Analysis of the Outdoor Patient Service Operation of Bangabandhu Sheikh Mujib Medical University Using Simulation Approach

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This Report Presented in Partial Fulfillment of the Requirements for the Degree of Master of Science in Management Information System.

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APPROVAL

This Project titled **"Analysis of The Outdoor Patient Service Operation of Bangabandhu Sheikh Mujib Medical University Using Simulation Approach"**submitte by Rakib Hasan Shimul (ID:**172-17-350**) to the Department of Management Information System, Daffodil International University, has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of MIS in Management Information System and approved as to its style and contents. The presentation has been held on 12 December, 2018.

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DECLARATION

I am declare that, this project has been done by me under the supervision **of Dr.Sheak Rashed Haidar Noori ,Assistant Professor, Department of CSE,** Daffodil International University. I also declare that neither this project nor any part of this project has been submitted elsewhere for award of any degree or diploma.

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ABSTRACT

Bangabandhu Sheikh Mujib Medical University (BSMMU) is the premier Postgraduate Medical Institution of the country. It has an enviable reputation for providing high quality postgraduate education in different specialties. BSMMU offers both in-patient service and out-patient service. Daily a large number of patients come to this hospital for treatment. These patients are happy with the doctor’s service.

This thesis report attempts to give an idea about the present condition of the outdoor patient service of dental OPD. Analysis of the current outdoor patients operation and to suggest some ways to make improvement of the outdoor patient service.

After visiting the dental OPD of BSMMU the researcher finds that the patients are satisfied with the doctor’s service but there are certain problems like the patients had to wait for a long time in the registration queue and in waiting room for the doctor’s arrival. These improvements can be made by some necessary steps like increasing the registration staff so that the patients don’t have to wait for so long in the queue. If the doctor arrives in time then the waiting time in the waiting room of the patients will decrease.

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CHAPTER 1
Introduction

1.1 Introduction

During the past few decades, there has been reawakening that health is a fundamental human right and a worldwide social goal; that it is essential to the satisfaction of basic human needs and to improve the productivity of nations. However it was recognized that in both developed and developing countries, the standard of the public health expected has not yet been achieved. The concept of quality services in the health care system has been introduced first in developed nations. However, this is rapidly becoming a global issue. Now more and more countries are focusing their attention on health care quality because of the concern that health care is costly, and therefore, needs to be dispensed appropriately and equitably with minimum variation. The last 20 years have witnessed an accelerating increase in attention given to patient satisfaction within health services.

Now a days, patients are looking for hassle free and quick services. This demand is only possible with optimum utility of the resources through multitasking in a single window system of the OPD.

For every hospital, patients are the main users. The primary function of the hospital is patient care. It is one of the yardsticks to measure the success of services that it produces. Effectiveness of the hospital relates to provision of good patient care as intended. Patient satisfaction is the real testimony to the efficiency of hospital administration. As the hospital serves all the members of the society, the expectations of the users differ from one individual to another individual because everyone carries a particular set of thoughts, feelings and needs. Hence determination of patient’s real feelings is very difficult. It is the responsibility of the administrator team. "Put yourself in your patient's shoes," was a proverb that explains how to proceed with a patient. Living in the world of information and technology, nowadays patients are aware of their needs and rights. They know that health care facilities are established to provide satisfactory and quality health services to them. If the health care facilities fail to do so, they are considered unsuccessful in implementing their assigned tasks.

This research is conducted in the dental OPD of Bangabandhu Sheikh Mujib Medical University and the registration booth because dental OPD is having more patients, quite crowded and some complains from this OPD as the information is gathered by me for 10 days visit to this department and provided by one staff working there.

1.2 Objective

- Analyse the current outdoor patients operation of dental OPD.
- To suggest improvements of the outdoor patient service of OPD of BSMMU.

1.3 Rationale of Study

This study is done to analysis the outdoor patient service of the dental OPD of BSMMU. After visiting the dental OPD of BSMMU and analysing the department it was clear the patients are not satisfied because they have to wait for a long time in the registration queue and in the waiting room for the doctor. These problems can solve by increasing the registration staff. The waiting time in waiting room can be decrease if the doctors come to their chamber in time.

1.4 Methodology

The researcher used survey questionnaire method (sample- 50 patients) to identify the present condition of the outdoor patient service operation of the dental OPD. Also observation method was used to collect data on the outdoor operation for 10 days to gather survey data. Through frequently observing data were analyse using queuing model and Any Logic simulation software.

1.5 Limitations of Study

Problems that I faced during this research are—

- The staffs of the hospital maintain confidentiality. They don't provide any data about the patients. It is possible to get only if any staff of that unit is well known to the researcher.
- During data collection, it was tough to get information about are the patients satisfied with the service of the hospital because the staffs didn't allow me talk with the patient in hospital premises.

1.6 Operational Definitions

Out Patient Department (OPD) referred to the hospital unit where a patient was attended for treatment or consultation and did not stay overnight in the hospital.

Registration Staff Services referred to the courtesy paid by the registration staff, their good communication skills etc.

Doctor's Service referred to the courtesy and respect of a doctor for patient and time spent by doctor in physical examination, history taking.

Accessibility to Services meant how comfortable it is to access the services in terms of waiting time, service process and working hours of OPD.

Patient Satisfaction referred to patient's feelings about hospital services at dental OPD of Bangabandhu Sheikh Mujib Medical University.

Working hours of OPD referred to the time for getting health services from dental OPD.

Waiting time included waiting time for registration, doctor and total time spent in

CHAPTER 2
SIMULATION & QUEUING THEORY

2.1 Literature Review

The topics of the literature review included-

- Simulation
- Queuing Theory
- AnyLogic

2.2 Simulation

Simulation is acting out or mimicking an actual or probable real life condition, event or situation to find a cause of a past occurrence (such as an accident) or to forecast future effects (outcomes) of assumed circumstances or factors. Simulation is an indispensable problem solving methodology for the solution of many real-world problems. Simulation is used to and analysis and describe the behaviour of a system, ask what-if questions about the real system and aid in the design of real system.

There are several concepts underlying simulation. These include system and model. System is a set of detailed methods, procedures and routines created to carry out a specific activity, perform a duty, or solve a problem. For examplea manufacturing system comprises of a number of departments such as production control department, purchase department, fabrication, assembly, finishing, packaging; inspection and quality control, shipping and personnel department etc. All of these departments are interlinked to maintain the proper flow of the materials and information. These components of the manufacturing system are individually very complicated and the system as a whole becomes very complex.

A model is a representation of an actual system. There is a concern about the limits of the model that supposedly represent the system. The model should be complex enough to answer the questions raised, but not too complex. An event is an occurrence that changes the state of system. Modeling is a way we can solve real-world problems. In many cases, we can't afford to experiment with real objects to find the right solutions: building, destroying, and making changes may be too expensive, dangerous, or just impossible. If that's the case, we can build a model that uses a modeling language to represent the real system. Modeling is about finding the way from the problem to its solution through a risk-free world where we're allowed to make mistakes, undo things, go back in time, and start over again.

2.2.1 Types of Simulation Models

- Static Simulation Model
- Dynamic Simulation Model
- Deterministic Simulation Model
- Stochastic Simulation Model
- Continuous Simulation Model
- Discrete Simulation Model

Static simulation model represents a system, which does not change with time or represents the system at a particular point in time. Static simulation is also sometimes called Monte-Carlo Simulation. These models do not take variable time into consideration. These models describe systems which are both stochastic and static.

2.2.2 Real Time Simulation

In many situations, the simulation of the complete system is either highly complicated or is not desirable form the application point of view. An actual physical part of the system is integrated with a computer, which simulates the parts of the system that do not exist or that cannot conveniently be used in the experiment. Such systems usually involve interaction with a human being thereby avoiding the need to design and validate a model of human behaviour. The aircraft cockpit simulator for the training of pilots and the simulated zero gravity chambers for the training of astronauts are examples of real-time simulators. These systems are called real time because the time taken by the experiment will be real that is the same as in case of a completely physical system.

2.2.3 Modeling and Simulation Modelling

Modeling is a way we can solve real-world problems. In many cases, we can't afford to experiment with real objects to find the right solutions: building, destroying, and making changes may be too expensive, dangerous, or just impossible. If that's the case, we can build a model that uses a modeling language to represent the real system. This process assumes abstraction: we include the details we believe are important and leave aside those we think aren't important. The model is always less complex than the original system. The model-building phases - mapping the real world to the world of models, choosing the abstraction level, and choosing the modelling language - are all less formal than the process of using models to solve problems. It's still more an art than a science. After we've built the model – and sometimes even as we build it – we can start to explore and understand our system's structure and behavior, test how it will behave under a variety of conditions, play and compare scenarios, and optimize. After we find our solution, we can map it to the real world. Modeling is about finding the way from the problem to its solution through a risk-free world where we're allowed to make mistakes, undo things, go back in time, and start over again.

2.2.4 Types of Models

There are many types of models, including the models we all use to understand how things work in the real world: friends, family, colleagues, car drivers, the town where we live, the things that we buy, the economy, sports, and politics. All of our decisions - what we should say to our child, what we should eat for breakfast, who we should vote for, or where we should take our girlfriend to dinner - are all based on mental models. Computers are powerful modeling tools, and they offer us a flexible virtual world where we can create nearly anything imaginable. Of course, there are many typesof computer models, from basic spreadsheets that allow anyone to model expenses to complex simulation modeling tools that help experienced users explore dynamic systems such as consumer markets and battlefields.

Analytical vs. simulation modelling Ask a major organization's strategic planning, sales forecasting, logistics, marketing, or project management teams to name their favourite modeling tool, and you'll quickly find Microsoft Excel is the most popular answer. Excel has several advantages: it's widely available, it's very easy to use, and it allows you to add scripts to your formulas as your spreadsheet's logic becomes increasingly sophisticated.

A simulation model is always an executable model: running it builds you a trajectory of the system's state changes. Think of a simulation model as a set of rules that tell you how to move from a system’s current state to a future state. The rules can take many forms, including differential equations, statecharts, process flowcharts, and schedules. The model's outputs are produced and observed as the model runs. Simulation modeling requires special software tools that use simulation-specific languages. While you’ll need training to do simulation modeling well, your time and effort are rewarded when your model offers a high quality analysis of a dynamic system.

2.2.5 When to Use Simulation

Following are some of the purposes for which simulation may be used-

- Simulation is very useful for experiments with the internal interactions of a complex system, or of a subsystem within a complex system.
- Simulation can be employed to experiment with new designs and policies, before implementing them.
- Simulation can be used to verify the results obtained by analytical methods and to reinforce the analytical techniques.
- Simulation is very useful in determining the influence of changes in input variables on the output of the system.
- Simulation helps in suggesting modifications in the system under investigation for its optimal performance.

2.2.6 Steps in Simulation Study

Like any other problem solving approach, simulation is also carried efficiently, if it is done in a predetermined orderly manner. The total procedure has been divided into different number of steps by different authors. In general a simulation study can be divided into following prominent steps:

- Problem formulation
- Model construction
- Data collection
- Model programming
- Validation
- Design of experiment
- Simulation run and analysis
- Documentation
- Implementation

2.2.7 Advantages and Disadvantages of Simulation

Advantages

- In the real system, the changes we want to study may take place too slowly or too fast to be observed conveniently. Computer simulation can compress the performance of system over years into a few minutes of computer running time.
- Through simulation, management can foresee the difficulties and bottlenecks, which may come up due to the introduction of new machines, equipment and processes. It thus eliminates the need of costly trial and error method of trying out the new concepts.
- Simulation being relatively free from mathematics can easily be understood by the operating personnel and non-technical managers. This helps in getting the proposed plans accepted and implemented.
- Simulation models are comparatively flexible, easier and can be modified to accommodate the changing environment to the real situation.
- Simulation technique is easier to use than the mathematical models, and can be used for a wide range of situations.
- Extensive computer software packages are available, making it so much convenient to use fairly sophisticated simulation models.
- Simulation is a very good tool of training and has advantageously been used for training the operating and managerial staff in the operation of complex systems. Airline pilots are given extensive training on flight simulators, before they are allowed to handle real aero planes.

Disadvantages

- Simulation does not produce optimum results. When the model deals with uncertainties, the results of simulation are only reliable estimates subject to statistical errors.
- Quantification of the variables is another difficulty. In a number of situations, it is not possible to quantity all the variables that affect the behavior of the system.
- In very large and complex problems, the large number of variables, and the inter-relationships between them make the problem very unwieldy.
- Simulation is by no means a cheap method of analysis. Even small simulations take considerable computer time. In a number of situations, simulation is comparatively costlier and time consuming.
- Another important limitation stem from too much tendency to rely on the simulation models.
- This results in applications of the technique to some simple situations, which can more appropriately be handled by other techniques of mathematical programming.

2.2.8 Areas of Simulation Applications

Simulation modeling has accumulated a large number of success stories in a wide and diverse range of application areas. As new modeling methods and technologies emerge and computer power grows, you can expect simulation modeling to enter an ever-larger number of areas.

The figure above shows a number of simulation applications, all sorted by the abstraction level of the corresponding models.

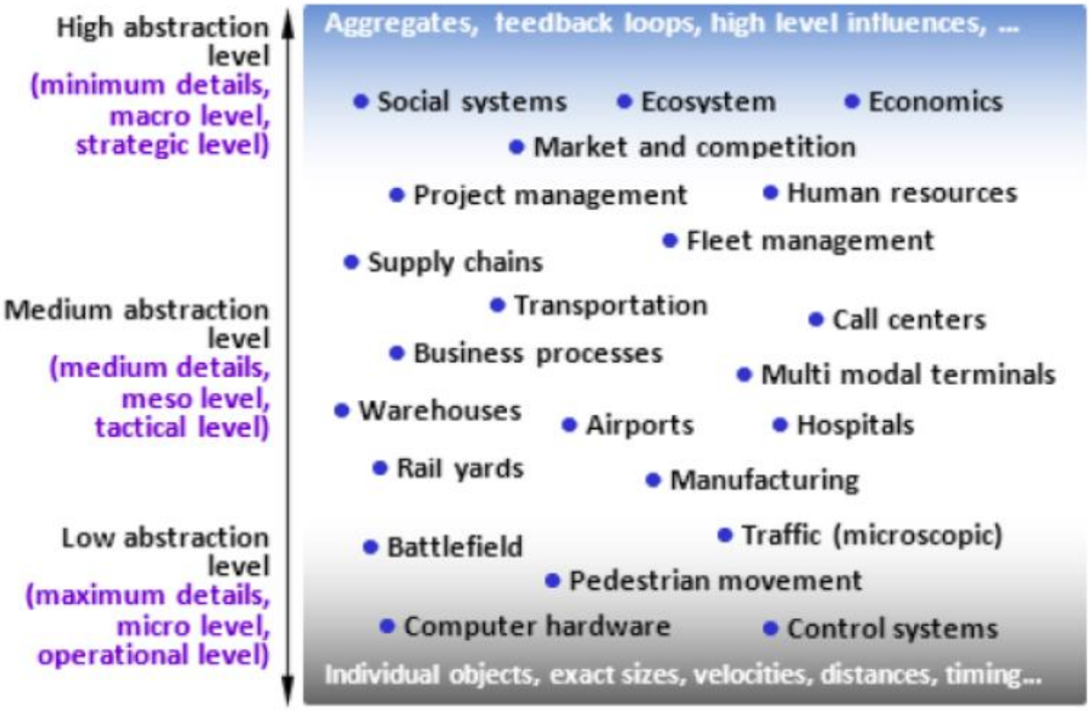

Fig 01: Applications Area of Simulation

At the bottom are the physical-level models that use highly-detailed representations of real-world objects. At this level, we care about physical interaction, dimensions, velocities, distances, and timings. An automobile's antilock brakes, the evacuation of football fans from a stadium, the traffic at an intersection controlled by a traffic light, and soldiers' actions on the battlefield are examples of problems that require low abstraction modeling.

The models at the top are highly abstract, and they typically use aggregates such as consumer populations and employment statistics rather than individual objects. Since their objects interact at a high level, they can help us understand relationships - such as how the money our company spends on advertising influences our sales - without requiring us to model intermediate steps.

Other models have an intermediate abstraction level. If we model a hospital's emergency department, we may care about physical space if we want to know how long it takes for someone to walk from the emergency room to an x-ray station, but the physical interaction among people in the building is irrelevant because we assume the building is uncongested.

In a model of a business process or a call center, we can model operations' sequence and duration rather than their location. In a transportation model, we carefully consider truck or rail car speed, but in a higher level supply chain model, we simply assume an order takes between seven and ten days to arrive.

Some of the areas in which simulation can be successfully employed are listed below-

- **Manufacturing:** Design analysis and optimization of production system, materials management, capacity planning, layout planning, and performance evaluation, evaluation of process quality.
- **Business:** Market analysis, prediction of consumer behavior, and optimization of marketing strategy and logistics, comparative evaluation of marketing campaigns.
- **Military:** Testing of alternative combat strategies, air operations, sea operations, simulated war exercises, practicing ordinance effectiveness, and inventory management.
- **Health care applications:** such as planning of health services, expected patient density, facilities requirement, hospital staffing, estimating the effectiveness of a health care program.
- **Communication applications:** such as network design, and optimization, evaluating network reliability, manpower planning, sizing of message buffers.
- **Computer applications:** such as designing hardware configurations and operating system protocols, sharing and networking.
- **Economic applications:** such as portfolio management, forecasting impact of Govt. Policies and international market fluctuations on the economy. Budgeting and forecasting market fluctuations.
- **Transportation applications:** Design and testing of alternative transportation policies, transportation networks - roads, railways, airways etc. Evaluation of timetables, traffic planning.
- **Environmental application:** Solid waste management, performance evaluation of environmental programs, evaluation of pollution control systems.
- **Biological applications:** such as population genetics and spread of epidemics. (4)

2.3 AnyLogic

AnyLogic is a multi-method simulation modelling software developed by The AnyLogic Company It supports agent-based, discrete event, and system dynamics simulation methodologies. It is a cross-platform simulation software .It works on Windows, macOS and Linux. AnyLogic simulation software is used to simulate markets and competition, healthcare, manufacturing, supply chains and logistics, retail, business processes , social and ecosystem dynamics, defence, project and asset management, pedestrian dynamics and road traffic, IT, aerospace.

2.3.1 Simulation Language

The AnyLogic simulation language consists of following items:

Stock & Flow Diagrams used for System Dynamics modeling.

Statecharts are used mostly in Agent Based modeling to define agent behavior. They are also often used in Discrete Event modeling, e.g. to simulate machine failure.

Action charts are used to define algorithms. They may be used in Discrete Event modeling, e.g. for call routing, or in Agent Based modeling, e.g. for agent decision logic.

Process flowcharts are the basic construction used to define process in Discrete Event modeling. Looking at this flowchart you may see why Discrete Event style is often called Process Centric

2.3.2 AnyLogic Libraries

AnyLogic includes the following standard libraries:

- Process Modeling Library
- Pedestrian Library
- Rail Library
- Road Traffic Library
- Fluid Library

Process Modeling Library is designed to support DE simulation in Manufacturing, Supply Chain, Logistics and Healthcare areas. Using the Process Modeling Library objects you can model real-world systems in terms of entities (transactions, customers, products, parts, vehicles, etc.), processes (sequences of operations typically involving queues, delays, resource utilization), and resources.

Pedestrian Library is dedicated to simulate pedestrian flows in “physical” environment. It allows creating models of pedestrian buildings (like subway stations, security checks etc.) or streets (big number of pedestrians).

Rail Library supports modeling, simulating, and visualizing operations of a rail yard of any complexity and scale. The rail yard models can be combined with discrete event or agent based models related to: loading and unloading, resource allocation, maintenance, business processes, and other transportation activities.

Road Traffic Library allows you to model, simulate and visualize vehicle traffic. The library supports detailed yet highly efficient physical level modeling of vehicle movement.

Fluid Library allows the user to model storage and transfer of fluids, bulk goods, or large amounts of discrete items, which are not desirable to model as separate objects

The components that are used to build these models are described below

Source generates agents. Is usually a starting point of a process model.

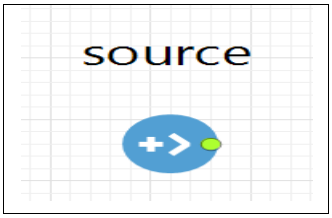

Fig 02: Source

Service seizes a given number of resource units, delays the agent, and releases the seized units. Is equivalent to a sequence Seize, Delay, Release and should be used if the agent does not need to do anything but execute a delay between seize and release. Most of parameters and extension points of these objects are exposed by Service.

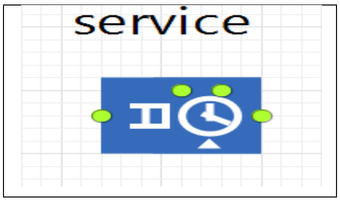

Fig 03: Service

ResourcePool defines a set of resource units that can be seized and released by agents using Seize, Release, Assembler and Service flowchart blocks. The resources can be of three types: static, moving, and portable

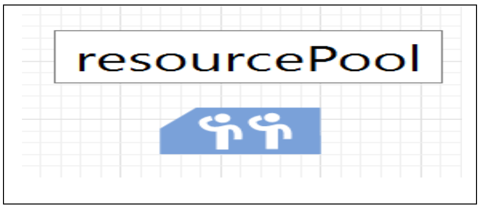

Fig 04: ResourcePool

Sink disposes agents. Is usually an end point in a process model.

Fig 05: Sink

Rectangular node is a space markup element that defines the locations of agents in the space:

- Node defines a place where agents can reside.
- Path defines a movement path for agents.

Nodes can be connected with paths. Altogether they compose a network. In the network, node defines a place where agents may reside, while paths define the routes that agents may take when moving from one node to another.

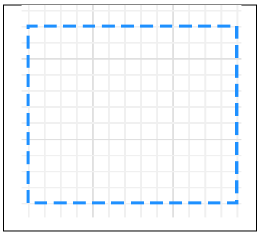

Fig 06: Rectangular Node

Attractor allows controlling agent's location inside a rectangular node or a polygonal node.

- If the node defines the destination of the agent movement (is referred, for instance, by MoveTo), attractors define exact positions inside the node.
-
-
-
- define a destination / location with an attractor:

    1. Source, Split, Assembler, Batch, Enter - location of the agent.

    2. MoveTo, RackPick, ResourceSendTo, Seize, Service - destination for agents / moving resources.

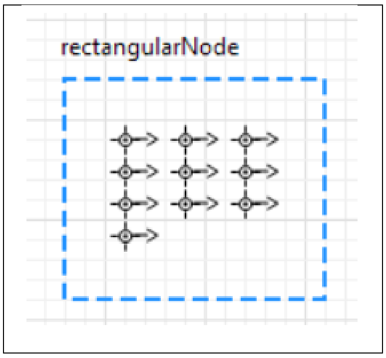

Fig 07: Attractors in rectangular node

3D Object element enables AnyLogic users to import ready-to-use 3D objects created with the help of any third-party 3D graphics packets into their models. 3d objects like chair, table, person and sitting person are also used in these models.

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2.4 Queueing Theory

Waiting line are a part of everyday life. Queueing theory is the mathematical study of waiting lines, or queues. A queueing model is constructed so that queue lengths and waiting time can be predicted .Providing too much service involves excessive costs. And not providing enough service capacity causes the waiting line to become excessively long. The ultimate goal is to achieve an economic balance between the cost of service and the cost associated with the waiting for that service. Queueing theory deals with problems which involve queuing (or waiting). It is extremely useful in predicting and evaluating system performance. Typical examples might be:

- Banks/supermarkets - waiting for service
- Computers - waiting for a response
- Public transport - waiting for a train or a bus

2.4.1 Basic Structure of Queueing Models

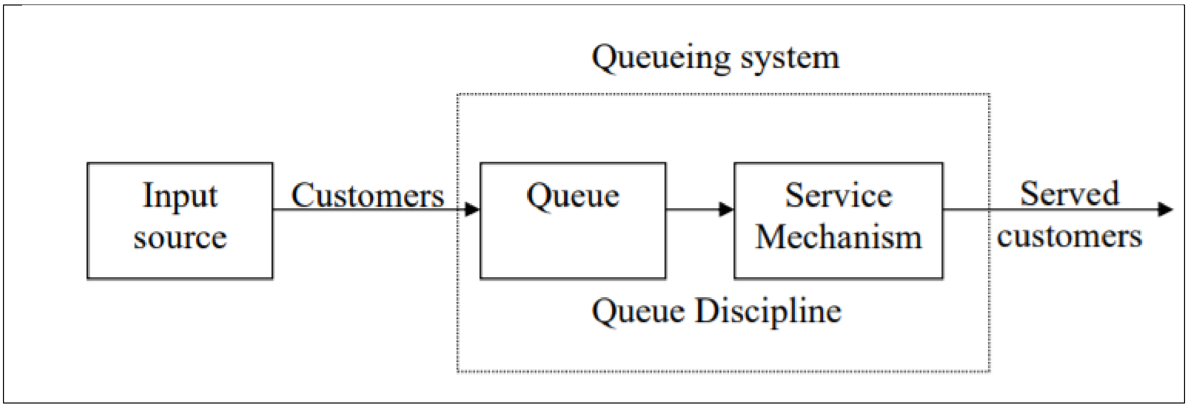

Fig 08: Basic Structure of Queueing Models

Input Source (Calling Population): One characteristic of the input source is its size. The size is the total number of customers. The size may be infinite (default one) or finite**.** Arrival of customer is normally exponential distribution (interarrival time). A customer may be balking, who refuses to enter the system and is lost if the queue is too long.

Queue: The queue is where customers wait before being served. A queue is characterized by the maximum permissible number of customers that it can contain. Queue may be infinite (default one) or finite.

Queue Discipline: Refers to the order in which members of the queue are selected for service. First-come-first-serve is normally used.

Service Mechanism: Consists of one or more service facilities, each of which contains one or more parallel service channels, called servers. At a given facility, the customer enters one of the parallel service channel sand is served by that server. Most elementary models assume one service facility with either one or a finite number of servers.(8)

2.4.2 Queueing System

A queueing system can be described as customers arrive for a given service, wait if the service cannot start immediately and leave after being served. Key elements of queueing systems are described below:

Customer refers to anything that arrives at a facility and requires service, e.g. people, machines, trucks, emails.

Server refers to any resource that provides the requested service, e.g. Repair persons, retrieval machines, runways at airport.

2.4.3 Queue Discipline and Service System

Queuing discipline represents the way the queue is organized (rules of inserting and removing customers to/from the queue). There are these ways:

1) FIFO (First In First Out) also called FCFS (First Come First Serve) - orderly queue.
2) LIFO (Last In First Out) also called LCFS (Last Come First Serve) - stack.
3) SIRO (Serve In Random Order).
4) Priority Queue that may be viewed as a number of queues for various priorities.

Service system represents the number of queue customs are waiting and the number of service facilities. These systems are given below:

1. A single service system where customers are standing in a single queue and only one server is giving them service e.g. Your family dentist's office, Library counter.

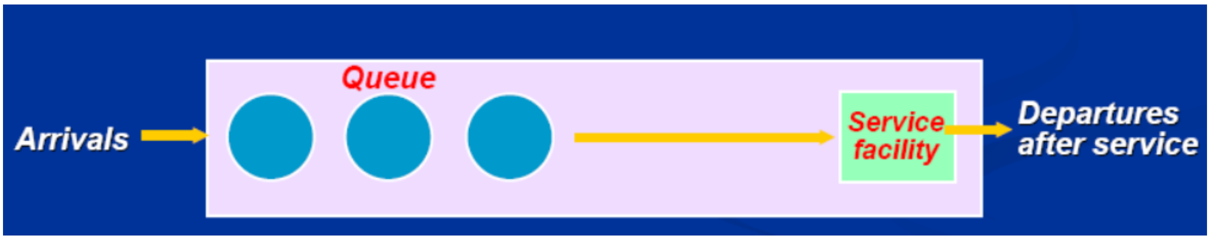

Fig 09: Single service system

2. Multiple, parallel server, single queue service system where customers arrive in single queue and the service is given by multiple servers e.g. booking at a service station.

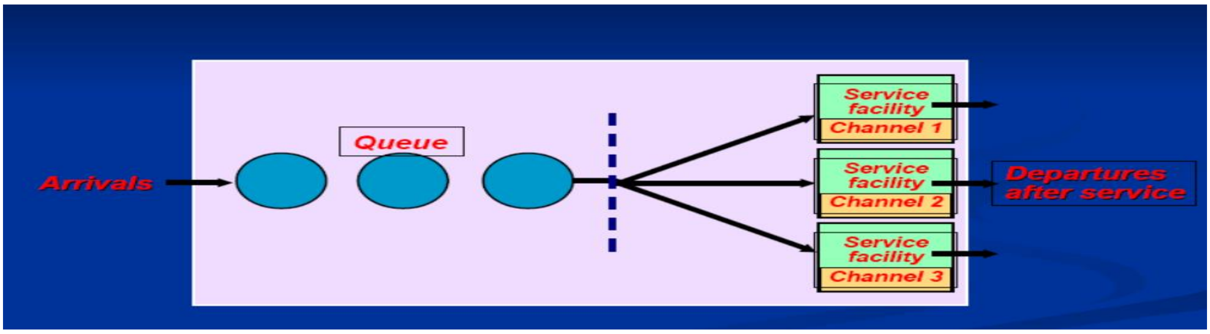

Fig 10: Multiple, parallel server, single queue model service system

3. Multiple, parallel facilities with multiple queues service system where the number of queues for customers and the number of servers are same and operating parallel e.g. Different cash counters in electricity office.

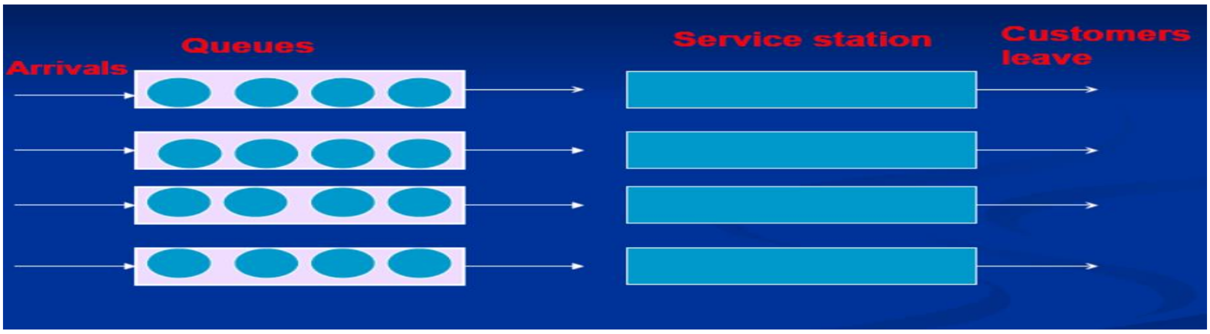

Fig 11: Multiple, parallel facilities with multiple queues service system

2.4.4 Applications of Queueing Theory

Some of the areas in which queueing theory can be successfully employed are listed below-

- Telecommunications
- Traffic control
- Determining the sequence of computer
- Operations
- Predicting computer performance
- Health services .
- Airport traffic, airline ticket sales
- Layout of manufacturing system

2.4.5 Limitations of Queueing Theory

- The assumptions of classical queueing theory may be too restrictive to be able to model real-world situations exactly.

- The complexity of production lines with product-specific characteristics cannot be handled with those models. Often, although the bounds do exist, they can be safely ignored.

- Because the differences between the real-world and theory is not statistically significant, as the probability that such boundary situations might occur is remote compared to the expected normal situation.

CHAPTER 3
ORGANIZATION PROFILE

3.1 Bangabandhu Sheikh Mujib Medical University

Bangabandhu Sheikh Mujib Medical University is the first public medical university in Bangladesh established in 1998. It is the premier Postgraduate Medical Institution of the country. It bears the heritage to Institute of Postgraduate Medical Research (IPGMR) which was established in December 1965. In the year 1998 the Government converted IPGMR into a Medical University for expanding the facilities for higher medical education and research in the country. It has very good reputation for providing high quality postgraduate education in different specialties. The university has strong link with other professional bodies at home and abroad. The university is expanding rapidly, the university has many departments equipped with modern technology for service, teaching and research. Besides education, the university plays the vital role of promoting research activities in various discipline of medicine. It also aims at promoting research appropriate to the development of healthcare services as per national needs as well as for the services of the mankind as a whole. From 2010, many of the medical and public health colleges/institutes have become affiliated to BSMMU. For example, BIRDEM, BIHS, DMC and others. Many foreigners, notably from Nepal and Bhutan, study at the university.

The university runs its own administration & finance with the rules, regulation and assistance set by the University Grant Commission and Ministry of Health and Family Welfare, Government of the People's Republic of Bangladesh.

BSMMU complex has five main multi-storied buildings that are identified as Block-A, Block-B, Block-C, Block-D and Cabin block respectively.

Block-A is a 7 storied building and accommodates the library, lecture theatre, auditorium, hospital record section, students hostel, dental faculty and blood transfusion services.

Block-B is a 6 storied building. It has two wings eastern and western. Its eastern wing accommodates the office of the Vice-Chancellor, administrative block, controller office, reception, conference hall, radiology department, digital library, hospital kitchen, maintenance department stores, endoscopy room, CT scan & MRI room, residential accommodation for the duty doctors and nurses. The western part of Block-B is a 9 storied building and accommodates all the departments of basic medical sciences such as Anatomy, Physiology, Biochemistry, Pharmacology, Pathology, Virology and Microbiology.

Block-C is the 10 storied main hospital building. This block accommodates the office of the Director of hospital and his administration, reception, telephone exchange, departments of physical medicine, paediatrics, neonatology, paediatrics surgery, clinical pathology, dermatology, nephrology, urology, neurology, neuro-Surgery, ophthalmology, ENT, obstetrics and gynaecology, surgery, lithotripsy room, operation theatre, pain clinic, intensive care unit (ICU) & Post-operative ward.

Block-D is the 18 storied building (under construction). This block accommodates the emergency, casualty, cardiac emergency, obstetrics and gynaecology emergency, orthopaedics emergency, cardiology, cath lab, CCU, cardiac surgery, vascular surgery, paediatric haematology & oncology, paediatric cardiology, paediatric gastroenterology, gastroenterology, medicine, oncology & institute of nuclear medicine (INM) a joint project of Bangladesh Atomic Energy Commission and BSMMU.

Goal: Goal of the university is to achieve a high standard in medical education, practice and research.

Aim: Aim of BSMMU is to develop human resources for health to ensure quality health care to the people of Bangladesh as well as South Asia Region. (10)

Departments of BSMMU are given below:

- Medicine
- Surgery
- Basic science and Para clinic science
- Dentistry
- Nursing
- Bio-Technology
- Medical Technology

CHAPTER 4
DESCRIPTIVE FINDINGS

4.1 Findings

This research was conducted in the dental OPD of Bangabandhu Sheikh Mujib Medical University. The researcher used simulation software AnyLogic to describe how the improvement can be done. The researcher collected data from the registration staff and asked some review from the patient about their satisfaction level with the service of the hospital, staff and doctor. The researcher also recorded the waiting time of patient registration service, waiting for doctor and time of doctor service.

4.1.1 Descriptive Findings

The descriptive findings that the researcher find out by visiting the hospital for 10 days and asking some questions from 5 patients daily is given below.

Questions asked to the patients by the researcher and the answers are given below:

Question 01: Are they happy to wait in the queue for 10-15 minutes to get their registration done?

The answer is no almost 85% of them are not happy and the other 15% came late to the hospital but they also want quick service.

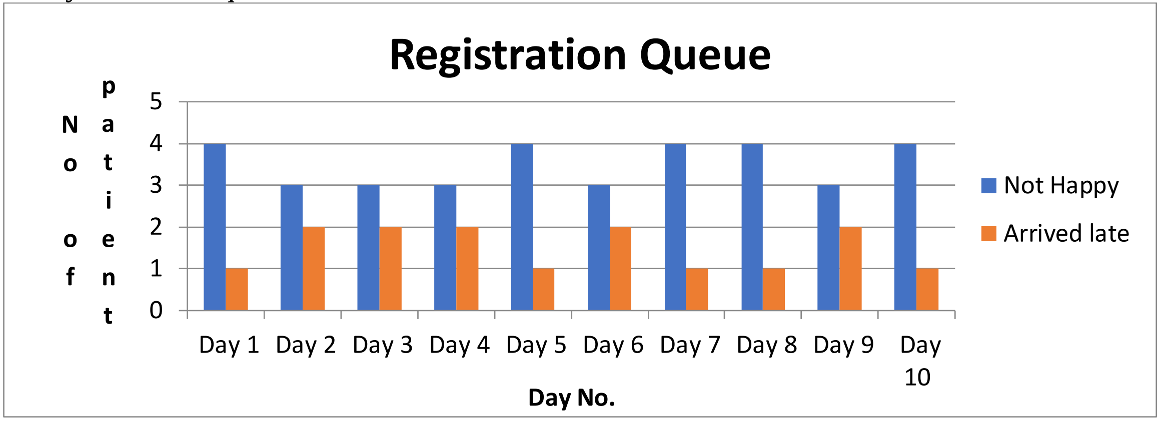

Fig 12 : Chart of registration Queue

Question 02: Are they happy with the behaviour of registration clerk and the staff working in the dental OPD?

The answer is almost 95% of the patients are happy with the service and the behaviour of the registration staff. Some patients are not happy about the fact the some new patients don't wait in queue but directly went to the clerk to ask any information.

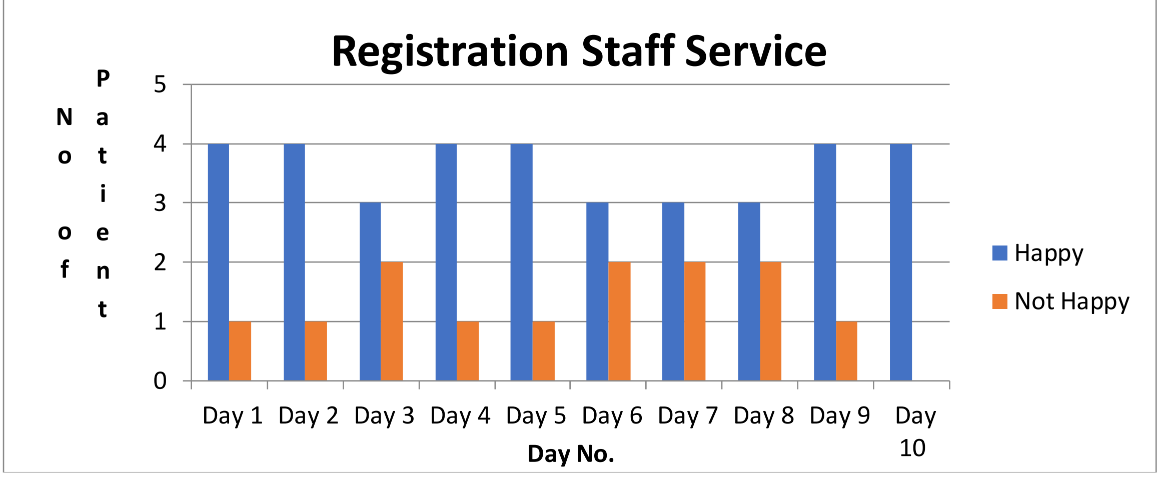

Fig 13 : Chart of Registration Staff Service

Question 03: Are they satisfied with waiting for 30-35 minutes in waiting room to get to doctor's service?

The answer is no. No one is happy with the fact that the doctors came late to their room. The patients don't have to wait for so long if the doctors came to consult the patients in time.

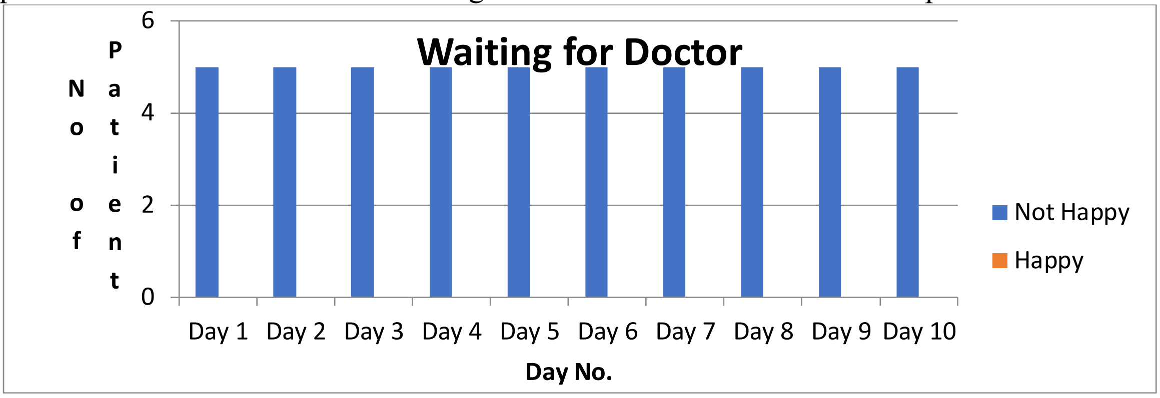

Fig 14 : Chart of Waiting for Doctor

Question 04: Are they happy with doctor's service?
The answer is yes. Most of the patients are happy with the doctor's service. Some of the patients are not happy because they thought the doctor prescribe them a lot of medicines.

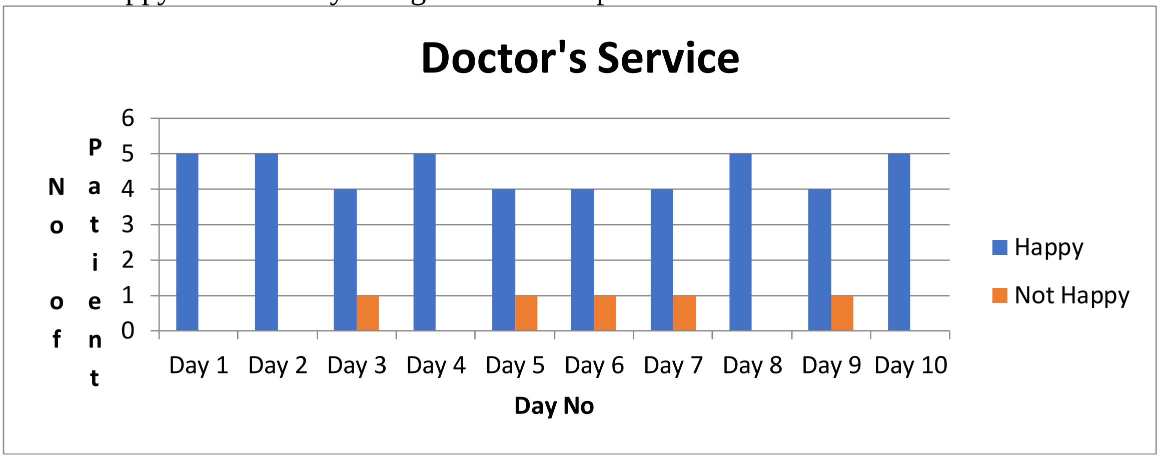

Fig 15 : Chart of Doctor's Service

4.1.2 Observation Findings

Registration counter opens at 8 a.m.
Patients start arriving for dental OPD at hospital premises approximately at 7.45 a.m.
Number of doctor giving service at a time is 2.
Time when doctors should start giving service to the patients is 8 a.m. but doctors normally arrive 15-20 minutes late.
Data of 10 days were collected and the researcher asked questions to 5 patients per day.
Some important data like the daily average waiting time in the registration queue and average waiting time in waiting room for doctor's service is given in the appendix section collected from the hospital by visiting the hospital for 10 day.

4.2 Data Analysis

After completing the process of data collection it was time to analyse these data. To analyse these data to suggest an improvement in the outdoor patient service of BSMMU and to make the patients satisfied with the service of the hospital. AnyLogic software is used to make some models using these data collected form BSMMU. These simulation models described about present scenario and suggestion that can be done to improve the service of the hospital towards patient.

Process modeling library is used to make this models. Using the process modelling library objects we can model real-world systems in terms of entities like transactions, customers, products, parts, etc. process like sequences of operations typically involving queues, delays, resource utilization and resources.

4.2.1 Model 01 [As Is]

This model represents the present situation of the hospital at first the researcher choose source block from process modeling library then go to its property and change its name to entry. Then change its arrival rate at 100 per hour as the real event. Almost 200 or more people are coming to the hospital registration queue to make their registration. From 1 registration server 3 departments' registration can be done. Limited number of arrival should be selected and maximum number of arrival should be 200 because 200 or less patients come to see doctor of three departments.

Now take service block from the palette and place it next to source block so it will connect automatically. Go to its properties and change its name to Registration Service. Set queue capacity to 100 and delay time to triangular(8, 9,10) minutes which is the delay in queue. Triangular(8,9,10) means minimum time of delay is 8 minutes, mean time is 9 minutes and maximum time is 10 minutes to do the registration.

Another service block we need to connect next to registrationService block. Name it Doctorservice. Set queue capacity to 80 as 80 people can sit outside of doctor's room and set delay time to triangular(25,30,35) minutes as it takes this time to wait for doctor and to take service.

Now connect sink block with Doctorsevice block and rename it to Exit as the patients exit after the Doctorservice.

Now place a ResourcePool block below RegistrationService it represents the server of registration. Name it Server and the capacity of Server is 1 so choose capacity to one. To connect this resource to service go to RegistrationService properties, click to resource set (alternatives) and choose Server.

Now we will draw waiting area for registration and the booth of registration. Two rectangular nodes is chosen for this and rename them to RegistrationQueue and RegistrationBooth respectively. Add an attractor to RegistrationBooth as there is only one booth of registration. To select this node with the RegistrationService, go to the properties of RegistrationService. Then select the node RegistrationQueue we have drawn in the Agent location (queue) option and the node RegistrationBooth have drawn in the Agent location (delay) option.

For DoctorService we have to do the same as we did with RegistrationService. Take a resourcePool from palette, name it to Doctor, change the capacity to 2 as there is always 2 doctors give service at the same time. Take to rectangular node, rename it to WaitingRoom and DoctorRoom respectively. Add two attractors to DoctorRoom as there are two doctors. To select this node with the DoctorService, go to the properties of DoctorService. Then select the node WaitingRoom we have drawn in the Agent location (queue) option and the node Doctor have drawn in the Agent location (delay) option.

This is how to build the model is built.

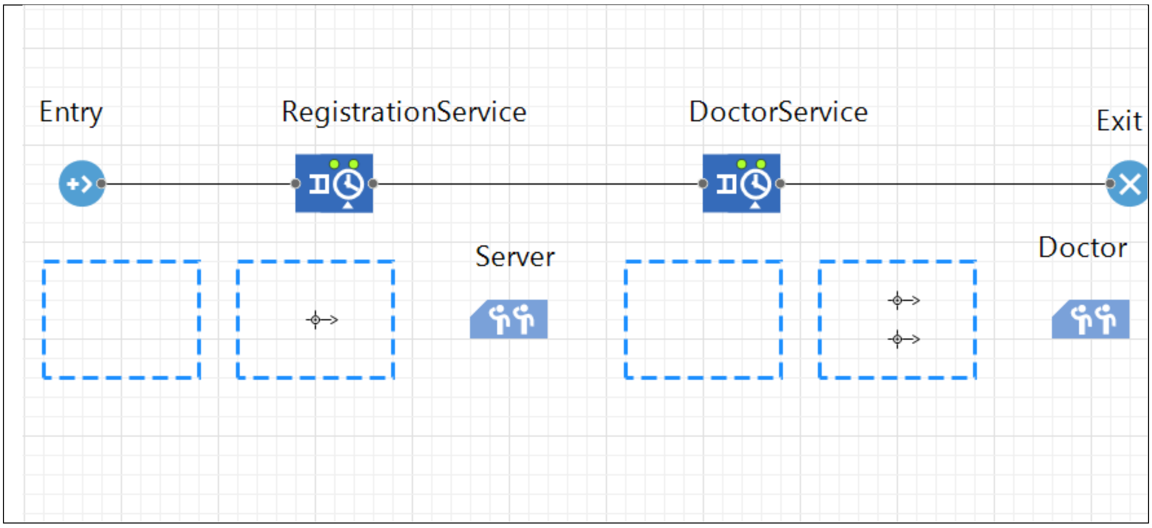

Fig 16: Model 01

Now click the build button and then run the model to see the result. Result of model 1 for the first 30 minutes there will be a little queue and the patients will wait just 2-3 minutes but as time goes after 2 hours the queue of registration will increase as patients come at a good rate and the service time will increase from 2 to 9 minutes. There will be delay at waiting room to as the doctor arrives late.

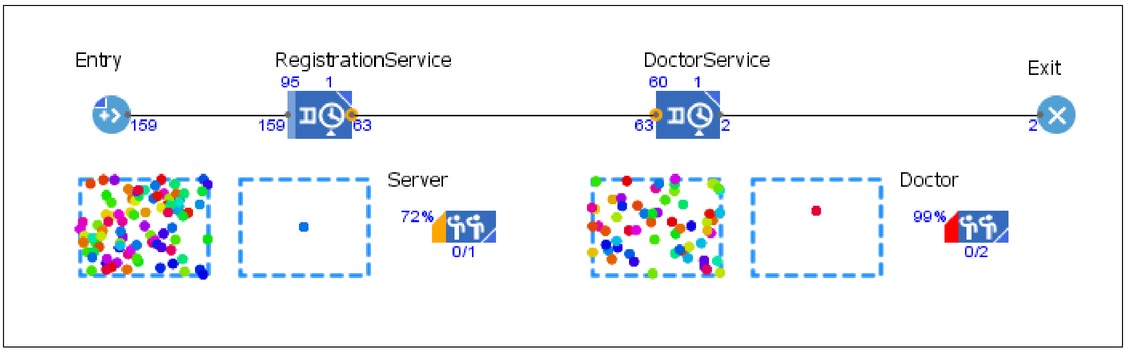

Fig 17: Result of Model 01

Summary of this model is in the result of this model we can see that there are so much patients waiting in RegistrationQueue and WaitingRoom. They are waiting for a long time for this process and to see the doctor. The patients are not satisfied with this outdoor service of the hospital.

4.2.2 Model 02 [Modified]

Some adjustments to model 01 can make model 02 and we can see how the improvement is done. The arrival rate of patients decrease to 30 per hour and the maximum number of patients is changed to 60 because if only the dental OPD patients make registration from one registration booth and the others will make registration from those departments OPD. So the delay time will also decrease from triangular(8, 9, 10) to triangular(2, 2.5, 3) minutes because the queue of patients decrease.

In this model the doctor come to his chamber to see patients in time so there will be so much less waiting time. From DoctorService properties the delay time will change to triangular (7,9,8) the time doctor take to examine patients.

The model 02 will look like same as model 01 but the parameter will change.

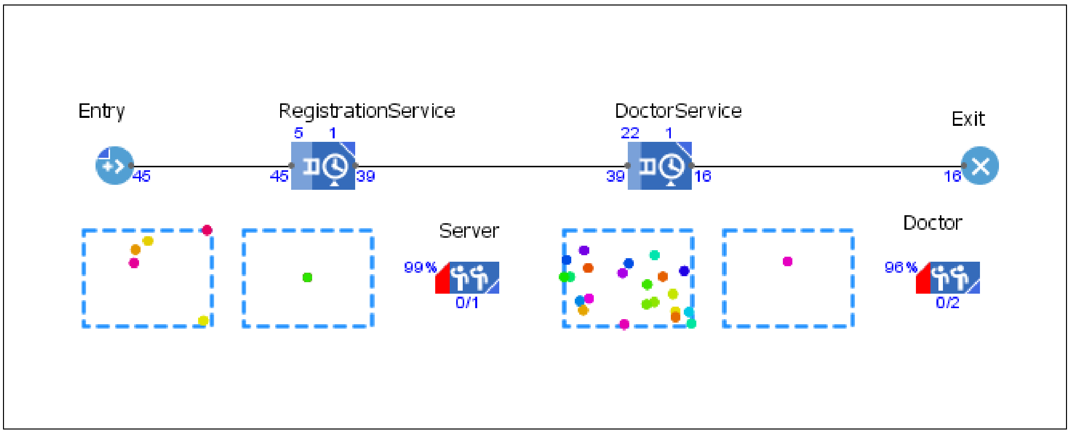

Fig 18: Result of Model 02

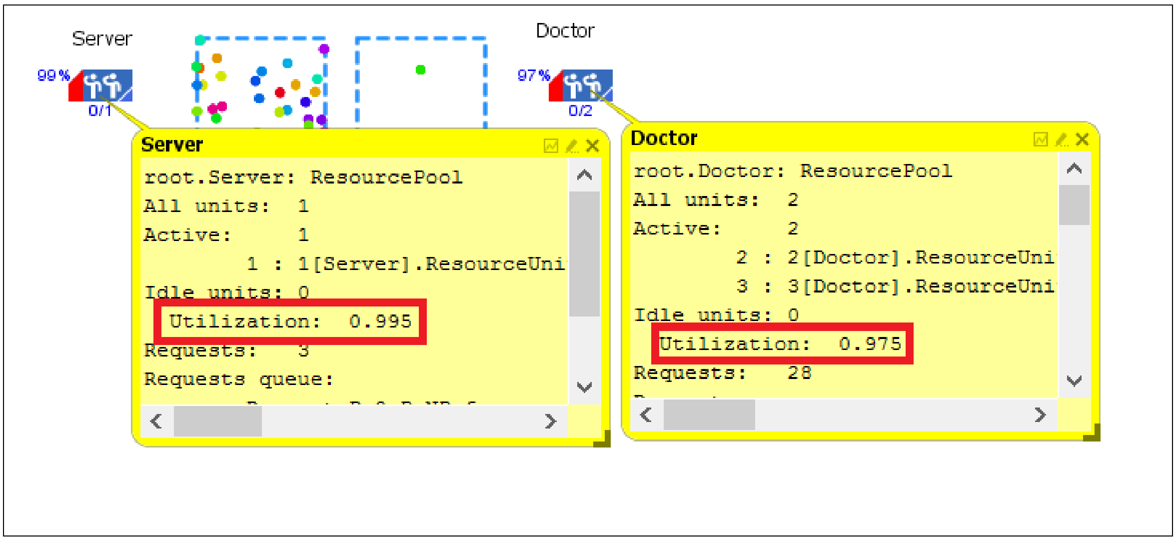

Fig 19: Utilization Rate of Server and Doctor in Model 02

Summary of model 02 is improved but in waiting room these are a lot of patients waiting because the registration is done quickly but the doctor is taking average of 6 minutes to consult a patient. In this model there is another problem the utilization rate of the server and doctor are 99.5% and 97.5% respectively. This utilization rate is not possible in real. The doctors and server must take some break in between their work to take calls, drink water or tea or to get fresh. So this model is not possible in real world.
The utilization rate cannot be more then 80% because no machine or human can be expected to work to a full capacity of 100%, the maximum capacity utilization rate that can be expected is of 80% as there can be many problems that can arise both with the man and the machine. Several issues relating to working of machinery that would not allow you to have optimum output. Similarly, a worker cannot always perform to his maximum every day. Utilization rate provides a rate that can help you with finding out the general output that can be generated.

4.2.3 Model 03 [Final]

In model 3 every parameter will remain same as model 2 just we will add one more server and 1 more doctor to see what difference happen. Our main focus is to minimize the utilization rate and decrease the waiting time in waiting room. The waiting time will decrease by adding another doctor. To do this one more attractor should be added to RegistrationBooth and DoctorRoom node respectively.

To give these model 3D effects sable, chair and sitting person need to be placed over the attractors from 3D objects. Person sitting in the registration booth on the tablerepresents server and the person sitting in chair in doctor room represents doctor. To add the patients moving from one area to another Resourse Type block should be placed in the model from process modelling library. The new agent wizard will open on the creating new agent step. Enter patient as the agent type name and leave the create the agent type "from scratch" selected. Press next.4.In the next step select 3D as the animation type and select person from the list of the 3D figures. At last click finish to build the model.

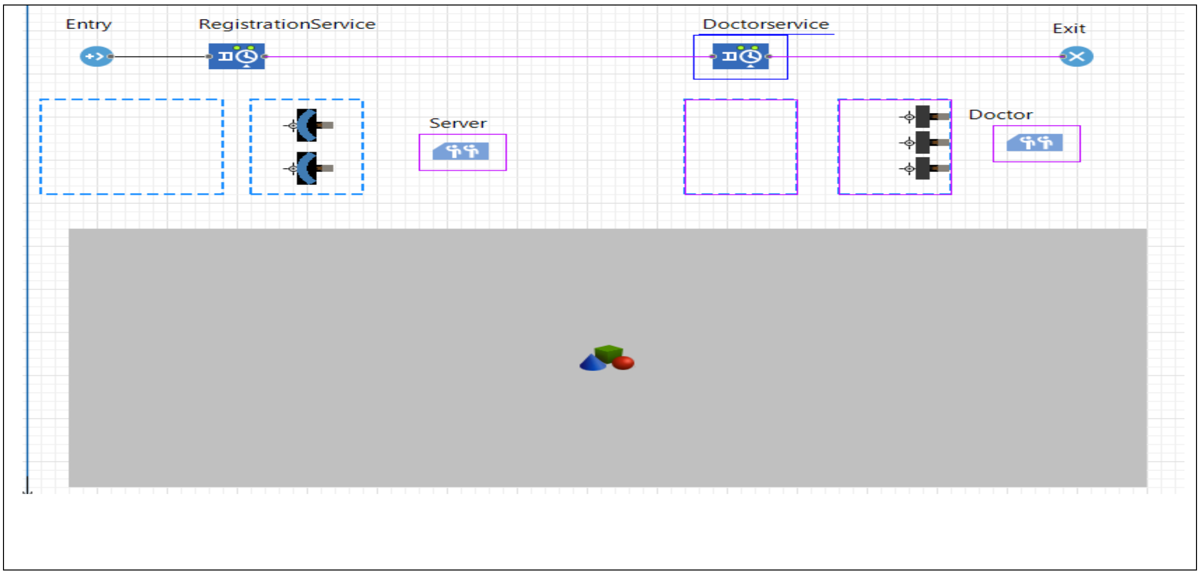

Fig 20: Model 03

Summary of model 3 is the result of this model is better than last two models. According to this model's result the patients stand in queue less time the registration queue and the waiting room not get over crowded so the patients don't have to wait to get doctor's service. The patients' satisfaction level should increase if this model is followed in real life as the delay time decrease.

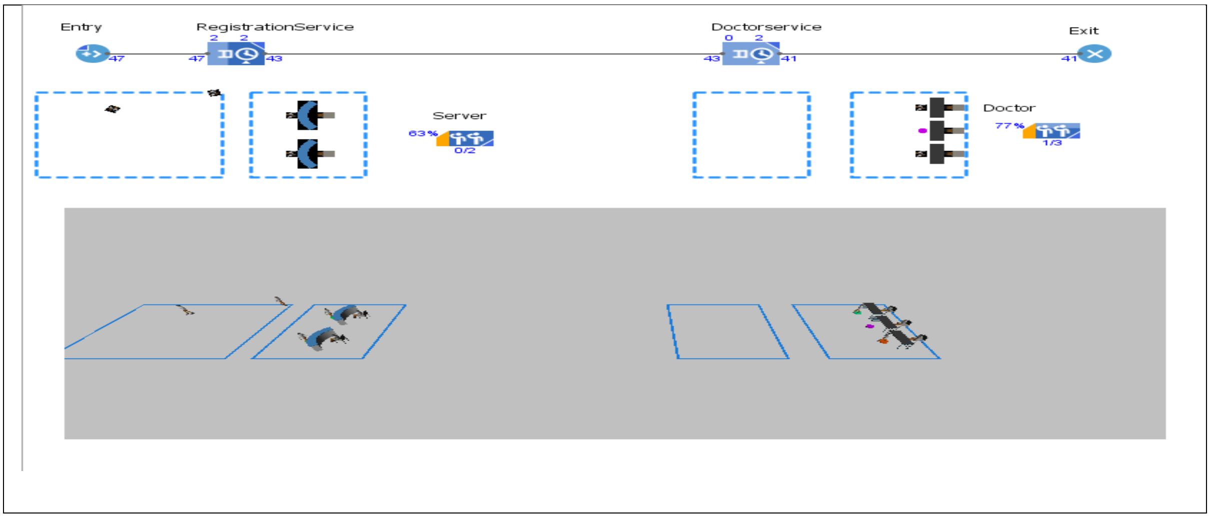

Fig 21: Result of Model 03

The utilization rate of server and doctor also decrease to 68.2% and 80.8% respectively. In this model there are certain times when one server and one doctor get idle. In the idle time they can make their calls or get fresh they also can take some time break too. This model can be used in real life to improve the outdoor patient service of BSMMU dental OPD.

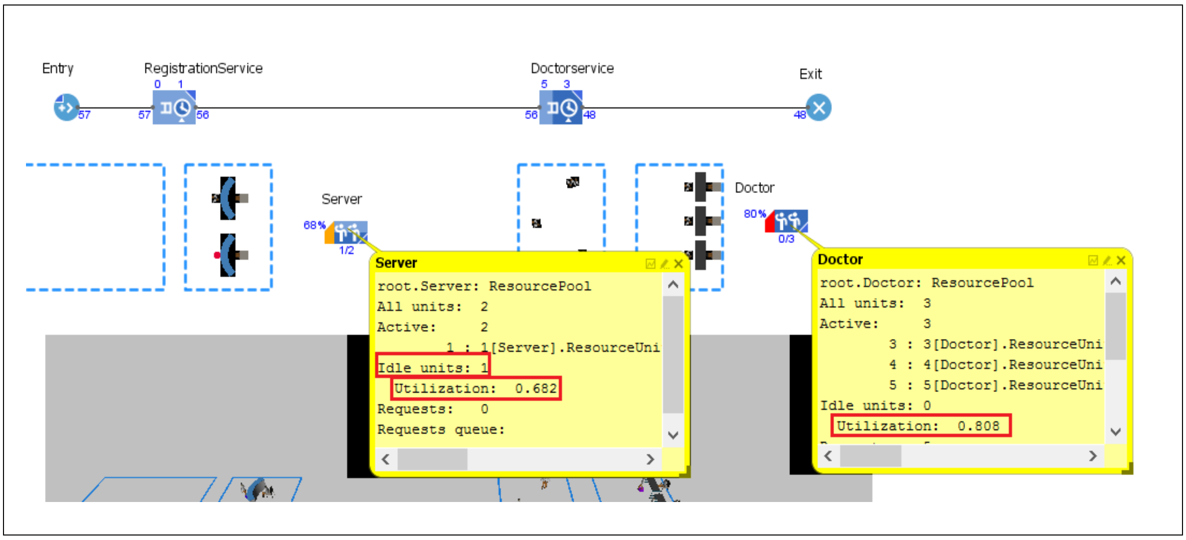

Fig 22: Utilization Rate of Server and Doctor in Model 03

4.3 Recommendation

In the present era of competition, with the increasing number of health service organizations, the competition is expected to favour those who offer the best services at the lowest price. This study has brought to light a few shortcomings in services of Bangabandhu Sheikh Mujib Medical University. This study suggests some improvements that can be made to improve the outdoor patient service of BSMMU. Model 3 shows what changes solve the problems with what the patients are dissatisfied.

The study findings recommend that following measures may be taken by the policy makers and hospital administrators to increase the patient service at hospital:

1. The patients are not satisfied waiting for 10 minutes at the registration queue to complete their registration. As Model 3, this problem can be solve if the patients of specific department can make registration from specific registration booth respectively for example the patient of dental OPD will do their registration from dental registration booth. The booth needs to have two servers so that when a server takes break the other can give service. For two servers giving the patient service will also decrease the waiting time in the queue and the utilization rate becomes 68.2%. The administration of this hospital can keep two servers for a specific period of time and then assign them

to another duty which will be beneficial for the hospital too. If the outdoor operation of registration staff is done according to the model 03 then the average time of waiting in the queue will be 2.5 minutes and the average time of registration will be 2.5 minutes

2. The patients are not satisfied waiting for so long to consult the doctor. The main reason behind this is the doctor coming late to their room. Normally doctors come to their chamber 20-30 minutes late. The patients have to wait for this time in the waiting room. If the doctors come on time the patients don't have to wait for this long and the waiting room will not become over-populated. If the outdoor operation of doctor's service is done according to the model 03 then the average time of waiting in the waiting room will be 6 minutes and the average time of doctor's service will be same.
3. In the dental OPD of BSMMU there are two doctors giving service at a time but according to model 2 the utilization rate of doctor is 97.5% which is not possible in real world because doctor take break in their duty time. If there are 3 doctors provide service at a time so the waiting room will not be over-populated, the patients will not have to wait in waiting room for so long and the utilization rate will decrease as model 3. This model 3 can be applied in real world situation to improve the outdoor patient service of BSMMU.
4. The cleanness of hospital and waiting room, availability of sufficient amount of chair for patients, availability of adequate drinking water these basic amenities are also useful to provide patients satisfaction. The staff working in hospital should be motivated in terms of careful and enthusiastic serv

CHAPTER 5
CONCLUSION

5.1 Conclusion

Patient satisfaction is the essential indicator that reflects the service quality at any level of health services. The study on the patient satisfaction is an effective mean of evaluating the performance of hospital from the view of the patients. The information obtained through this type of studies is valuable to remove problems which are distorting the patient satisfaction and to make this hospital and OPD more attractive for the patients.

The dental OPD of BSMMU is very efficient and cost effective for the patients and it is well known for its service in Bangladesh. From this study it is also clear that patients are coming in large number everyday to do their treatment. These patients are happy with registration service, doctor service and the behaviour of the staff. But these patients are not happy with the outdoor service like waiting in the queue for too long and waiting in the waiting room for doctor. These things made the patients frustrated.

In this study the researcher analyze the data collected from the hospital and build some models using AnyLogic simulation software. These models represent the real world situation and the improvements that can be made to the hospital. Model 3 shows how the improvement can be done. In this process the main focus was to decrease the waiting time of the patients. The patients are not satisfied with this long time they are wasting in registration queue and in waiting room.

Patients' satisfaction is very important because satisfied patients are more likely to maintain aconsistent relationship with a specific provider. So the hospital management of BSMMU should make some rearrangements to solve these problems. The patients will be more satisfied with these improvements in the outdoor service and they will not change the hospital for treatment.

Continuous efforts should be made by the hospital administrative to improve certain area in the service based on satisfaction level of the dimensions in this patient satisfaction study. Overall improvement in facilities and hospital environment, customer services quality and the effects of committed work force were reflected by improved level of patient satisfaction.

The author is hopeful that results of this research will motivate a lot of researchers to undertake various research projects in order to improve the services of both in and out patient departments of hospital for the best interest of patients for whom these institutions have been opened.

Appendix

Data obtained from the registration queue about waiting time in registration service queue and average time of registration service.

Date	Number of patient per hours	Avg. waiting time in registration service queue (minute)	Avg. time of registration service (minute)
15-11-18	45	8.5	2.5
17-11-18	21	8	2.5
18-11-18	32	9	2.5
19-11-18	30	10	2.5
20-11-18	29	7.5	2.5
22-11-18	40	9	2.5

24-11-18	17	8	2.5
25-11-18	30	9	2.5
26-11-18	34	8.5	2.5
27-11-18	37	9	2.5

Table 01: Data obtained from registration queue

If the outdoor operation of registration staff is done according to the model 03 then the average time of waiting in the queue will be 2.5 minutes and the average time of registration will be 2.5 minutes.

Data obtained from the waiting room about waiting time in waiting room and avere time of doctor's service.

Date	Number of patient per hours	Avg. waiting time for doctor's service in waiting room (minute)	Avg. time of doctor's service (minute)
15-11-18	43	30	5.5
17-11-18	21	28.5	6
18-11-18	32	30	5.5
19-11-18	30	32	5.85
20-11-18	29	35	6.15
22-11-18	40	25	5.15
24-11-18	17	32	5.60
25-11-18	30	30	6
26-11-18	34	35	6
27-11-18	37	35	6.25

Table 02: Data obtained from dental OPD

If the outdoor operation of doctor's service is done according to the model 03 then the average time of waiting in the waiting room will be 6 minutes and the average time of doctor's service will be same.

So the total time of a patient spent in the OPD for service is 50 minutes in present situation. This can be decreased in to 18 minutes if the hospital operates according to the model 03.

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