

# Improving Patient Flow by Reducing Emergency Department Length of Stay

Olivia Goss (PM), Brooks Langdon, Ali Madere, Domenic Pacitti  
Veterans Healthcare System of the Ozarks

Dr. Ed Pohl  
VA Advisory Board

## Data Analysis

### Level 3 Acuity Tukey Pairwise Comparisons

Grouping Information Using the Tukey Method and 95% Confidence

MD_1	N	Mean	Grouping
Provider A	18	247	A
Provider B	31	241.5	A
Provider C	23	238.7	A
Provider D	19	217.1	A
Provider E	35	212.9	A
Provider F	14	207.1	A

Means that do not share a letter are significantly different.

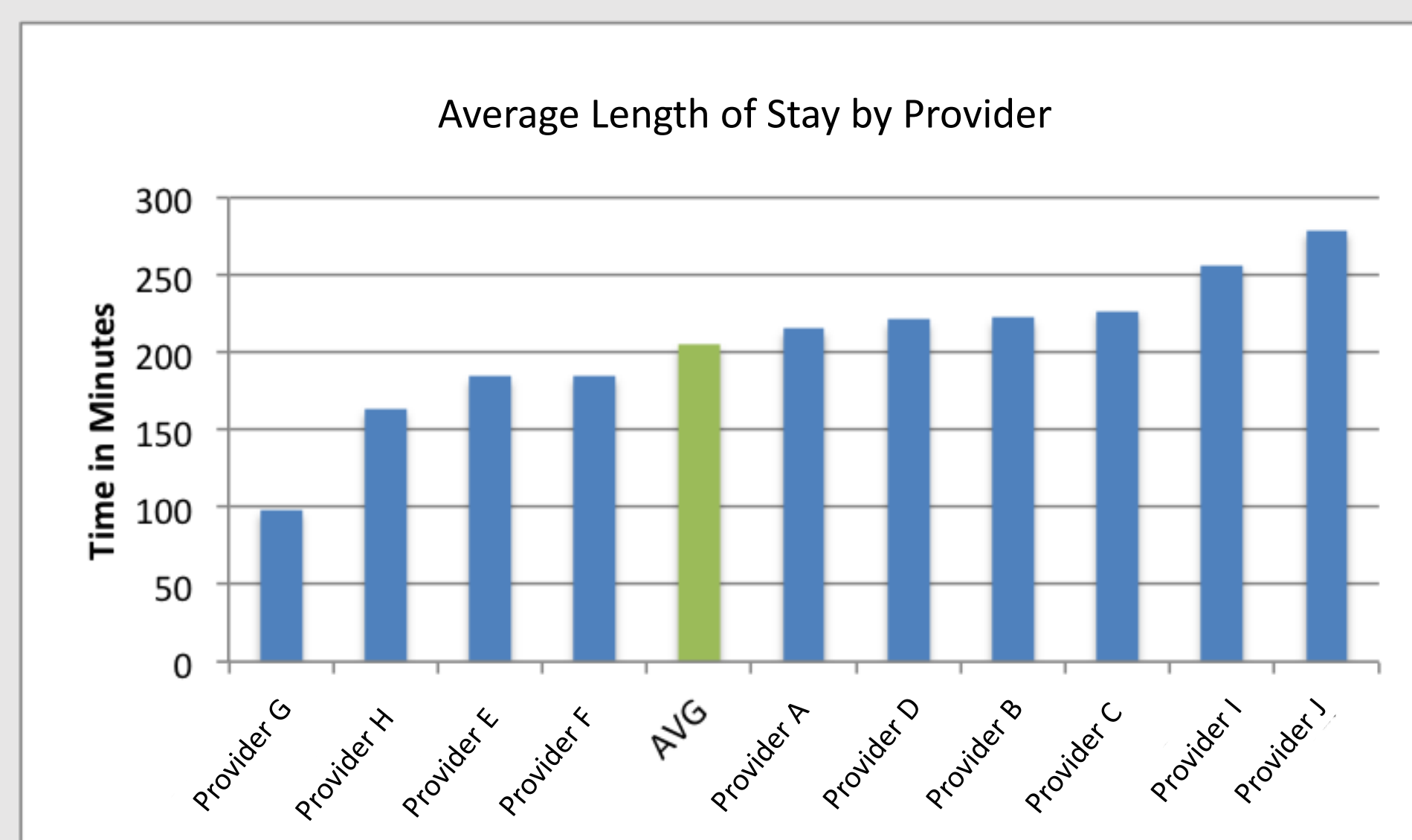
### Level 4 Acuity Tukey Pairwise Comparisons

Grouping Information Using the Tukey Method and 95% Confidence

MD_2	N	Mean	Grouping
Provider C	13	238.4	A
Provider D	11	189.5	B
Provider B	15	188.8	B
Provider F	14	164.9	B
Provider E	24	125	B

Means that do not share a letter are significantly different.

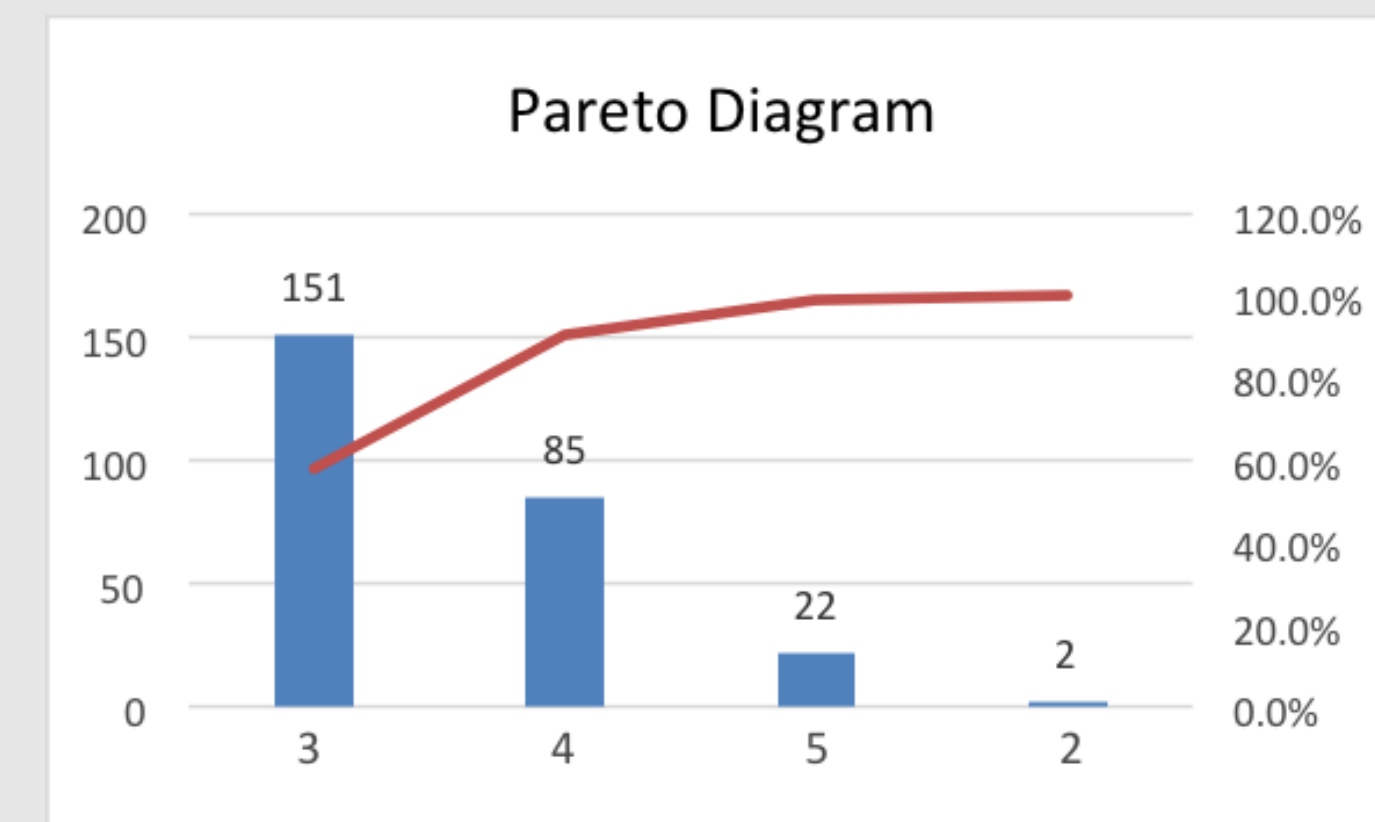
**Insights:** All doctors seeing level 3 acuity patients average around the same patient length of stay. However, in level 4 acuity patients, there is a significant difference in patient length of stay for Provider C. This provider also experiences the same time for levels 3 and 4.



This figure shows the average length of stay for acuity level 3 for all providers. The green bar indicates the average for a weeks worth of data with varying amounts of patients seen by each provider.

For data analysis, it was discovered that there is a significant difference in patient length of stay between level 3 and 4 acuity. This is represented in our simulation model.

Two-Sample T-Test and CI: Elapsed Acuity 3 & 4				
Method				
$\mu_1$ : mean of Elapsed_1				
$\mu_2$ : mean of Elapsed_2				
Difference: $\mu_1 - \mu_2$				
Equal variances are not assumed for this analysis.				
Descriptive Statistics				
Sample	N	Mean	StDev	SE Mean
Elapsed_1	140	227.8	97.4	8.2
Elapsed_2	77	173	107	12
Estimation for Difference				
95% CI for				
Difference	54.8	(25.7, 83.8)		
Test				
Null hypothesis: $\mu_1 - \mu_2 = 0$				
Alternative hypothesis: $\mu_1 - \mu_2 \neq 0$				
T-Value	3.73			
P-Value	0.000			
Statistically Significant Difference of Means P-Value < 0.05				



This figure shows that 90% of the patients seen are level 3 and 4 acuity. Therefore our model focuses on these acuity levels.

## Portfolio Analysis

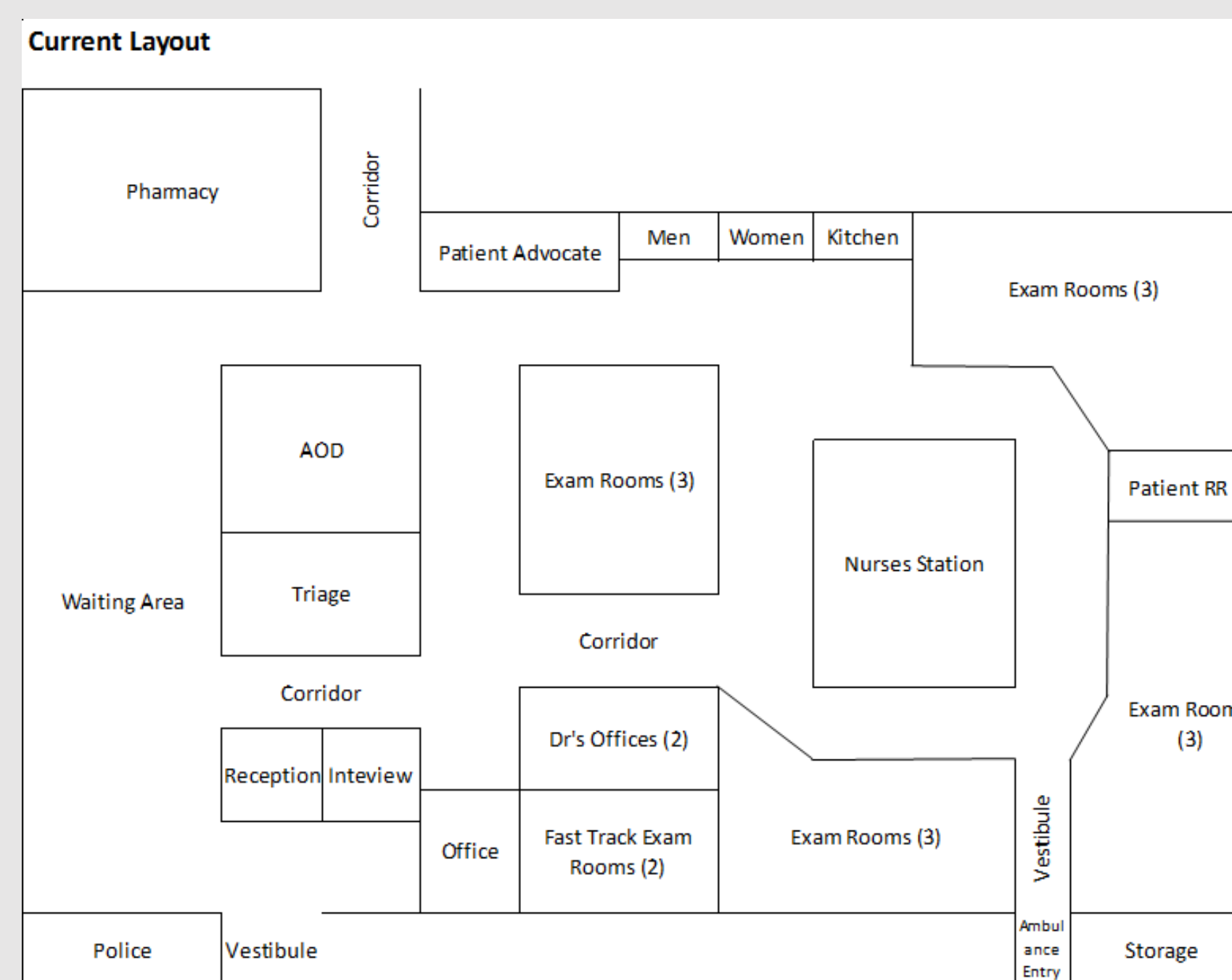
Project	Cost	Time Reduction	Benefit/Cost	Cumulative Cost	Cumulative Time Reduction
1 Labs and radiology max 1 hr.	1	40.54	4054000.00	1	40.54
2 Admit patients in 30 mins	1	16.26	1626000.00	2	56.8
3 Reconfigure Doctors' Station	11000	11.50	104.55	11002	68.3
4 Tubing system	100000	5.44	5.44	111002	73.74
5 Add provider	100000	5.07	5.07	211002	78.81
6 ER beds	100000	1.74	1.74	311002	80.55



**Recommendation:** The VA emergency department should implement projects 1-3 based on the portfolio analysis. This is determined by where the curve begins to level off and the benefit comes at a high cost. However when discussing with the advisory board, project 4 would be another viable option.

**Sensitivity Analysis:** If the VA emergency department experiences a 25% increase in patient arrivals the current system would result in an average length of stay of around 248 minutes. With recommended changes the system would result in an average length of stay of 155 minutes.

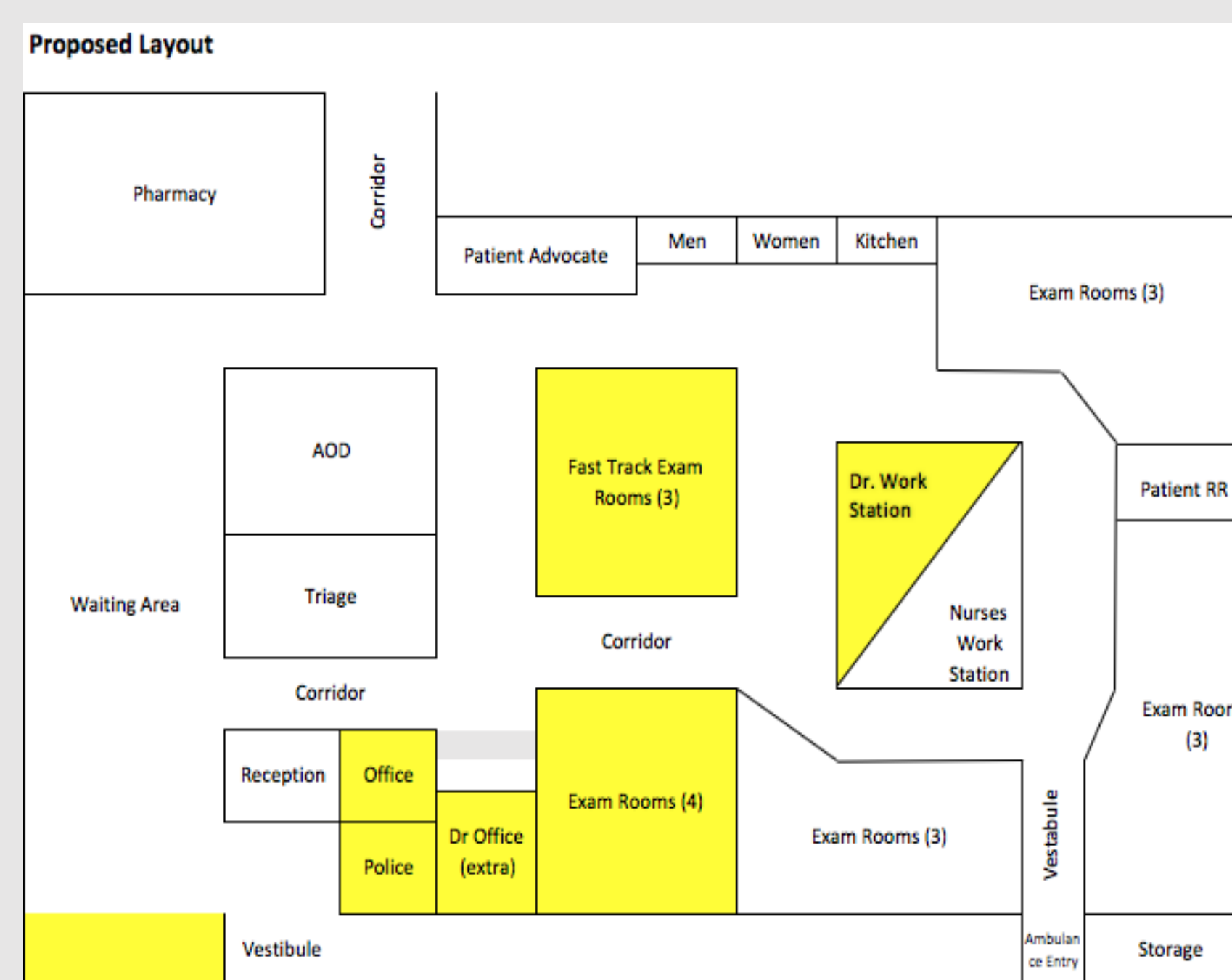
## Facility Layout



	Main ED rooms	Nurse Station	Dr. Station	Triage	Waiting Room	Front Clerk	Labs	Imaging	Psych Eval	Fast Track	Pharm	Current
Main ED rooms	8	4	4	1	0	0	0	0	0	4	2	23
Nurse Station	4	8	1	1	1	0	0	0	0	2	2	18
Dr. Station	2	2	8	1	1	0	0	0	0	4	1	9
Triage	8	2	8	8	2	0	0	0	0	4	1	15
Waiting Room	8	0	0	0	0	0	0	0	0	2	0	10
Front Clerk	0	0	0	0	0	0	0	0	0	1	0	1
Labs	0	0	0	0	0	0	0	0	0	0	0	0
Imaging	0	0	0	0	0	0	0	0	0	0	0	0
Psych Eval	0	0	0	0	0	0	0	0	0	0	0	0
Fast Track	0	0	0	0	0	0	0	0	0	1	0	1
Pharmacy	0	0	0	0	0	0	0	0	0	0	1	1
												77

Current Layout Efficiency 65%

**Current Layout:** The current layout is at 65% efficiency. This is due to doctors primary location being far away from patients and nurses as well as the distance from ancillary services to the emergency department.

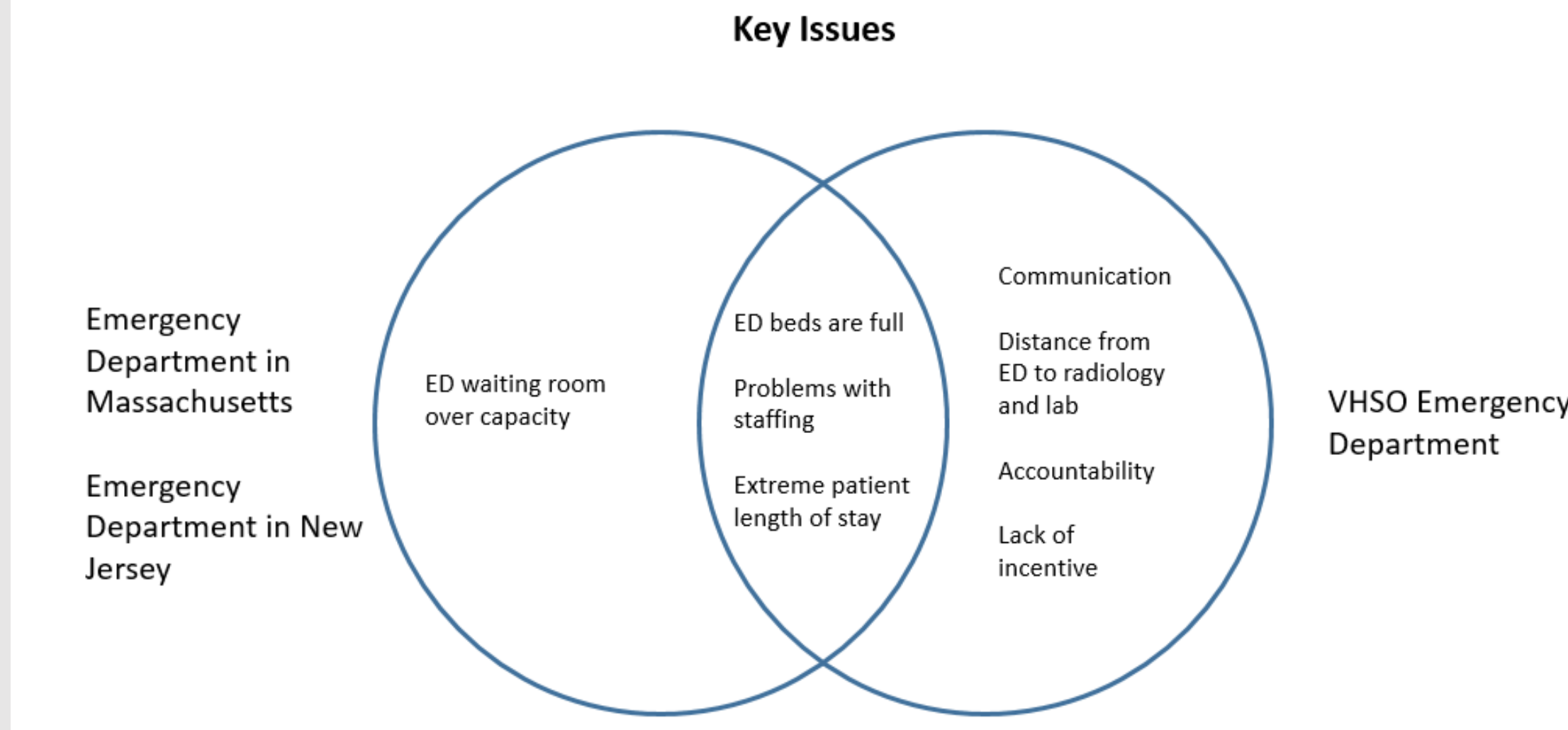


	Main ED rooms	Nurse Station	Dr. Station	Triage	Waiting Room	Front Clerk	Labs	Imaging	Psych Eval	Fast Track	Pharm	Proposed
Main ED rooms	8	8	8	1	0	0	0	0	0	4	2	31
Nurse Station	8	8	1	1	1	0	0	0	0	8	2	28
Dr. Station	2	2	8	1	1	0	0	0	0	4	1	9
Triage	8	2	8	8	2	0	0	0	0	4	1	15
Waiting Room	8	0	0	0	0	0	0	0	0	2	0	10
Front Clerk	0	0	0	0	0	0	0	0	0	1	0	1
Labs	0	0	0	0	0	0	0	0	0	0	0	0
Imaging	0	0	0	0	0	0	0	0	0	0	0	0
Psych Eval	0	0	0	0	0	0	0	0	0	0	0	0
Fast Track	0	0	0	0	0	0	0	0	0	1	0	1
Pharmacy	0	0	0	0	0	0	0	0	0	0	1	1
												95

Proposed Layout Efficiency 80%

**Proposed Layout:** The proposed layout increases efficiency to 80%. This layout includes moving the doctors station closer to the nurses station and patients and implementing a fast track area. If the ancillary services like labs and radiology could be moved closer this would improve efficiency.

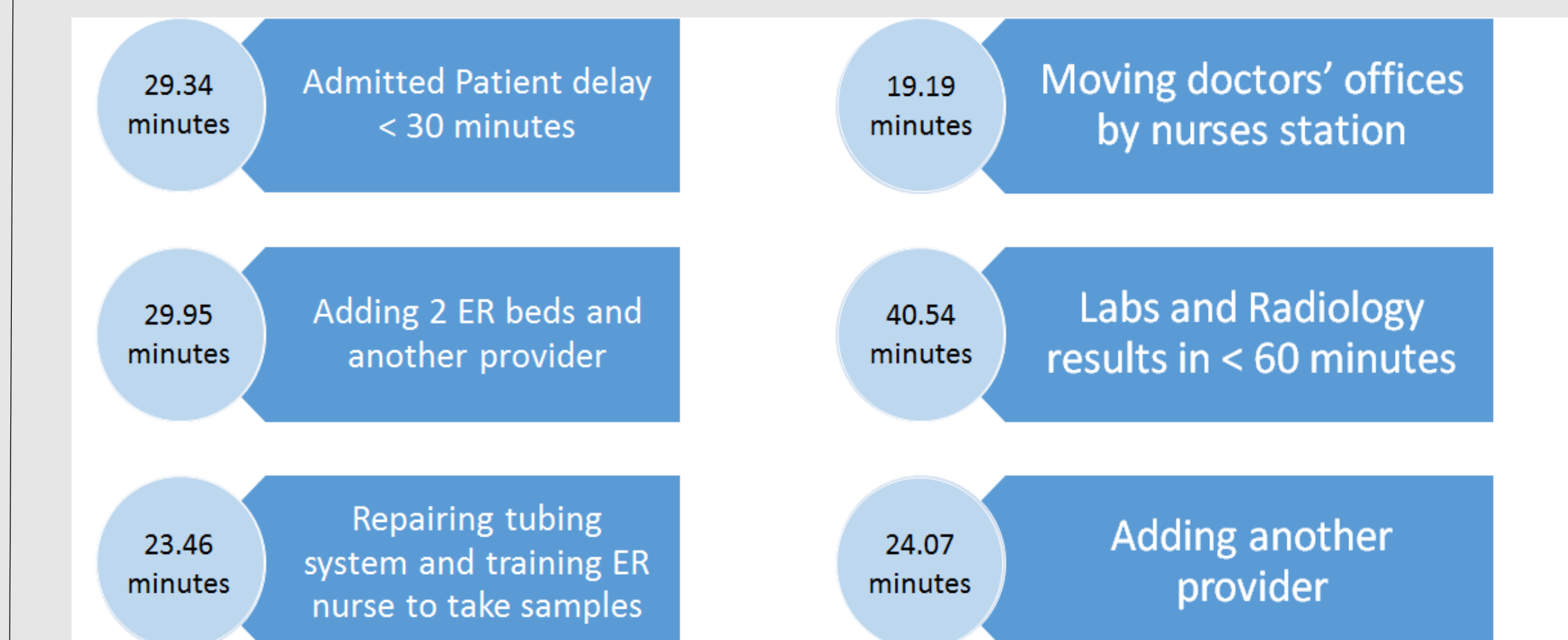
## Modeling



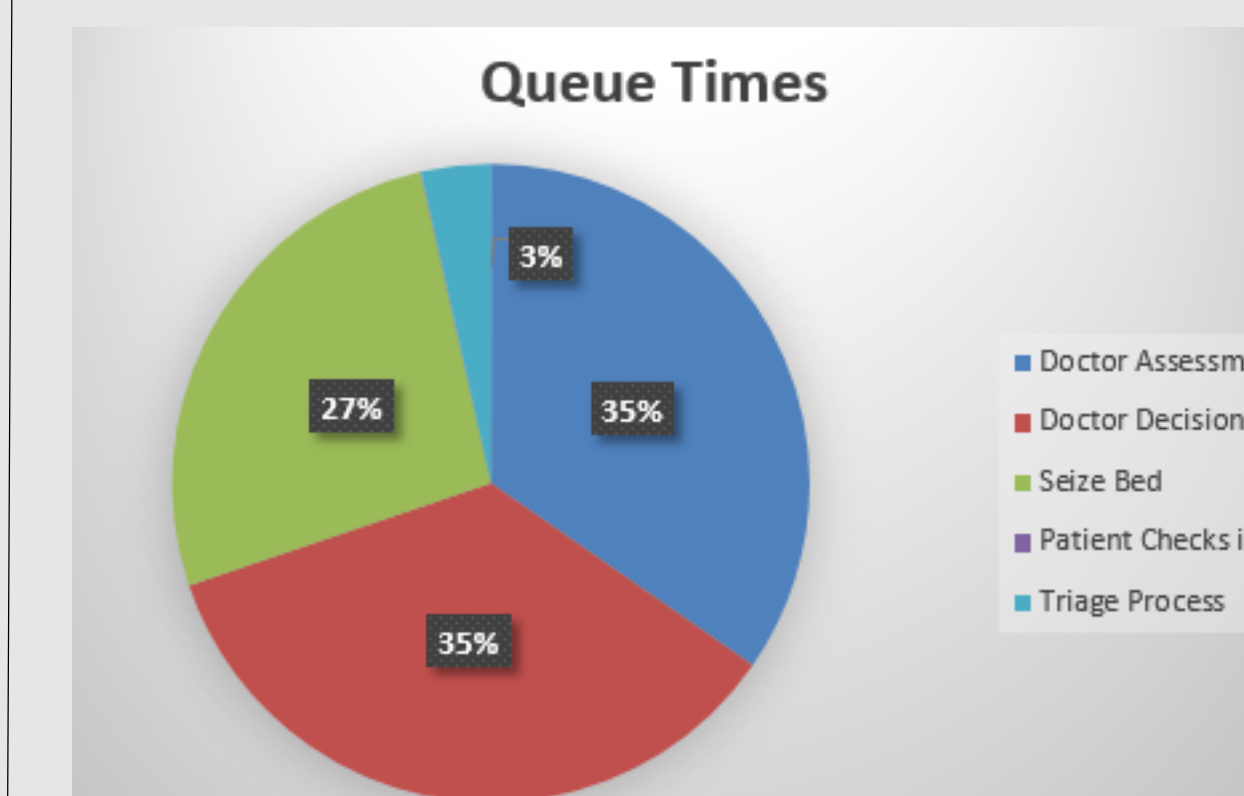
**Literature Review:** Based on private emergency departments facing similar key issues, our team used simulation to find unforeseen bottlenecks as well as test modifications.

METHOD	Arrivals per week	Length of Stay (mins)	Triage Time (mins)
1. Work Sampling	275	202	12
2. Data Analysis	281	205.2	9.3
3. Simulation Results	287	208.78	14.8

**Verification/Validation:** The data given and work sampling collected both validated and verified that the model is an accurate representation of the system.



**Modifications:** Different alternatives were tested in the simulation model to determine the affect on patient length of stay.



**Insights:** Patients experience many delays within the process but the majority of time in the queue is spent waiting on a doctor. The maximum average beds used with infinite number of beds available is 8.5 which means 9 beds is an appropriate number of beds given the amount of patients seen.

