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Developing an efficient scheduling template of a chemotherapy treatment unit: A case study

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REVIEW

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Abstract

This study was undertaken to improve the performance of a Chemotherapy Treatment Unit by increasing the throughput and reducing the average patient's waiting time. In order to achieve this objective, a scheduling template has been built. The scheduling template is a simple tool that can be used to schedule patients' arrival to the clinic. A simulation model of this system was built and several scenarios, that target match the arrival pattern of the patients and resources availability, were designed and evaluated. After performing detailed analysis, one scenario provide the best system's performance. A scheduling template has been developed based on this scenario. After implementing the new scheduling template, 22.5% more patients can be served.

1. Introduction

CancerCare Manitoba is a provincially mandated cancer care agency. It is dedicated to provide quality care to those who have been diagnosed and are living with cancer. MacCharles Chemotherapy unit is specially built to provide chemotherapy treatment to the cancer patients of Winnipeg. In order to maintain an excellent service, it tries to ensure that patients get their treatment in a timely manner. It is challenging to maintain that goal because of the lack of a proper roster, the workload distribution and inefficient resource allotment. In order to maintain the satisfaction of the patients and the healthcare providers, by serving the maximum number of patients in a timely manner, it is necessary to develop an efficient scheduling template that matches the required demand with the availability of resources. This goal can be reached using simulation modelling. Simulation has proven to be an excellent modelling tool. It can be defined as building computer models that represent real world or hypothetical systems, and hence experimenting with these models to study system behaviour under different scenarios.[1, 2]

A study was undertaken at the Children's Hospital of Eastern Ontario to identify the issues behind the long waiting time of a emergency room.[3] A 20-day field observation revealed that the availability of the staff physician and interaction affects the patient wait time. Jyväskylä et al.[4] used simulation to test different process scenarios, allocate resources and perform activity-based cost analysis in the Emergency Department (ED) at the Central Hospital. The simulation also supported the study of a new operational method, named "triage-team" method without interrupting the main system. The proposed triage team method categorises the entire patient according to the urgency to see the doctor and allows the patient to complete the necessary test before being seen by the doctor for the first time. The simulation study showed that it will decrease the throughput time of the patient and reduce the utilisation of the specialist and enable the ordering all the tests the patient needs right after arrival, thus quickening the referral to treatment.

Santibáñez et al.[5] developed a discrete event simulation model of British Columbia Cancer Agency's ambulatory care unit which was used to study the impact of scenarios considering different operational factors (delay in starting clinic), appointment schedule (appointment order, appointment adjustment, add-ons to the schedule) and resource allocation. It was found that the best outcomes were obtained when not one but multiple changes were implemented simultaneously. Sepúlveda et al.[6] studied the M. D. Anderson Cancer Centre Orlando, which is a cancer treatment facility and built a simulation model to analyse and improve flow process and increase capacity in the main facility. Different scenarios were considered like, transferring laboratory and pharmacy areas, adding an extra blood draw room and applying different scheduling techniques of patients. The study shows that by increasing the number of short-term (four hours or less) patients in the morning could increase chair utilisation.

Discrete event simulation also helps improve a service where staff are ignorant about the behaviour of the system as a whole; which can also be described as a real professional system. Niranjon et al.[7] used simulation successfully where they had to face such constraints and lack of accessible data. Carlos et al. [8] used *Total quality management and simulation – animation* to improve the quality of the emergency room. Simulation was used to cover the key point of the emergency room and animation was used to indicate the areas of opportunity required. This study revealed that a long waiting time, overload personnel and increasing withdrawal rate of patients are caused by the lack of capacity in the emergency room.

Baesler et al.[9] developed a methodology for a cancer treatment facility to find stochastically a global optimum point for the control variables. A simulation model generated the output using a goal programming framework for all the objectives involved in the analysis. Later a genetic algorithm was responsible for performing the search for an improved solution. The control variables that were considered in this research are number of treatment chairs, number of drawing blood nurses, laboratory personnel, and pharmacy personnel. Guo et al. [10] presented a simulation framework considering demand for appointment, patient flow logic, distribution of resources, scheduling rules followed by the scheduler. The objective of the study was to develop a scheduling rule which will ensure that 95% of all the appointment requests should be seen within one week after the request is made to increase the level of patient satisfaction and balance the schedule of each doctor to maintain a fine harmony between "busy clinic" and "quiet clinic".

Huschka et al.[11] studied a healthcare system which was about to change their facility layout. In this case a simulation model study helped them to design a new healthcare practice by evaluating the change in layout before implementation. Historical data like the arrival rate of the patients, number of patients visited each day, patient flow logic, was used to build the current system model. Later, different scenarios were designed which measured the changes in the current layout and performance.

Wijewickrama et al.[12] developed a simulation model to evaluate appointment schedule (AS) for second time consultations and patient appointment sequence (PSEQ) in a multi-facility system. Five different appointment rule (ARULE) were considered: i) Baily; ii) 3Baily; iii) Individual (Ind); iv) two patients at a time (2AtaTime); v) Variable Interval and (V-I) rule. PSEQ is based on type of patients: Appointment patients (APs) and new patients (NPs). The different PSEQ that were studied in this study were: i) first-come first-serve; ii) appointment patient at the beginning of the clinic (APBEG); iii) new patient at the beginning of the clinic (NPBEG); iv) assigning appointed and new patients in an alternating manner (ALTER); v) assigning a new patient after every five-appointment patients. Also patient no show (0% and 5%) and patient punctuality (PUNCT) (on-time and 10 minutes early) were also considered. The study found that ALTER-Ind. and ALTER5-Ind. performed best on 0% NOSHOW, on-time PUNCT and 5% NOSHOW, on-time PUNCT situation to reduce WT and IT per patient. As

NOSHOW created slack time for waiting patients, their WT tends to reduce while IT increases due to unexpected cancellation. Earliness increases congestion whichin turn increases waiting time.

Ramis et al.[13] conducted a study of a Medical Imaging Center (MIC) to build a simulation model which was used to improve the patient journey through an imaging centre by reducing the wait time and making better use of the resources. The simulation model also used a Graphic User Interface (GUI) to provide the parameters of the centre, such as arrival rates, distances, processing times, resources and schedule. The simulation was used to measure the waiting time of the patients in different case scenarios. The study found that assigning a common function to the resource personnel could improve the waiting time of the patients.

The objective of this study is to develop an efficient scheduling template that maximises the number of served patients and minimises the average patient's waiting time at the given resources availability. To accomplish this objective, we will build a simulation model which mimics the working conditions of the clinic. Then we will suggest different scenarios of matching the arrival pattern of the patients with the availability of the resources. Full experiments will be performed to evaluate these scenarios. Hence, a simple and practical scheduling template will be built based on the indentified best scenario. The developed simulation model is described in section 2, which consists of a description of the treatment room, and a description of the types of patients and treatment durations. In section 3, different improvement scenarios are described and their analysis is presented in section 4. Section 5 illustrates a scheduling template based on one of the improvement scenarios. Finally, the conclusion and future direction of our work is exhibited in section 6.

2. Simulation Model

A simulation model represents the actual system and assists in visualising and evaluating the performance of the system under different scenarios without interrupting the actual system. Building a proper simulation model of a system consists of the following steps.

i) Observing the system to understand the flow of the entities, key players, availability of resources and overall generic framework.
ii) Collecting the data on the number and type of entities, time consumed by the entities at each step of their journey, and availability of resources.
iii) After building the simulation model it is necessary to confirm that the model is valid. This can be done by confirming that each entity flows as it is supposed to and the statistical data generated by the simulation model is similar to the collected data.

Figure 1 shows the patient flow process in the treatment room. On the patient's first appointment, the oncologist comes up with the treatment plan. The treatment time varies according to the patient's condition, which may be 1 hour to 10 hours. Based on the type of the treatment, the physician or the clinical clerk books an available treatment chair for that time period.

On the day of the appointment, the patient will wait until the booked chair is free. When the chair is free a nurse from that station comes to the patient, verifies the name and date of birth and takes the patient to a treatment chair. Afterwards, the nurse flushes the chemotherapy drug line to the patient's body which takes about five minutes and sets up the treatment. Then the nurse leaves to serve another patient. Chemotherapy treatment lengths vary from less than an hour to 10 hour infusions. At the end of the treatment, the nurse returns, removes the line and notifies the patient about the next appointment date and time which also takes about five minutes. Most of the patients visit the clinic to take care of their PICC line (a peripherally inserted central catheter). A PICC is a line that is used to inject the patient with the chemical. This PICC line should be regularly cleaned, flushed to maintain patency and the insertion site checked for signs of infection. It takes approximately 10–15 minutes to take care of a PICC line by a nurse.

Cancer Care Manitoba provided access to the electronic scheduling system, also known as "ARIA" which is comprehensive information and image management system that aggregates patient data into a fully-electronic medical chart, provided by VARIAN Medical System. This system was used to find out how many patients are booked in every clinic day. It also reveals which chair is used for how many hours. It was necessary to search a patient's history to find out how long the patient spends on which chair. Collecting the snapshot of each patient gives the complete picture of a one day clinic schedule.

The treatment room consists of the following two main limited resources:

i) Treatment Chairs: Chairs that are used to seat the patients during the treatment.
ii) Nurses: Nurses are required to inject the treatment line into the patient and remove it at the end of the treatment. They also take care of the patients when they feel uncomfortable.

Mc Charles Chemotherapy unit consists of 11 nurses, and 5 stations with the following description:

i) Station 1: Station 1 has six chairs (numbered 1 to 6) and two nurses. The two nurses work from 8:00 to 16:00.
ii) Station 2: Station 2 has six chairs (7 to 12) and three nurses. Two nurses work from 8:00 to 16:00 and one nurse works from 12:00 to 20:00.
iii) Station 3: Station 4 has six chairs (13 to 18) and two nurses. The two nurses work from 8:00 to 16:00.
iv) Station 4: Station 4 has six chairs (19 to 24) and three nurses. One nurse works from 8:00 to 16:00. Another nurse works from 10:00 to 18:00.
v) Solarium Station: Solarium Station has six chairs (Solarium Stretcher 1, Solarium Stretcher 2, Isolation, Isolation emergency, Fire Place 1, Fire Place 2). There is only one nurse assigned to this station that works from 12:00 to 20:00. The nurses from other stations can help when need arises.

There is one more nurse known as the "float nurse" who works from 11:00 to 19:00. This nurse can work at any station. Table 1 summarises the working hours of chairs and nurses. All treatment stations start at 8:00 and continue until the assigned nurse for that station completes her shift.

Currently, the clinic uses a scheduling template to assign the patients' appointments. But due to high demand of patient appointment it is not followed any more. We believe that this template can be improved based on the availability of nurses and chairs. Clinic workload was collected from 21 days of field observation. The current scheduling template has 10 types of appointment time slot: 15-minute, 1-hour, 1.5-hour, 2-hour, 3-hour, 4-hour, 5-hour, 6-hour, 8-hour and 10-hour and it is designed to serve 95 patients. But when the scheduling template was compared with the 21 days observations, it was found that the clinic is serving more patients than it is designed for. Therefore, the providers do not usually follow the scheduling template. Indeed they very often break the time slots to accommodate slots that do not exist in the template. Hence, we find that some of the stations are very busy (mostly station 2) and others are underused. If the scheduling template can be improved, it will be possible to bring more patients to the clinic and reduce their waiting time without adding more resources.

In order to build or develop a simulation model of the existing system, it is necessary to collect the following data:

i) Types of treatment durations.
ii) Numbers of patients in each treatment type.
iii) Arrival pattern of the patients.
iv) Steps that the patients have to go through in their treatment journey and required time of each step.

Using the observations of 2,155 patients over 21 days of historical data, the types of treatment durations and the number of patients in each type were estimated. This data also assisted in determining the arrival rate and the frequency distribution of the patients. The patients were categorised into six types. The percentage of these types and their associated service times distributions are determined too.

ARENA Rockwell Simulation Software (v13) was used to build the simulation model. Entities of the model were tracked to verify that the patients move as intended. The model was run for 30 replications and statistical data was collected to validate the model. The total number of patients that go though the model was compared with the actual number of served patients during the 21 days of observations.

3. Improvement Scenarios

After verifying and validating the simulation model, different scenarios were designed and analysed to identify the best scenario that can handle more patients and reduces the average patient's waiting time. Based on the clinic observation and discussion with the healthcare providers, the following constraints have been stated:

i) The stations are filled up with treatment chairs. Therefore, it is literally impossible to fit any more chairs in the clinic. Moreover, the stakeholders are not interested in adding extra chairs.
ii) The stakeholders and the caregivers are not interested in changing the layout of the treatment room.

Given these constraints the options that can be considered to design alternative scenarios are:

i) Changing the arrival pattern of the patients: that will fit over the nurses' availability.
ii) Changing the nurses' schedule.
iii) Adding one full time nurse at different starting times of the day.

Figure 2 compares the available number of nurses and the number of patients' arrival during different hours of a day. It can be noticed that there is a rapid growth in the arrival of patients (from 13 to 17) between 8:00 to 10:00 even though the clinic has the equal number of nurses during this time period. At 12:00 there is a sudden drop of patient arrival even though there are more available nurses. It is clear that there is an imbalance in the number of available nurses and the number of patient arrivals over different hours of the day. Consequently, balancing the demand (arrival rate of patients) and resources (available number of nurses) will reduce the patients' waiting time and increases the number of served patients. The alternative scenarios that satisfy the above three constraints are listed in Table 2. These scenarios respect the following rules:

i) Long treatments (between 4hr to 11hr) have to be scheduled early in the morning to avoid working overtime.
ii) Patients of type 1 (15 minutes to 1hr treatment) are the most common. They can be fitted in at any time of the day because they take short treatment time. Hence, it is recommended to bring these patients in at the middle of the day when there are more nurses.
iii) Nurses get tired at the end of the clinic day. Therefore, fewer patients should be scheduled at the late hours of the day.

In Scenario 1, the arrival pattern of the patient was changed so that it can fit with the nurse schedule. This arrival pattern is shown Table 3. Figure 3 shows the new patients' arrival pattern compared with the current arrival pattern. Similar patterns can be developed for the remaining scenarios too.

4. Analysis of Results

ARENA Rockwell Simulation software (v13) was used to develop the simulation model. There is no warm-up period because the model simulates day-to-day scenarios. The patients of any day are supposed to be served in the same day. The model was run for 30 days (replications) and statistical data was collected to evaluate each scenario. Tables 4 and 5 show the detailed comparison of the system performance between the current scenario and Scenario 1. The results are quite interesting. The average throughput rate of the system has increased from 103 to 125 patients per day. The maximum throughput rate can reach 135 patients. Although the average waiting time has increased, the utilisation of the treatment station has increased by 15.6%. Similar analysis has been performed for the rest of the other scenarios. Due to the space limitation the detailed results are not given. However, Table 6 exhibits a summary of the results and comparison between the different scenarios. Scenario 1 was able to significantly increase the throughput of the system (by 21%) while it still results in an acceptable low average waiting time (13.4 minutes). In addition, it is worth noting that adding a nurse (Scenarios 3, 4, and 5) does not significantly reduce the average wait time or increase the system's throughput. The reason behind this is that when all the chairs are busy, the nurses have to wait until some patients finish the treatment. As a consequence, the other patients have to wait for the commencement of their treatment too. Therefore, hiring a nurse, without adding more chairs, will not reduce the waiting time or increase the throughput of the system. In this case, the only way to increase the throughput of the system is by adjusting the arrival pattern of patients over the nurses' schedule.

5. Developing a Scheduling Template based on Scenario 1

Scenario 1 provides the best performance. However a scheduling template is necessary for the care provider to book the patients. Therefore, a brief description is provided below on how scheduling the template is developed based on this scenario.

Table 3 gives the number of patients that arrive hourly, following Scenario 1. The distribution of each type of patient is shown in Table 7. This distribution is based on the percentage of each type of patient from the collected data. For example, in between 8:00-9:00, 12 patients will come where 54.85% are of Type 1, 34.55% are of Type 2, 15.163% are of Type 3, 4.32% are of Type 4, 2.58% are of Type 5 and the rest are of Type 6. It is worth noting that, we assume that the patients of each type arrive as a group at the beginning of the hourly time slot. For example, all of the six patients of Type 1 from 8:00 to 9:00 time slot arrive at 8:00.

The numbers of patients from each type is distributed in such a way that it respects all the constraints described in Section 1.3. Most of the patients of the clinic are from type 1, 2 and 3 and they take less amount of treatment time compared with the patients of other types. Therefore, they are distributed all over the day. Patients of type 4, 5 and 6 take a longer treatment time. Hence, they are scheduled at the beginning of the day to avoid overtime. Because patients of type 4, 5 and 6 come at the beginning of the day, most of type 1 and 2 patients come at mid-day (12:00 to 16:00). Another reason to make the treatment room more crowded in between 12:00 to 16:00 is because the clinic has the maximum number of nurses during this time period. Nurses become tired at the end of the clinic which is a reason not to schedule any patient after 19:00.

Based on the patient arrival schedule and nurse availability a scheduling template is built and shown in Figure 4. In order to build the template, if a nurse is available and there are patients waiting for service, a priority list of these patients will be developed. They are prioritised in a descending order based on their estimated slack time and secondarily based on the shortest service time. The secondary rule is used to break the tie if two patients have the same slack. The slack time is calculated using the following equation:

Slack time = Due time- (Arrival time + Treatment time)

Due time is the clinic closing time. To explain how the process works, assume at hour 8:00 (in between 8:00 to 8:15) two patients in station 1 (one 8-hour and one 15-minute patient), two patients in station 2 (two 12-hour patients), two patients in station 3 (one 2-hour and one 15-minute patient) and one patient in station 4 (one 3-hour patient) in total seven patients are scheduled. According to Figure 2, there are seven nurses who are available at 8:00 and it takes 15 minutes to set-up a patient. Therefore, it is not possible to schedule more than seven patients in between 8:00 to 8:15 and the current scheduling is also serving seven patients by this time. The rest of the template can be justified similarly.

Conclusion

This study was undertaken to improve the performance of a Chemotherapy Treatment Unit by increasing the throughput and reducing the average patient's waiting time. The main objective was to build an efficient scheduling template. In order to achieve this objective, the facility was studied to understand the journey of the patients through different stages of their treatment. Secondly, important data was collected regarding the patient's type, treatment time and resource availability. Finally a simulation model of this system was built. Different scenarios were designed and evaluated to find the best schedule of the patients and nurses. Comparing the scenarios, Scenario 1 provides the best performance. This scenario proves to serve 125 patients daily with an average resources utilisation of 77.6%. On the other hand, the stakeholders do not have to hire additional nurses compared to other scenarios. A scheduling template has been developed based on Scenario 1.

Due to the success of implementing the template at MacCharles Chemotherapy unit, we are about to implement a similar template at St Boniface satellite unit. Moreover, we are rolling this methodology out across the city of Winnipeg to the Winnipeg Regional Health Authority (WRHA) community oncology programme sites and to rural community cancer programme sites too.

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PEER REVIEW

Not commissioned. Externally peer reviewed.

CONFLICTS OF INTEREST

The authors declare that they have no competing interests.

Figures and Tables

Figure 1: Flow of patients though the treatment room

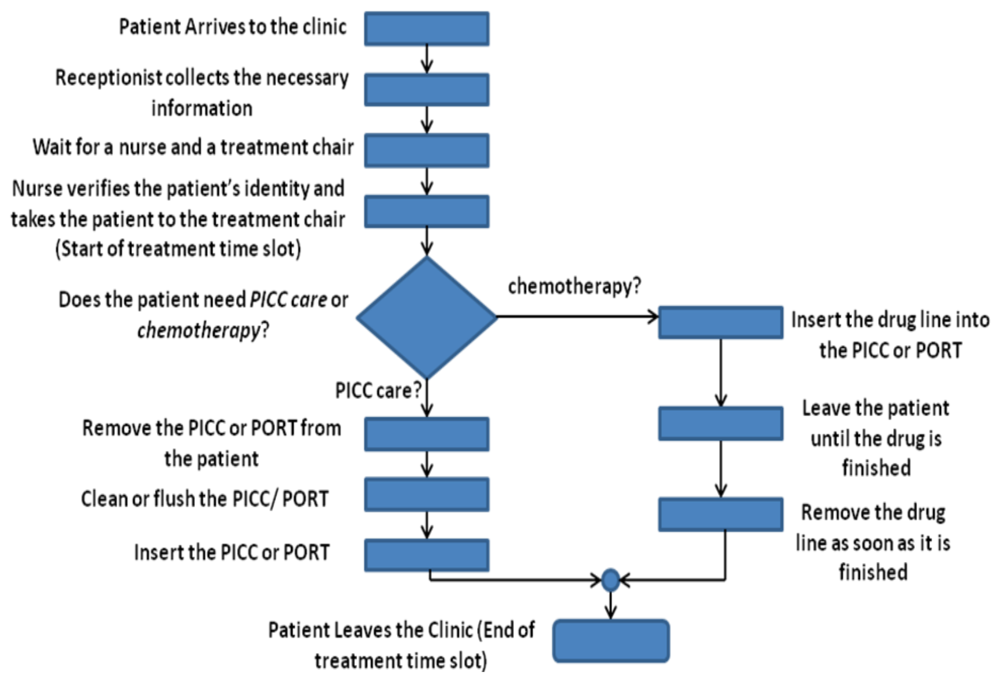

Table 1: Allocation of treatment chairs and nurses' schedule

Station	No of Chairs	Regular Nurses and Working Hours	Float Nurse
Station 1	6	Nurse 1: From 8:00 to 16:00 Nurse 2: From 8:00 to 16:00	Float nurse works from 11:00 to 19:00
Station 2	6	Nurse 1: From 8:00 to 16:00 Nurse 2: From 8:00 to 16:00 Nurse 3: From 12:00 to 20:00	
Station 3	6	Nurse 1: From 8:00 to 16:00 Nurse 2: From 8:00 to 16:00	
Station 4	6	Nurse 1: From 8:00 to 16:00 Nurse 2: From 10:00 to 18:00	
Solarium Station	6	Nurse 1: From 12:00 to 20:00 All the nurses from other station.	

Figure 2: Comparison between number of nurses and number of patient arrivals during different hours of the day.

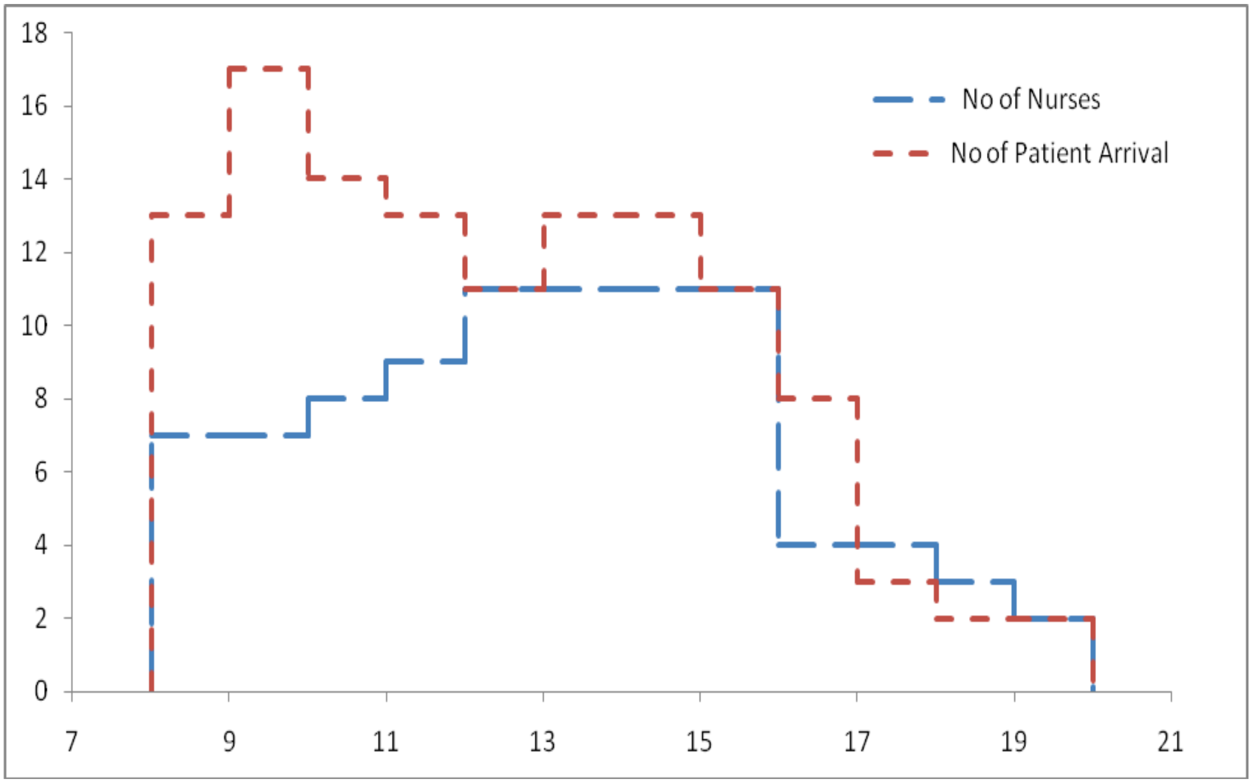

Figure 3: Patients' arrival pattern of Scenario 1 compared with the current one.

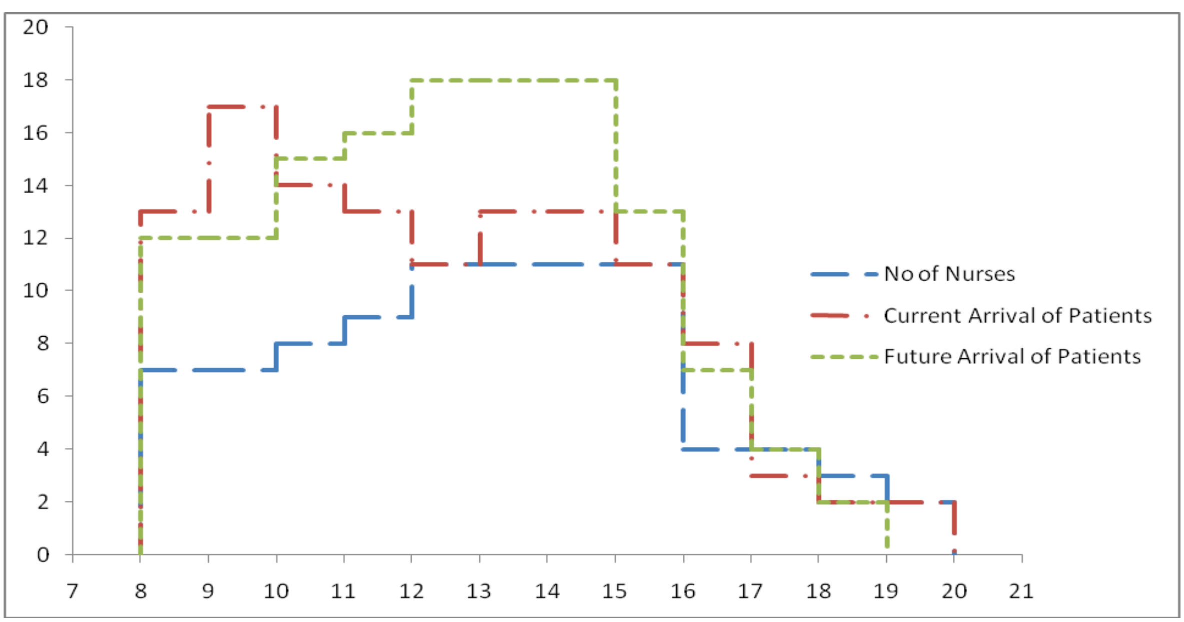

Table 2: Suggested improvement scenarios.

Scenarios	Changes
Scenario 1	Change the arrival pattern of the patient to fit the current nurse schedule.
Scenario 2	Reschedule the Float nurse schedule to 10:00-18:00 instead of 11:00 – 19:00
Scenario 2.2	Reschedule the Float nurse schedule to 10:00-18:00 instead of 11:00 – 19:00 and change the arrival pattern of the patient that to fit the change in nurse schedule.
Scenario 3	Add one nurse at different stations from 8:00 to 16:00.
Scenario 4	Add one nurse at different stations from 10:00 to 18:00.
Scenario 4.2	Add one nurse at different stations from 10:00 to 18:00 and change the arrival pattern of the patient to fit the change in nurse schedule.
Scenario 5	Add one nurse at different stations from 11:00 to 19:00.
Scenario 5.2	Add one nurse at different stations from 11:00 to 19:00 and change the arrival pattern of the patient to fit the change in nurse schedule.

Table 3: The patient arrival pattern of Scenario 1

Working Hour	No of Nurses	Current Arrival Rate	Changed Arrival Rate
8:00 --- 9:00	7	13	12
9:00 --- 10:00	7	17	12
10:00 --- 11:00	8	14	15
11:00 --- 12:00	9	13	16
12:00 --- 13:00	11	11	18
13:00 --- 14:00	11	13	18
14:00 --- 15:00	11	13	18
15:00 --- 16:00	11	11	13
16:00 --- 17:00	4	8	7
17:00 --- 18:00	4	3	4
18:00 --- 19:00	3	2	2
19:00 --- 20:00	2	2	0

Table 4: Comparison of the system performance between the current system and Scenario 1

Patient Type	Average Number of Served Patients		Average Patient Wait Time (minutes)	
	Current Scenario	Scenario 1	Current Scenario	Scenario 1
15 minute	33.9	43.7	4.3	16.6
30 minute	15.4	20.9	3.9	14.9
45 minute	1.06	1.2	3.2	12
1 hour	8.4	11.8	4.9	9.02
1.5 hour	7.3	8.3	6.1	17.25
1.25, 1.75, 2.25, 2.75 hr	3	3.5	4.2	5
2 hr	10	10.8	5	14.4
2.5 hr	1.6	2.2	1.4	8.6
3 hr	4.8	5.3	3.8	8.1
3.25, 3.5, 3.75 hr	2.3	1.4	3.6	4.2
4 hr	4.6	4.6	3.2	8.6
4.25, 4.5, 4.75 hr	0.733	0.7	2.5	3.32
5 hr	4.2	3.3	3.1	8.1
5.25, 5.5, 5.75, 6, 6.5, 6.75, 7 hr	2.8	3.32	2.3	2.5
7.25, 7.5, 7.75, 8, 8.25, 8.5 hr	1.96	3.1	3.53	3.5
9.5, 10, 11, 11.5 hr	1	1.3	10	0.71
Average	**103**	**125**	**4.3**	**13.4**
Maximum	**108**	**135**		

Table 5: Comparing the use of stations

	Station 1	Station 2	Station 3	Station 4	Solarium	Average Utilization
Current Scenario	0.73	0.8	0.49	0.49	0.58	0.62
Scenario 1	1.06	0.72	0.76	0.74	0.6	0.776

Table 6: Summary of the results of all scenarios

Scenarios	Main Effect	Average Wait time (Minute)	Average Throughput	Average Station Utilization
Current Scenario	It represents the current working condition.	4.3	102	61.8%
Scenario 1	It results in minor increase in the waiting time but significantly increases the stations utilisation.	13.4	125	77.6%
Scenario 2	It reduces the throughput compared to Scenario 1.	13	119	76.9%
Scenario 2.2	It is similar to Scenario 1 with respect to waiting time and stations utilisation but results in lower throughput.	13.21	116	78%
Scenario 3	It obtains best results if the nurse is assigned to station 1. Comparable to Scenario 1.	11.75	125	77.8%
Scenario 4	It obtains best results if the nurse is assigned to station 2. Comparable to Scenario 1	12.45	125	77.8%
Scenario 4.2	It obtains best results if the nurse is assigned to station 2. Compared to Scenario 1, it has lower throughput and waiting time.	10	120	76.2%
Scenario 5	It obtains best results if the nurse is assigned to solarium station. Comparable to Scenario 1.	11.75	125	77.6%
Scenario 5.2	It obtains best results if the nurse is assigned to solarium station. It results in lower throughput and higher stations utilisation.	12	122	79.2%

Table 7: Arrival pattern (hourly) of different types of patients based on Scenario 1

TYPE	Type 1	Type 2	Type 3	Type 4	Type 5	Type 6	Total Patient (by Hour)
8:00-9:00	6	2	1	1	1	1	12
9:00-10:00	6	2	1	1	1	1	12
10:00-11:00	7	4	2	1	1		15
11:00-12:00	8	4	2	1	1		16
12:00-13:00	10	5	2	1			18
13:00-14:00	10	5	2	1			18
14:00-15:00	12	4	2				18
15:00-16:00	10	3					13
16:00-17:00	5	2					7
17:00-18:00	4						4
18:00-19:00	2						2
19:00-20:00							
Total Patient (by Type)	80	31	12	6	4	2	135

Figure 4: Scheduling template based on Scenario 1