**The Rocksoft City Hospital**

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**Project Overview**

The Rocksoft City Hospital simulation projects primary focus is the Emergency Department and the patients there in. There were four main objectives defined in the outline of the hospital to which the simulation was made to explore. These objectives are defined to be optimizations for aspects of the hospital in the areas of, staffing and patient schedules, cost to the hospital and patients time in the hospital as well as the interrelationships between these factors. We were able to model the primary functions involved in the simulation with minimal changes from the specifications. The largest variation of our model with the specifications is our treatment for the Operating Room / Surgery Department. All variations from the specifications and assumptions made are as follows:

* + 1. Patients entering the OR are removed from the system as being considered outside the scope of the ED.
    2. Because of the removal of the OR we did not have to model scheduled surgery or emergency surgery entity types.
    3. All schedules given are assumed to be exact inputs.
    4. Entity arrivals are currently on a max allowed basis. This was one parameter to change for run lengths but we noticed that after a while the simulation began only sending the remaining patient type which is inaccurate.

Our largest change to our model was simply a size issue. This simulation has a lot of small components and their simply was not enough allowed modules in the student version to completely model this portion of the hospital (and since it is listed as optional it was decided that it was the acceptable portion to push out of our ED simulation).

One of the more clever implementations used in the Arena model was the creation of a sub model tasked with cloning the entities entering the waiting rooms.  In the simulation, there is a listed maximum time that arriving patients will wait in the waiting room before leaving.  The sub model creates clones of these patients, runs the time tolerances, and disposes of the clones when the original entity leaves the waiting room.  If the patient leaves or dies, it is recorded.

**Hypothesis**

Since the main purpose of the simulation is to gain an understanding of the hospital and how it functions in order to optimize along four key areas our hypothesis is four part:

1. We will need to add doctors and nurses to improve patients time moving through the system, at some added cost
2. We will be able to determine an optimum schedule for scheduling surgeries and diagnostics patients arrivals
3. In order to achieve the Joint Commission of Healthcare Accreditation standard door to doctor time for critical patients we will need to increase the number of trauma rooms or add enough doctors to push patients quicker through the system
4. Finally our last initial hypothesis is the best improvements to patients times will come from a joint increase in the number of rooms as well as the number of doctors and nurses on staff

**Experiments**

In order to model the changes we wished to run in the following experiments we were able to change the resources defined in our model.

Our experiments are analyzed during the running of the model. We ran the experiments under each condition watching parameters such as the line in the waiting room, the number of people who left because the waiting room was too full, the time spent waiting in queues for imaging or lab diagnostics, and average times that the resources were being utilized.

Experiments run:

(Currently all experiments are all run with one random number seed – same inputs to see effect on the output)

1. All resources set as constants as defined by the handout
2. Creating Schedules for nurse and doctor resources
   1. Schedule more nurses during peak times given by patient arrivals
   2. Schedule more doctors during peak times given by patient arrivals
   3. Adjust nurse and doctor schedules up or down to find optimum combinations
3. Adjusting the number of rooms up by two standard rooms
4. Adjust the number of rooms up by two trauma rooms
5. Adjust the number of rooms up by one trauma and one standard room
6. Adjust the number of rooms by one trauma room
7. Adjust the number of rooms by one standard room

Sample Outputs:

|  |  |  |
| --- | --- | --- |
| Number Standard Rm | Number Trauma Rm | LWBS |
| 6 | 2 | 2 |
| 6 | 3 | 1 |
| 6 | 4 | 1 |
| 7 | 2 | 0 |
| 7 | 3 | 0 |
| 8 | 2 | 0 |

It seems adjusting the number of standard treatment rooms up by as little as one room will make the hospital run without losing any patients to the LWBS category. In terms of our hypothesis the changing of the room’s resource is very effective in perfecting our hospitals desire to no longer loose patients before they can be seen.

|  |  |  |
| --- | --- | --- |
| Number of Nurses | Number of Doctors | LWBS |
| 1 | 1 | 0 |
| 2 | 1 | 2 |
| 3 | 1 | 0 |
| 1 | 2 | 1 |
| 2 | 2 | 3 |

After running some preliminary tests with changing the number of nurses and doctors in terms of constants, before building schedules, I noticed that the numbers of patients reneging did not seem to match with the logic behind the addition of resource. It would seem that our Nurses and Doctors make some sort of error by this behavior. But the error has not been found. Logically it should be that more nurses or doctors should increase performance or have no effect.

**Conclusions**

According to our data and the model the hospital runs fairly smoothly as is. Our best suggestions for improvements, at the smallest cost, were to increase the number of standard rooms by one. From our data it also seemed that we could remove a nurse and improve efficiency, this however does not seem like a viable data set and so this is a point for future work to better understand.

The best possible solution to handle the four key areas described in the handout included only making these small changes.

Future Work:

This assignment consists of a very large model that needs some more adjustments and fine tuning. Including points to record times entities take go from door to doctor, door to registration, and door to leaving simulation. Also, keeping track of time spent actually being seen versus total time in the system. These were recommended benchmarks to understand patients traveling through the system.

Also, adding an animation of the patients moving through the hospital would be beneficial to see the queues filling and the areas were patient flow was bottlenecking. Also adding a animation of the hospital would be a more explanation friendly view of the system. Currently viewing the patients moving around in the system is still beneficial in understanding.