

*Design and Implementation Process Reflection:*

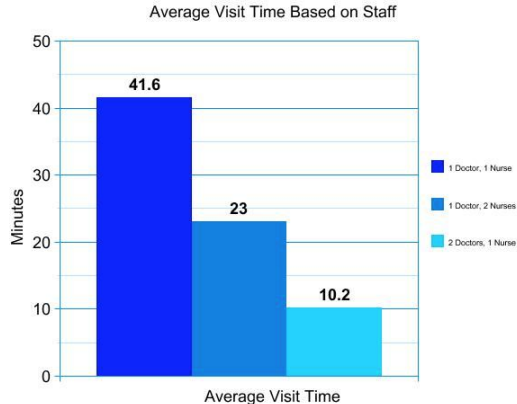
Originally, I started with two doctor and nurse classes that were independent and not based off of a parent class. Later, this was problematic because I needed to create a vector that would include both doctors and nurses. Because of this, I created a base class called staff that the doctor and nurse classes are children of. I had to use polymorphism so that the children classes had their own variables and functions that were different than the base class. Also, originally, I was just going to generate random numbers whenever I needed them. However, this was a problem because this simulation requires lots of random numbers and it is not efficient to always generate a number when you need it. Thus, in the final design, I ended up creating a separate random class that could be used to generate random numbers in any other class. This was much more efficient and made writing the code much easier. Moreover, at first, I was going to have an untreated patient queue within the simulation class. This was a problem because I needed a lot of variables and functions within the untreated patient queue class. Therefore, I ended up creating a separate class for the untreated patient queue in the final implementation, allowing me to fully implement the simulation class.

The final design is comprised of a staff parent class that has doctor and nurse children classes. Then, there is a simulation class that contains the majority of the variables and functions involved in the program. There is a random class for generating random numbers, and there is an untreated patient queue class that is comprised of patient objects created in my patient class.

While implementing this simulation, I learned how to use maps and priority queues because I hadn't learned about them in class yet. Moreover, I learned how to create a medium-sized project from scratch for the first time, and I feel really proud of my work. I learned how to take multiple classes and fit them together while figuring out where specific variables and functions were supposed to go.

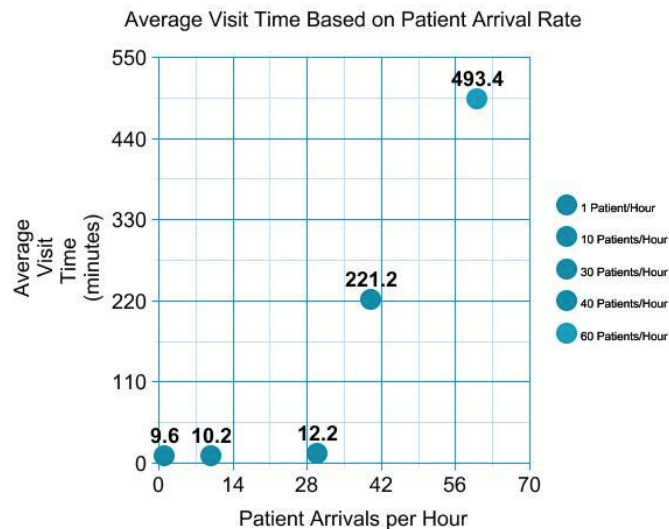
*Using the Simulation:*

The thing that I really like about simulations is that you can learn from them. First of all, we can see how the average patient visit time changes based on the number and types of staff that are in the emergency room. To see how the visit time changed based on these things, I ran the simulation 5 times when the emergency room had 1 doctor and 1 nurse, 5 times when the emergency room had 1 doctor and 2 nurses, and 5 times when the emergency room had 2 doctors and 1 nurse. For all of these simulations, I set the patient arrival rate to 10 patients per hour. Then, I took the average of each category and compared the different combinations of staff members. The results were the following:



As one can see, when there was only 1 doctor and 1 nurse, the visit time was the longest. The visit time was lower when there was 1 doctor and 2 nurses, and the visit time was lowest when there were 2 doctors and 1 nurse. In other words, it seems like adding more staff decreases the average visit time. Additionally, doctors seem to decrease the average visit time more than nurses. This would be helpful to know if you wanted to make your emergency room as efficient as possible.

Another thing that we can learn from the simulation is the average visit time based on increasing patient arrival rates. I ran the simulation 5 times with a patient arrival rate of 1, 5 times with a patient arrival rate of 10, 5 times with a patient arrival rate of 30, 5 times with a patient arrival rate of 40, and 5 times with a patient arrival rate of 60. For all of the simulations, 3 doctors and 3 nurses were working. I took the average for each arrival rate and compared the average visit time for the different rates. The results were the following:



As one can see, as the patient arrival rate increased, the average visit time also increased. Particularly between 30 and 40 patient arrivals per hour, the average visit time really increased, as there were no doctors or nurses available for a long time. Seeing information like this would be important because you would know that the patient arrivals per hour ought to be well below 30 patients per hour for this number of doctors and nurses.