Problem Definition:

San Francisco General Hospital is experiencing a 25% ambulance diversion rate due to the hospital often being at max capacity and is unable to take in new patients. In 2010, SFGH experienced the highest percentage of diversion across all hospitals in San Francisco. This is the result of the complex end-to-end process with many moving parts within the hospital at each time which leads to inefficiencies and poor communication. The goal of our simulation is to reduce the time spent on diversion as it creates unnecessary delays which could impact a patient's health and take time away from administering critical treatment which could save a patient's life. From an administration point of view, we must aim to minimize diversion through internal optimization of the entities within the hospital, specifically focusing on triage levels, zone capacity, and ambulance arrival patients.

In this health care environment, there are several stakeholders where each have their own objectives. The main internal stakeholders of the hospital mainly include the staff and patients. Within the staff, this can include doctors, nurses, health specialists, ambulance drivers, social workers and care workers. The main objectives of these stakeholders revolve around ensuring patients receive the best, most effective treatment possible to maintain their health and wellbeing. Regardless of the patients triage status or current health state, it is crucial that staff stakeholders ensure the best treatment is being delivered. Hospital administration is another massive stakeholder whose goals are to make sure the hospital is running smoothly, both logistically and financially. Furthermore, while this is most prevalent in the United States, insurance companies are another massive stakeholder whose goals do not always align with the staff and administration. The objective of these companies is profit which may conflict with the staff's objectives of delivering the best treatment. Depending on the patient's coverage, insurance companies often limit the medication and treatment patients can receive, conflicting with the staff's objective of delivering the best treatment. This is just one example of conflicting objectives within hospital stakeholders.

Additional stakeholders include:

- Patients
- Hospital Staff (Doctors, nurses specialists)
- Hospital Administration
- Ambulance drivers
- Insurance Companies
- Social Workers

For diagram of hospital system, see **figure #1** in the appendix

Development of a Simulation Model:

Assumptions:

Time-related Assumptions :

- Hospital operates 24 hours a day.
- Walk-in patients' arrival time is expressed as a linear expression.
- Zone 1 workup time has an upper limit of 3 hours.
- Zone 1 time combines lab and workup.
- Zone 2 and Zone 1 have the same workup time.
- Zone 3 and 4 have half of the workup time of Zone 1.

Patient-related Assumptions:

- Ambulances' patients cannot be assigned ESI level 5.
- Walk-in patients cannot be assigned ESI levels 1 and 2.
- Ambulances' patients have equal chances of being assigned ESI 1-4 after triage.
- Walk-in patients have equal chances of being assigned ESI 3-5 after triage.
- Walk-in patients and trauma arrivals cannot be diverted.
- Hospital admission is immediate.
- 75% of patients are ambulance, 25% are walk in
- 50% of ambulance patients are trauma, 50% are non-trauma patients

Hospital Operation Assumptions:

- Constant number of hospital staff.
- Hospital zones always operate at the maximum available beds.
- No lack of hospital staff, and all doctors can treat all patients.
- No maximum capacity in the waiting room.
- No patients die randomly throughout the Emergency Department process.
- Total Diversion occurs when Zone 1 and Zone 2 are completely filled.
- If no resuscitation is needed and Zone 1 is full then move to Zone 2 and vice versa
- All resuscitation beds are reserved for resuscitation patients.

Communication and Staffing Assumptions:

- Hospital staff do not need to congregate, and there are no communication efficiencies.

Static Formulation

Entities

- Patients
- Hospital Staff
    - Doctors
    - Nurses

Attributes

- Patients
  - Arrival type (Walk-in, ambulance)
  - Triage level (1-5)
  - Zone (1-4)

System State

- LS_{1R} : capacity of zone 1 resuscitation beds
- LS_{1RN} : capacity of zone 1 non-resuscitation beds
- LS_2 : capacity of zone 2
- LS_3 : capacity of zone 3
- LS_4 : capacity of zone 4
- LQ_w : waiting room for zone 3 and 4
- LS_t : triage status (0, 1)
- LQ_t : triage queue

Events

- A : Patient arrival
- D_t : Departure from Triage
- E_i : Departure from Zones i = R, 1, 2, 3, 4
- AD : Ambulance diversion

Event Notice

- (A, T) arrival event
- ($D_{t,}$ T) triage departure event
- (D_z, T) zone departure event
- (E, T) system exit event
- (AD, T) diversion event

Activities

- IAT constant (110/day - 5/hr)
- Series time of Triage 1 cont (1-2min) = 1 + (rand()*(2-1))
- Series time of Triage 2 cont (1-2min) = 1 + (rand()*(2-1))
- Series time of Triage 3 cont (1-2min) = 1 + (rand()*(2-1))
- Series time of Triage 4 cont (10-15min) = 10 + (rand()*(15-10))
- Series time of Triage 5 cont (10-15min) = 10 + (rand()*(15-10))
- Series time of Zone 1 cont (20+15 to 3*60 + 1*60) = 35 + (rand()*(180-35))
- Series time of Zone 2 cont (35 -180) = 35 + (rand()*(180-35))
- Series time of Zone 3 cont (20 - 90) = 20 + (rand()*(90-20))
- Series time of Zone 4 cont (20 - 90) = 20 + (rand()*(90-20)

As Dr. Chris Barton, what additional information would you need to construct a simulation model of the ED at SFGH?
For Dr, Chris Barton, there is some additional information that would be required to construct a simulation model. Firstly would be availability of hospital staff. For the sake of our model, we assume that staff limitations do not exist, meaning when a nurse is needed, they are always available. Some additional information that would be important would be staff availability and scheduling to ensure there is sufficient staff. Another important piece of additional information may include resuscitation statistics. The success rate for resuscitation is an important piece of information in determining the flow of the hospital. The last important piece of information would be split between walk-in arrivals

What do you think some of the possible constraints are?
The primary constraint in the hospital's emergency department is evidently the availability of beds, with the degree of constraint escalating with the criticality of the ESI level. The more severe the ESI level, the more pronounced the limitation imposed by the number of beds. The second significant bottleneck arises from specialized beds equipped with x-ray machines and resuscitation facilities; with only 8 such beds in the hospital, this creates a substantial constraint. The third constraint stems from communication inefficiencies within the hospital, necessitating meetings among hospital staff, including doctors and social workers, to ensure the smooth operation of processes. However, in our optimization model, we are eliminating these inefficiencies to push the theoretical limits of optimization.

Dynamic Formulation
For pseudocode of simulation see figure #2 in the appendix or see the attached PDF in the Learn dropbox

What data would you need to complete the static model and construct the dynamic model and what would you want it to look like?
All data that is needed to complete the static model and construct the dynamic model is put into the assumptions, however I will summarize the most critical ones here.

- Zone 1 workup upper limit time or how the workup time data is distributed
- Zone 2, Zone 3, Zone 4 workup times are not mentioned, only that it decreases in danger
- Arrival ratio on average of ambulances versus walk in, this is important.
- Are patients arrival linear or are there times of the day where there is a spike
- What % of patients are assigned to each ESI level on average
- What % of arriving patients are trauma patients

All these data points help us to build a more comprehensive and accurate simulation of the emergency department model.

How do you analyze the data in order to parameterize the data for the simulation model and where do you consider the variability within the model and how would that impact your model?
In order to analyze the data for the simulation model, there are several key elements to look at that would impact the model the greatest. The first is different bottlenecks, unnecessarily long waiting times for example. Aligning the hospital's priority with yours, checking if all trauma patients are capable of being treated and in the long run it can hold all incoming patients. Metrics and objective functions that measure

success would be if the system is in a steady state and does not have infinite queues that build up over a long simulation period. Certain questions need to be answered such as does this system decrease ambulance diversion from 25%. If it does we must consider if there are external factors that are unaccounted for that may be causing the inefficiencies that lead the hospital to be mostly at capacity.

How would you incorporate the rest of the hospital in the ED simulation model?
There are many different channels in which the emergency department is connected to the rest of the hospital. The best place to start is by adding other key departments connections such as the psychiatry department, pharmacy, maternity ward depending on the patient's needs once their issue has been assessed. The existing simulation model would need to be updated while reviewing the flow, the management of staff and other hospital resources. It would be an extremely complicated process, but it is most important to have a strong understanding of how different departments are connected whether by doctor communication or the transfer of patients.

Implementation of the simulation model

The simulation was created in python, you can find and run the code in Google Colab here. You can also find the link to simulation attached in the dropbox notes.

Verification and Validation

According to the feedback received on our last simulation as well as the new given parameters, here are the following changes that have been implemented in our python code.

- Ambulance arrival probability distribution has been altered to match the distribution provided in the parameters
- Walk in arrivals probability distribution has been changed to match the distribution provided in the parameter
- Previously, triage level 2 (emergency) was assumed to not be applicable to walk-in patients. This triage level has now been added to walk-in possibilities

We found that the rest of our similarity was made with valid assumptions and while not all assumptions match exactly with the assumptions provided in the parameters sheet, we believe that our model is valid.

We believe our model is justified given the assumptions we made during the development. We wanted to be very clear about our assumptions as we split them up into 4 different categories: time, patient, hospital and communication assumptions. Many of these were made based off the information provided in the initial case study, as well as our own understanding and experience with hospitals. Firstly with time related assumptions, the main points we wanted to deliver were that the hospital never shuts off, and our workup time calculations included all the actions performed after the patient had been triaged until patient discharge. We set an upper limit of 3 hours for workup time in zones 1 and 2 since this was information provided in the case study. Based on this piece of information, we estimated that workup times in zones 3 and 4 were half of the workup time in zone 1 given that these patients had much lower triage levels so they were dealing with less severe issues. In patient-related assumptions, we made assumptions related to patient attributes and their entrance type. From the original case study, it is not explicitly stated what the ratio of ambulance to walk-in visits is so we assumed based on external sources. Furthermore, we also wanted to make triage levels dependent on arrival type so we assumed that ambulance arrival triage levels are more severe ranging from 1 to 4. Walk-in triage levels are less severe ranging from 3-5. These were made based on our understanding of these arrival types and logically, ambulance arrivals are generally more severe. Lastly, in hospital assumptions, we wanted to simplify the model of hospital staff as well as establish possible flows between zones. We first assumed that there was never a shortage of hospital staff. The case study never specified the amount of available staff and never went too in-depth of any issues related to staff shortage. Therefore we thought the assumption of no staff shortages was valid. Next, we established flows between our zones. In the event that zone 1 was filled, we allowed patients to move to zone 2 as long as they did not need resuscitation beds. In the event that all resuscitation beds were filled, we would then declare diversion.

Ultimately, we based our model heavily on the assumptions listed above, and by verifying the validity of the assumptions, we in turn verify the validity of the model.

Numerical Experimentations and Output Analysis

Where is the primary bottleneck in the hospital system?

The primary bottleneck in the hospital system occurs in the process following the zone assigning stage. With SFGH, the issue lies in the capacity of resuscitation beds as there are only 8 in the entire hospital. Given that 20% of all ambulance arrivals are assigned triage level 1 (resuscitation) and the workup time taken for level 1 triage patients can be up to 3 hours, this creates a huge issue. SFGH is also one of the only hospitals in the area that accept diverted ambulances from other hospitals, so with a resuscitation capacity of only 8, a 20% resuscitation arrival probability and being the sole accepter of diverted patients, zone 1 and zone 1 resuscitation is almost guaranteed to fill up, forcing the hospital to go into critical care diversion at a rate much greater than the neighboring hospitals.

How would you assess whether or not the present number of beds is optimal for the demand levels?

For zones 1 and 2, one way that we can assess the optimality of zone capacity is by analyzing the time spent in critical care diversion. Critical care diversion is when zones 1 and 2 are completely full, forcing the hospital to divert patients of critical triage levels away to other hospitals. There are a few methods that I believe that we can use. Firstly, we can conduct external comparisons with neighboring hospitals to look at the proportion of time SFGH is spent in critical care diversion compared to their statistics. If we find that SFGH is spending an above-average amount of time in CC diversion, then we can quickly conclude that the current amount of beds is not optimal for zones 1 and 2. Similarly with zones 3 and 4, we can look at the waiting room capacity and calculate average waiting room times and capacity. By conducting an external analysis with neighboring hospitals and given the case where SFGH has abnormal waiting room levels, then we can conclude their present number of beds is not optimal. For further analysis, we can conduct internal analysis and compare the capacity of zones 1 and 2 with the capacity of zones 3 and 4. If we find the average capacity of zones 1 and 2 is much greater than the average capacity of zones 3 and 4, this provides some insight into a possible solution of converting some beds in low triage-level zones to be assigned for high triage-level patients.

How else could the beds be allocated in such a way to speed up the processing of certain types of patients.

From the case study, SFGH seems to have fixed capacity levels for all zones which we believe is one of the major causes for high levels of total diversion. It is extremely difficult to re-allocate beds for resuscitation patients given the equipment limitations of the hospital. Only 8 rooms are fitted with proper resuscitation equipment so without additional investment, we do not see a possible way to solve this issue through reallocating beds. For low-urgency or referral patients, one bed allocation strategy could be to have 2 rooms specifically designed for very quick treatments that do not require any additional treatment apart from a prescription. By designating 2 rooms, we essentially create another triage zone for the patients of lowest priority that allows them to be treated very quickly. In the case that a patient has a more serious issue than at first expected, they can then be assigned a bed from the quick treatment room which again, quickly frees up the room for the next non-urgent patient. Apart from creating new quick treatment rooms, allowing flow between zones would also be helpful. Patients assigned to zone 3 should not be fixed to that zone in the event that a more critical patient needs a bed. Patients zones should be variable to prevent which provides an added layer of flexibility which in turn increases patient treatment time.

What would be your measure of success when evaluating the success of the ED and any proposed changes? What are some possible success metrics or objective functions?
When evaluating the success of the ED after implementing new changes, the main measure of success would be looking at the time spent in CC or total care diversion as a proportion to neighboring hospitals. I think that the comparison factor is extremely important in this case since it provides a baseline or goal that we want to reach that is reasonable. For example, if after implementing changes we find that time spent in total diversion has decreased, it is a good sign, however if it is still much greater in comparison to other hospitals more work needs to be done. In the case of SFGH, if we can decrease time spent in diversion to be the same as the city average, then it would be a great indication of successful changes. Some possible success metrics also include the average waiting room capacity and waiting times for non-urgent patients. While addressing the diversion issue takes priority, we also need to ensure that all patients are treated quickly and efficiently, regardless of their urgency.

What are the costs associated with the current diversion plan versus any change you plan on implementation?
With the current plan, the costs associated are typical with any hospital where the main 2 costs include staff and maintenance costs. Staff costs include salaries of all employees and maintenance include supply costs, resources, electricity and heating. If we choose to implement changes to decrease zone capacity and demand, which in turn decrease time spent in diversion, one of the main costs that will be affected are ambulance costs. There are many costs associated with ambulances including fuel, wage, tools, vehicle maintenance, and vehicle insurance. If we are able to decrease diversion time, we lower the distance traveled for each ambulance on average. At scale, this will reduce the costs previously mentioned which would be hugely beneficial to SFGH.

Conclusion

How could you extend this model to assess the impact of ambulance diversion on all the hospitals in the city?
To model all hospitals in the city, we would need to create a massive model where each hospital and all of its processes are modeled within. We would essentially need to repeat the model of SFGH we created for every hospital in the city. An important step would be to establish relationships and a hierarchy between the hospitals to address the issue of which hospital diverts where. For example, if SFGH is on critical care

diversion and so is the next closest hospital, where are ambulances diverted? Also, do all hospitals on diversion divert to the same hospital until that target hospital is full? By establishing pre-defined relationships between each hospital, we can create an internal diversion policy that is most efficient. This is also very similar to some of the simulations we have been creating in class. This is very similar to a bank teller system with multiple queues where each teller is a hospital and the queues are the ambulances. Based on the status of the bank teller and the length of queues, visitors may need to switch queues, representing the diversion. Ultimately, we can extend the model of our simulation by creating individual models of each hospital, as well as use in-class DES concepts to simplify and replicate this model which would be a great tool for analysis and estimation.

How do processes and decisions at SFGH affect the other hospitals in San Francisco?
From the case study, it is shown that SFGH spends the most time on average compared to all neighboring hospitals in San Francisco. This essentially means that a large portion of the ambulance patients received by the other hospitals were patients originally meant for SFGH but were diverted. Therefore, the processes and decisions at SFGH will significantly impact the other hospitals. In the case that new processes are implemented and diversion time at SFGH has decreased, this would also reduce the demand for a bed at all other hospitals since the patients that would normally be diverted now have a bed at their original target hospital. Neighboring hospitals will experience lower demand for beds due to decreased diversion from SFGH. However, the opposite can also be said. If newly implemented processes are not effective, diversion rates can increase which further increases demand at neighboring hospitals. A good analogy to use to represent this dilemma is a factory. The factory is only as fast as its slowest worker. If the slowest worker increases their speed, then the entire factory prospers. In our case, the factory is San Francisco and SFGH is the slowest worker.

What are the strengths and limitations of using hospital administrative data to build a simulation model like this?
The strengths of using administrative data to build a model include:
Data is easily accessible and available: Since the data is coming from the source directly, it is easily accessible to the simulation builders and you can trust the legitimacy due to the validity of the source.

Cheap. We are simply accessing records that are kept within the hospital. No additional research or surveying is required which will be much more cost-effective.

The limitations include:
Biased and inaccurate data: The samples used in the data may not be the best representation of the hospital population. Also, it is entirely possible for busy departments to be sampled more than less common departments which lead to biases and inaccuracies in the data

Data from the perspective of the board: If the data is coming from administration, it may not be a true representation of what the staff are feeling. Doctors and nurses are much more involved and can provide more valuable insights that are not recorded in administrative data.

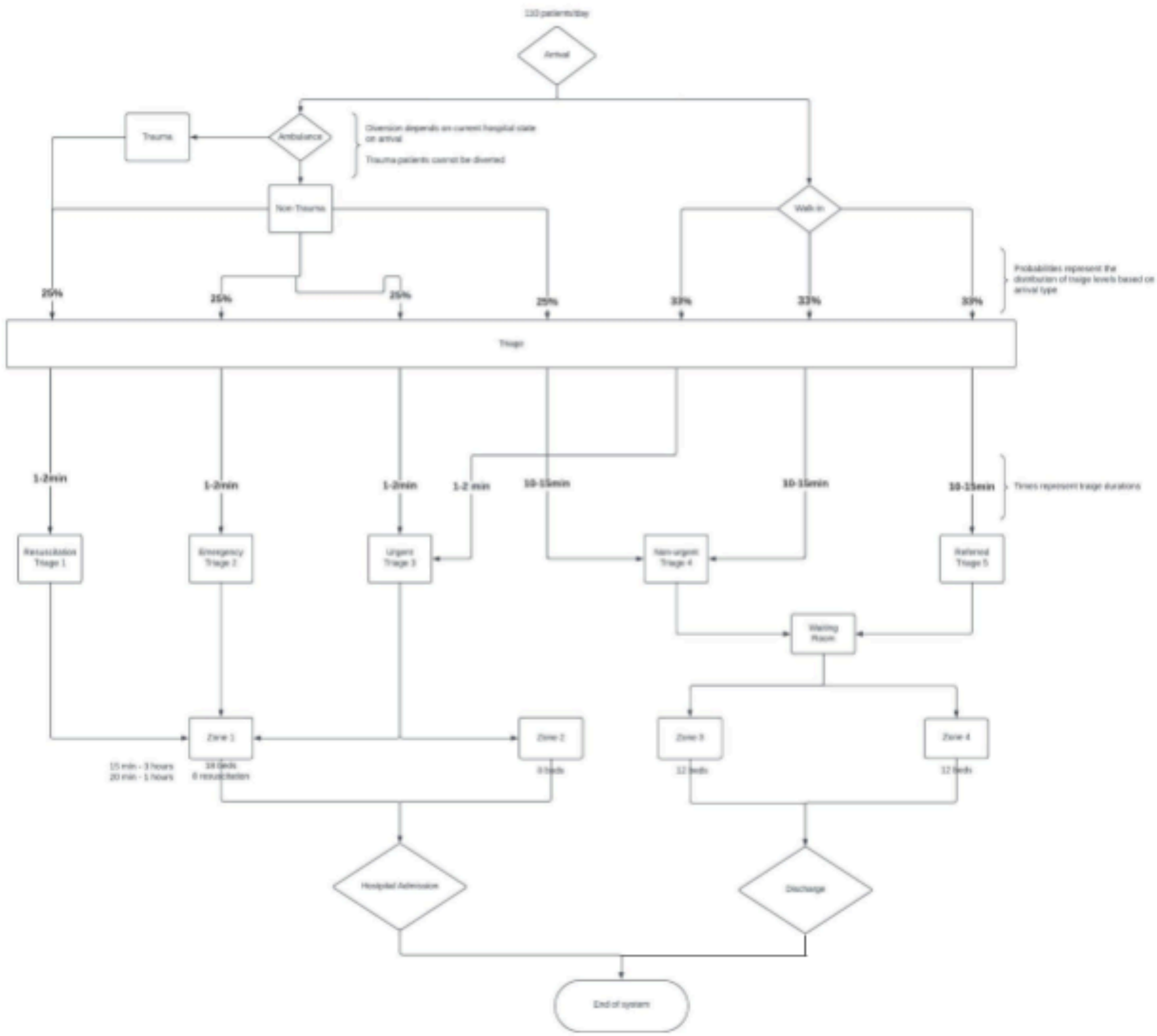
Other than hospital administrative data, are there other data sources that could be used?

Some other great sources include data from hospital staff and patients directly. Administrative data tells us what should be happening, but data from those who experience it first hand tells us the reality. For patients who are either discharged or admitted into the hospital, we can ask them to fill out a questionnaire to outline their experience inside the ED. After collecting responses over the course of a certain time period, we can go over the results of the questionnaires to see what problems pationest are complaining about. The popularity of these issues allows us to place issues into a ranking so we can tackle the most prevalent issues first. Interviewing doctors and nurses would also be another great source of information. Since they are the ones dealing with patients directly, they may be able to provide data and insights we wouldn't be able to capture from administrative data. They would also be a great source of solutions. Again, since they experience it daily, they may be able to provide a new strategy or process to reduce diversion times.

How would you ensure that all stakeholders are satisfied by your report on findings and change recommendations?

Ensuring satisfaction starts before the modeling process even begins. It is critical to speak with as many stakeholders as possible to determine the key issues to address. During the process I would maintain a strong level of transparency so they are aware of what's going on at every stage in the development process. Finally, in my actual report, I would include evidence of my findings through simulation results and staff interviews. This way not only is there proof of my recommendation from the simulation, but also supporting proof from trusted sources within the hospital.

Appendix:



[LucidChart Link]

Figure #1: Flowchart of hospital system

Arrival

```
1. generate next arrival (A, t+ta), add to FEL

2. r = rand()
   if r ≤ 0.75
         go to step 3
   else go to step 4

3. r1 = rand()
   if r1 ≤ 0.33
       assign urgent triage level
       if LSt = 1
           LQt = LQt + 1
       else LSt = 1, schedule (Dt, t + S)    S = continuous(1, 2)
   else if r1 ≤ 0.66
       assign non-urgent
       if LSt = 1
           LQt = LQt + 1
       else LSt = 1, schedule (Dt, t + S)    S = continuous(10, 15)
   else
       assign referral
       if LSt = 1
           LQt = LQt + 1
       else LSt = 1, schedule (Dt, t + S)    S = continuous(10, 15)

4. r2 = rand()
   r3 = rand()
   if r3 ≤ 0.5
       assign trauma
       assign resuscitation
                                     if LSt = 1
                                         LQt = LQt + 1
                                     else LSt = 1, schedule (Dt, t + S)    S = continuous(1, 2)
   else
       assign non-trauma
       if r2 ≤ 0.25
           assign resuscitation
           if LS1R ≥ 8, schedule (AD, t)     <- CC Diversion
           if LSt = 1
               LQt = LQt + 1
           else LSt = 1, schedule (Dt, t + S)    S = continuous(1, 2)
       if r2 ≤ 0.5
           assign emergency
           if LS1 + LS2 ≥ 26, schedule (AD, t)     <- total diversion
           if LSt = 1
               LQt = LQt + 1
           else LSt = 1, schedule (Dt, t + S)    S = continuous(1, 2)
       if r2 ≤ 0.75
           assign urgent
           if LS1 + LS2 ≥ 26, schedule (AD, t)     <- total diversion
           if LSt = 1
               LQt = LQt + 1
           else LSt = 1, schedule (Dt, t + S)    S = continuous(1, 2)
```

if $r_2 \leq 1$

  assign non urgent

  if $LS_t = 1$

    $LQ_t = LQ_t + 1$

  else $LS_t = 1$, schedule $(D_t, t + \sigma)$ σ = continuous(10, 15)

Triage Departure

1. if $LQ_t > 0$

   $LS_t = 1$, $LQ_t = LQ_t - 1$, schedule $(D_t, t + \sigma)$

   else

   $LS_t = 0$

   go to step 2

2. if resuscitation

   $LS_{IR} = LS_{IR} + 1$, schedule $(D_2, t + z)$

   else if emergency

   if $LSIRN \geq 15$

   $LS_2 = LS_2 + 1$, schedule $(D_2, t + z)$

   else

   $LS_{IRN} = LS_{IRN} + 1$, schedule $(D_2, t + z)$ z = continous(35, 160)

   else if urgent

   if $LSIRN \geq 15$

   $LS_2 = LS_2 + 1$, schedule $(D_2, t + z)$

   else

   $LS_{IRN} = LS_{IRN} + 1$, schedule $(D_2, t + z)$

   else if non-urgent

   if $LS_3 \geq 12$ and $LS_4 \geq 12$

   $LQ_v = LQ_v + 1$

   if $LS_3 \geq 12$ and $LS_4 < 12$

   $LS_4 = LS_4 + 1$, schedule $(D_2, t + z)$

   if $LS_3 < 12$ and $LS_4 \geq 12$

   $LS_3 = LS_3 + 1$, schedule $(D_2, t + z)$

   else if referral

   if $LS_3 \geq 12$ and $LS_4 \geq 12$

   $LQ_v = LQ_v + 1$

   if $LS_3 \geq 12$ and $LS_4 < 12$ z = continuous(20, 90)

   $LS_4 = LS_4 + 1$, schedule $(D_2, t + z)$

   if $LS_3 < 12$ and $LS_4 \geq 12$

   $LS_3 = LS_3 + 1$, schedule $(D_2, t + z)$

Zone Departure

Depart Zone R

1) $LS_{1R} = LS_{1R} - 1$

patient admitted

Depart Zone 1

1) $LS_{1RN} = LS_{1R1} - 1$

patient admitted

Depart Zone 2

1) $LS_2 = LS_2 - 1$

patient admitted

Depart Zone 3

1) if $LQ_w > 0$

$LS_3 = LS_3 + 1$, $LQ_w = LQ_w - 1$, schedule $(D_{z3}, t + z)$

else

$LS_3 = LS_3 - 1$, patient departs

Depart Zone 4

1) if $LQ_w > 0$

$LS_4 = LS_4 + 1$, $LQ_w = LQ_w - 1$, schedule $(D_{z4}, t + z)$

else

$LS_4 = LS_4 - 1$, patient departs

Figure #2 - Dynamic formulation pseudocode

Case Study Notes:

- Problem: Ambulance diversion 25% of the time (too much waiting) at capacity
    - AD is the process where ambulances are redirected to other hospitals because the primary hospital is full capacity
- Stats: SFGH has 686 total beds annual 40,000 patients, 36-40 beds ED
- 3 levels of AD: open, CCD must be taken no diversion, TD overload of patients
- Two types of clients: Cardiace, respirator or traumatic arrest or post-arrest patients, other
- SFGH override trauma, open for all trauma always

- SFGH Zones 4:
    - Operating room: immediate surgery, ICU equipment, once restore -> leave
    - Zone 1: Four rooms, x ray, resuscitation, trauma, criticall ill, urgent patients also
      18 bed capacity (resuscitation can be doubled up
    - Zone 2: urgent patients without need for advanced equipment
      four patients (option to double up)
    - Zone 3: Lower acuity, waiting for available bed
      Six patients (option to double up)

        - Zone 4: Lower aquiety
            12 beds (8 exam, 4 hallway <- if necessary additional)

- Patients arrive in 2 ways
    - Walk in
    - Ambulance
        - Immediately brought to triage bed for initial assessment
            - Urgent patients undergo assessment and workup immediately
                - Triage time: 1-2min
                - Zone 1 workup time: 15min to several hours
                - After workup is completed they wait in ED or assessed by specialist
                - During or after workup tests may be completed which take between 20min to 1 hour
            - Non-urgent waiting in hallway in a queue
                - Triage time: 10-15min

- At any given time patients are assigned at least 1 nurse
    - Some patients have only 1
    - Some have 1 primary and another who assists in initial evaluation
    - Critically ill patients can have 3-4 nurses
- Each patient is assigned a resident physician and 1 supervising physician

- When patients arrive by walk in…
    - Check in a nurses desk
    - Triage process to measure vitals and assigned to a triage category
    - Moved to a wait area to be called to enter ED
    - Once in ED workup is done by the team
- When patients arrive by walk in they are likely more stable and will endure wait times

- After undergoing workup patients are either discharged or admitted for further treatment
- If patient is admitted…
    - Bed request is made to specific unit for patient (ex. Post surgery are admitted to ICU)
    - Due to space stable admitted patients wait in the ED and ICU is reserved for critical or post surgery patients
    - Admitted patients are assigned a primary admitting team
        - Physician
        - Nurses
        - Social workers

- When the decision is made for a patient to be discharged…
    - Large number of individuals involved so times are variable
    - In the case a patient passes at any point in their stay they are discharged

1: Resuscitation
2: Emergency
3: Urgent
4: Non-urgent
5: Referred

Ambulance triage levels range from 1-4
25% resuscitation, 25% emergency, 25% urgent, 25% non-urgent

Walk ins ranges from 3-5
33% urgent, 33% non-urgent, 33% referred

Assume levels 1-3 are considered urgent and immediate
Assume zone 1-2 patients are admitted
Assume zone 3-4 patients are discharged