution may produce the required IT skills.This happened subsequent to an ED physician staffing project (Green et al) where, as a result of the research, the hospital introduced a new electronic data collection system to record physician delays.

Another important area where techniques of operations research are largely applied is in the treatment of Tuberculosis. TB is prevalent in most parts of India, especially the highly populated cities. People in slums and other poverty-driven areas are most prone to the disease as they lack sanitation, clean water, and other basic amenities and usually live-in overcrowded areas. Therefore, the need and requirement for ease in TB treatment in such areas have been increasing. OR techniques are highly used in diagnosis, cure, and control of the same.

However, a few recommendations to enhance the use of OR in TB can be

• Improved diagnosis and clarity in classification and definitionof cure:

Operational search models that factor in possible losses on the road between symptoms and cure will help us identify pressure points in systems that surround the technology. It would also be useful to shape the effects on the new transmission rates for the early diagnosis of TB in children. Technologies, such as Geographic Information Systems (GIS), combined with infectious disease modelling, are potentially useful for identifying transmission access points.

• Better infection control:

Systems to accelerate the progress of smear-positive individuals need to consider the caseloads at different facilities. Models could help us to recognise and to have a clear idea of the transmission dynamics (especially of M/XDR-TB) within facilities and the probability of future transmission in the community.

Talking about business applications, these techniques enable a hospital to treat its patient more efficiently, meet performance targets and manage costs. The increasing cost of operations and maintenance, and healthcare costs to the patients due to the use of newer technologies, resources, and methods have added newer dimensions as constraints to the problems of the healthcare system.

REFERENCES

1. Boaden, R., Proudlove, N., & Wilson, M., 1999, "An exploratory study of bed management," Journal of Management in Medicine, 13(4), 234 250.
2. Cudney, E. A., Elrod, C. C., & Stanley, S. M., 2014, "A systematic literature review of Six Sigma practices in education," International Journal of Six Sigma and Competitive Advantage, 8(3), 163-175.
3. Cardoen, B., Demeulemeester, E., & Beliën, J., 2010, "Operating room planning and scheduling: A literature review," European Journal of Operational Research, 201(3), 921-932.
4. Cayirli, T., & Veral, E., 2003, "Outpatient scheduling in health care: a review of literature," Production and Operations Management, 12(4), 519-549.
5. Kim, S. C., Horowitz, I., Young, K. K., & Buckley, T. A. (1999). Analysis of capacity management of the intensive care unit in a hospital. European Journal of Operational Research, 115(1), 36-46.
6. McClean, S. I., & Millard, P. H., 1998, "A three compartment model of the patient flows in a geriatric department: a decision support approach," Health care management science, 1(2), 159-163.
7. Operations research in healthcare Xiaolan Xie Centre for Biomedical & Healthcare Engineering & CNRS UMR 6158 LIMOS, Ecole Nationale Supérieure des Mines de Saint Etienne, France.
8. Allen, A.O., 1978, Probability, statistics and queueing theory, with computer science applications. New York, Academic Press.
9. Brecher, C. and Speizio, S., 1995, Privatization and Public Hospitals, Twentieth Century Fund Press, N.Y. Brewton, J.P., 1989, Teller staffing models, Financial Manager's Statement, July-August: 22- 24.
10. Brigandi, A.J., Dargon, D.R., Sheehan, M.J. and Spencer III, T., 1994, AT&T's call processing simulator (CAPS) operational design for inbound call centers, Interfaces 24: 6- 28
11. Ameh, N., Sabo, B., &Oyefabi, M. O. (2013). 'Application of queuing theory to patient satisfaction at a tertiary hospital in Nigeria', Nigerian medical journal: journal of the Nigeria Medical Association, Vol.54, No.1, pp.64.

Plagiarism report from introduction to literature review

SmallSEOTools

PLAGIARISM SCAN REPORT

Words	997	Date	September 12, 2021
Characters	6933	Excluded URL	

0% Plagiarism	100% Unique	0 Plagiarized Sentences	50 Unique Sentences

Content Checked For Plagiarism

OR is a method of analysis that helps management in making decisions. OR covers several qualitative and mathematical models to create effective solutions for overcoming challenges in the development and implementation of health policies. This is especially helpful in situations where the burden of disease is high, but the healthcare system is weak, and resources are limited.

The whole objective of having OR in healthcare is to find interventions, make strong strategies, improve effectiveness, assess the workability of interventions in specific population groups or settings, and advocate policy change. It can lead to a better health system in terms of 4A's â€" accessibility, affordability, availability, acceptability.
Several factors like rise in healthcare expenditures force growing pressures to improve efficiency in the healthcare industry, operations research can be effectively used for this aim.

The models which we are focusing on in this paper are Queuing model and simulation model

The queuing system improves resource allocation and lowers patient wait times before seeing a doctor. The use of the principle of the queuing principle in the construction of a model is that it provides effective performance measures of service structures in hospitals. The frequency and pattern of arrivals, availability of medical services on time, and the preferred mode of transportation and the availability of information technology are factors that affect the performance of an appointment system.

A linear data structure, or more specifically, a sequential collection is an example of queuing. Queue is used in operations research to store and hold diverse entities such as data, objects, people, and events to be handled later on the computer.

In the literature, researchers have used a combination of operations research and simulation to decrease complexities and increase patient flow. This combination method aids in the identification of various crucial elements that influence patient flow in hospitals, as well as the optimization of bed use by eliminating bed blocking. The flow patterns are first analysed using queuing networks, and then the flow is maximised using discrete event simulation. After that, bed reallocation can be done via queuing network analysis. The model uses simulation to maximise flow and predict waiting times; specifically, the ARENA simulation tool was used in this study. The restriction is that a big simulation model must be evaluated before it can be validated with real-world data. This may necessitate a lengthy warm-up process, which is inconvenient.

whereas Simulation is especially effective when there are large uncertainties in a problem that require stochastic analysis. It's also a great model for doing what-if analyses. Simulation is commonly used to analyse a system's performance under normal and abnormal conditions, to evaluate alternative techniques to discover the best solution,

Plagiarism report from analysis and finding to conclusion

SmallSEOTools

PLAGIARISM SCAN REPORT

Words	965	Date	September 12, 2021
Characters	6485	Excluded URL	

2% Plagiarism	98% Unique	1 Plagiarized Sentences	47 Unique Sentences

Content Checked For Plagiarism

Analysis and findings on our exploration of the topic

Based on our research, as mentioned in literature, see our perspective or is that it has played a very crucial role in the progress of modern health. The entire goal of having or in medical assistance is to find interventions, make strong strategies and improve efficacy. Since the investigation into operations makes use of advanced analytical methods, such as simulation, queue, optimization, etc., provides a better understanding of complex systems and, therefore, helps in the decision-making process.

Use of techniques as the queue proved to be useful for managing the patient's flow that reduces waiting time, but also further alleviates the bed assignment process to patients. With the increasing availability of medical data or can now be used to understand diseases and ensure disease prevention. Our research document focuses on the prevention and treatment of tuberculosis. This article mentions the use of mining techniques for the prevention of TB. India is the largest load creator of the TB cases which has implemented techniques to reduce the load.

The need to or to examine the most recent areas that have been added to the revised tuberculosis control program (RNTCP), such as the TB Drug Resistant TB, TB HIV and Pediatric TB, has been emphasized in socio-cultural and economic factors. A wide range of problems has been highlighted during this national level meeting, given the range and depth of the experts present. New trends in medicine will provide opportunities for the development and application of ISE methods, in the areas of patient behavior, natural history of diseases and medical interventions.

Furthermore, paying attention to these common decision-making problems, requests are also considered a wide range of other applications for the approach proposed in this study.

Conclusion, limitations, and recommendations

Different types of literature have been reviewed to define medical care problems and address them with the application of Or. These use different optimization techniques in different areas of the sector.

Bed administration is a complex theme in the health system. However, current literature has addressed the problem from more perspectives. Here, several ways have been designed to resolve bed management using queuing and simulation techniques in OR.

While the review is limited to the administration of the bed, queuing and simulation, there are many other documented examples to resolve the management of beds with different techniques. Therefore, there is a lot of research, and it is fine to mention that a successful bed management strategy is complex and should be judiciously managed. Administration and staff must be educated more, and consciousness is needed to use different software for the administration of the bed. The research must continue in this sector to determine the best practices for the management of beds.

The application of business research has greatly improved the treatment of medical patients. Of all the areas of operations research that provide medical services, this area is possibly the fastest growing area. These models/techniques form the basis for artificial intelligence, management information systems, and decision support