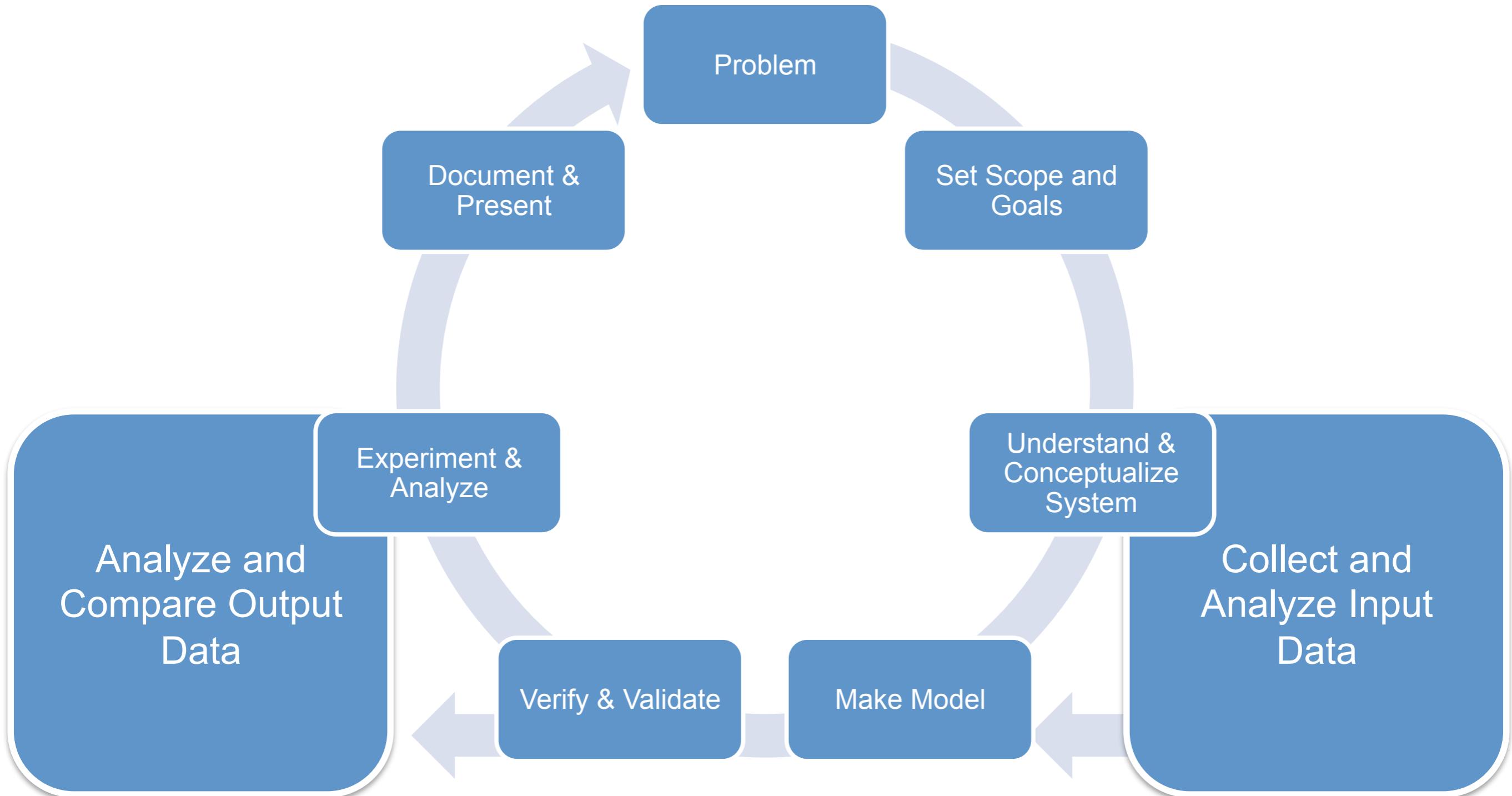


FlexSim Simulation Competition

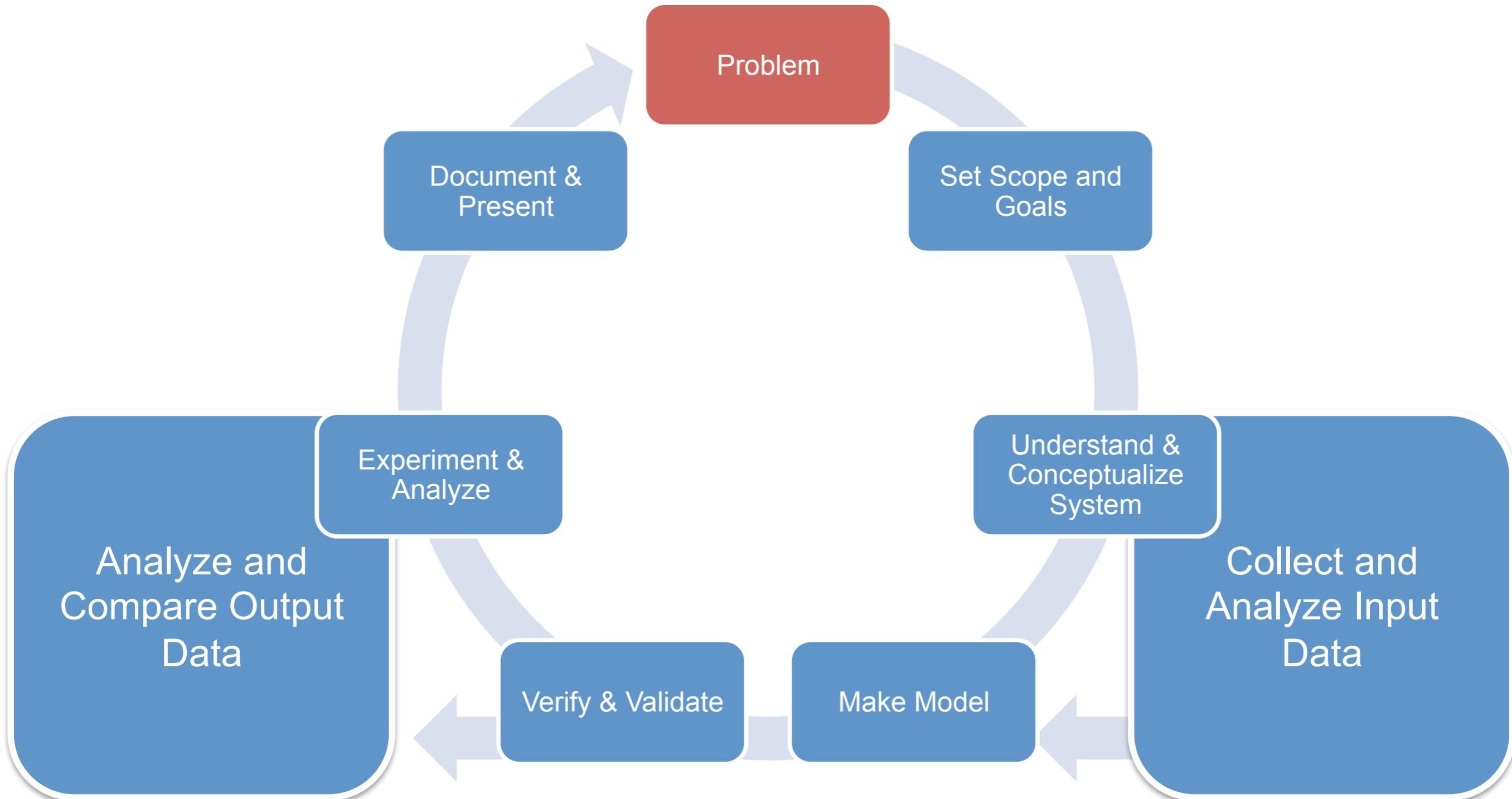
Society for Health Systems
University of Wisconsin - Madison

Samuel Schmitt, April Soler, Erkin Otles & Mike Russo

The Simulation Cycle



The Simulation Cycle

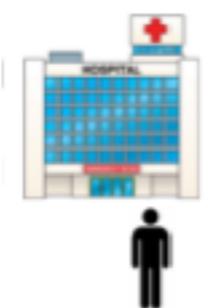
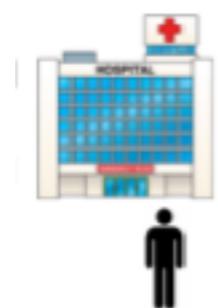
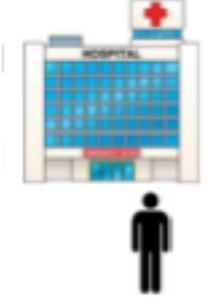
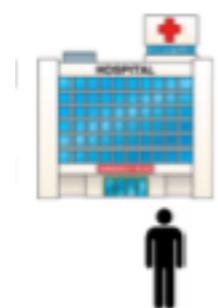
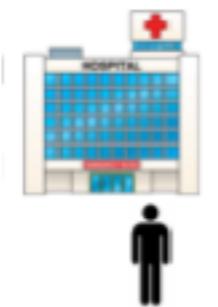
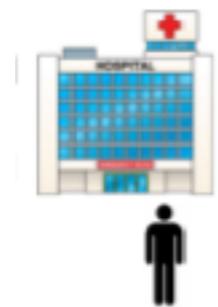


Why EM needs IEs

- Shifting landscape of healthcare
 - In pt utilization down
 - EM utilization
 - EM becoming a new gate keeper
- Emergency Medicine
- Should be citations on this page

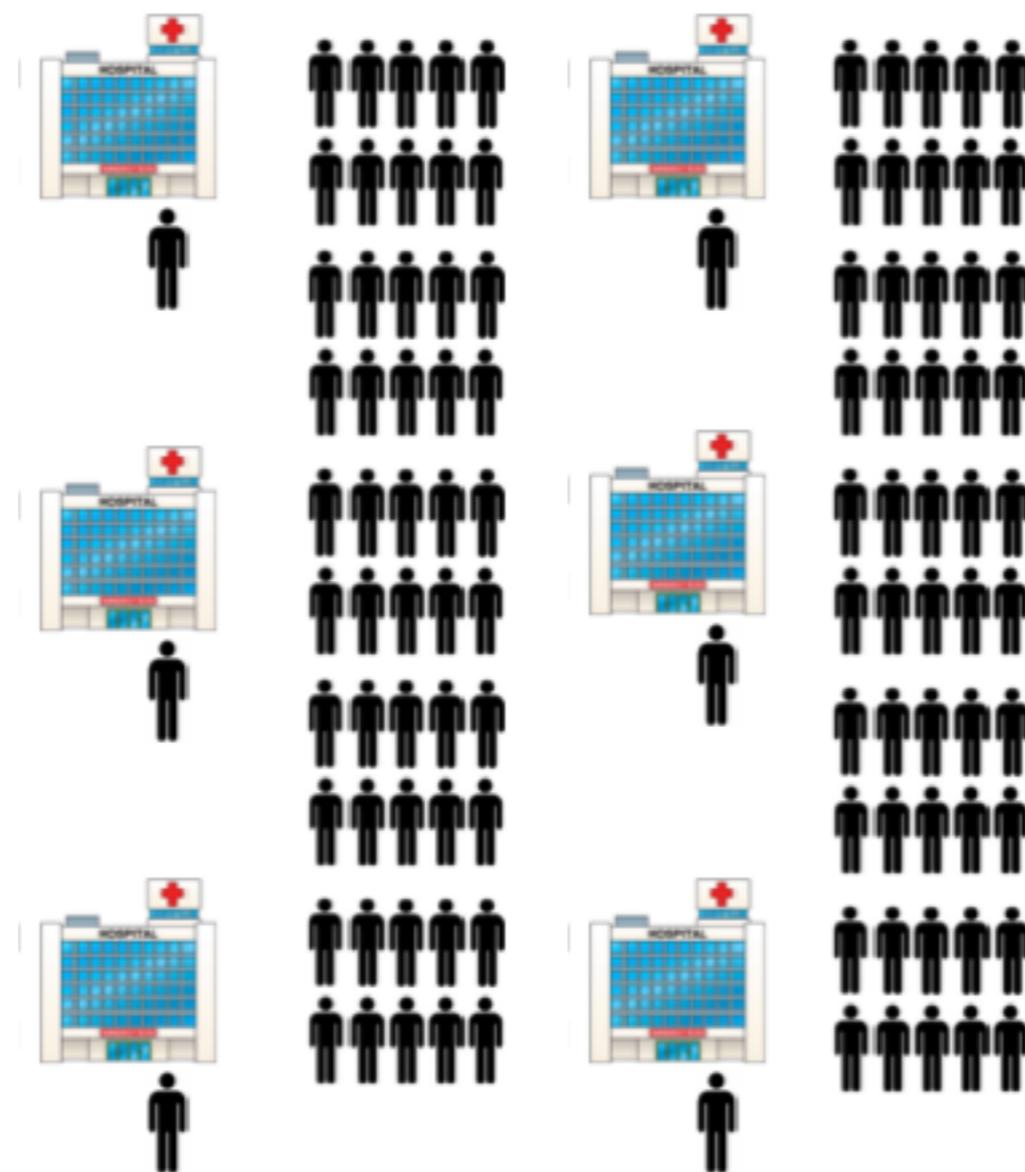
In order to face today's healthcare trends of declining reimbursement, increasingly high debt, and greater focus on outpatient services, streamlining operations is essential.

ED Crowding



ED Crowding

ED Visits
+30,000

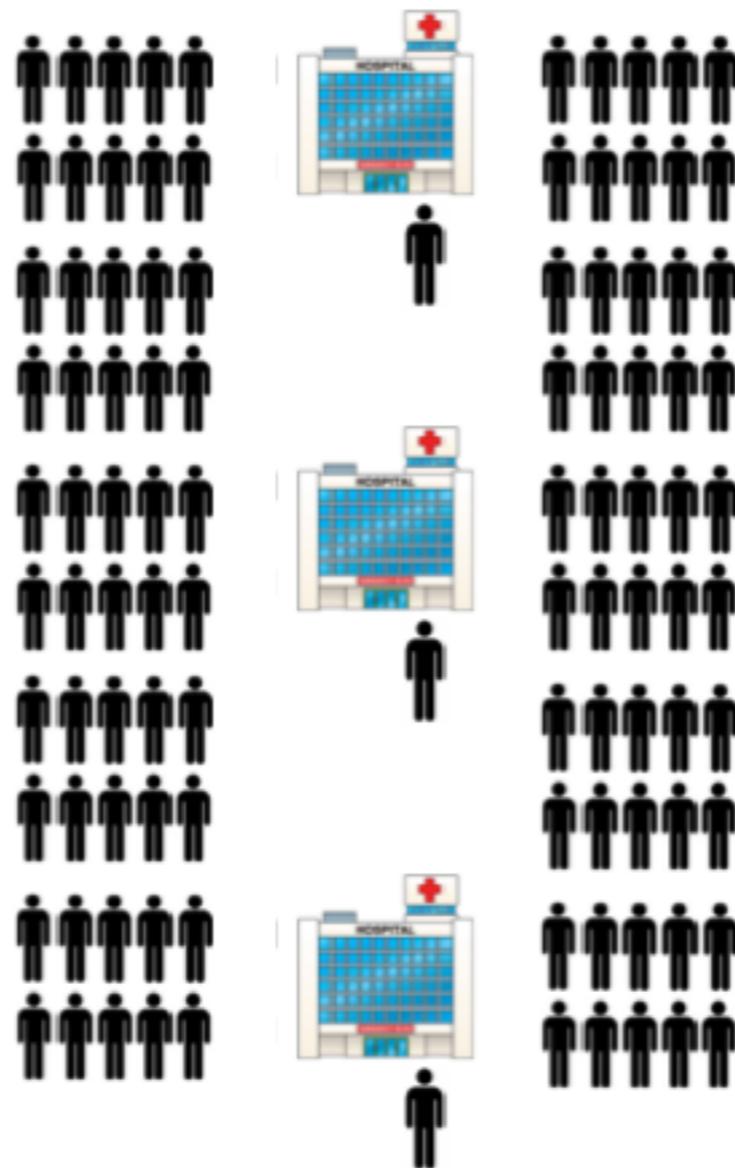
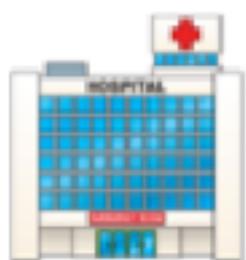


ED Crowding

ED Visits
+30,000



ED Facilities
-560

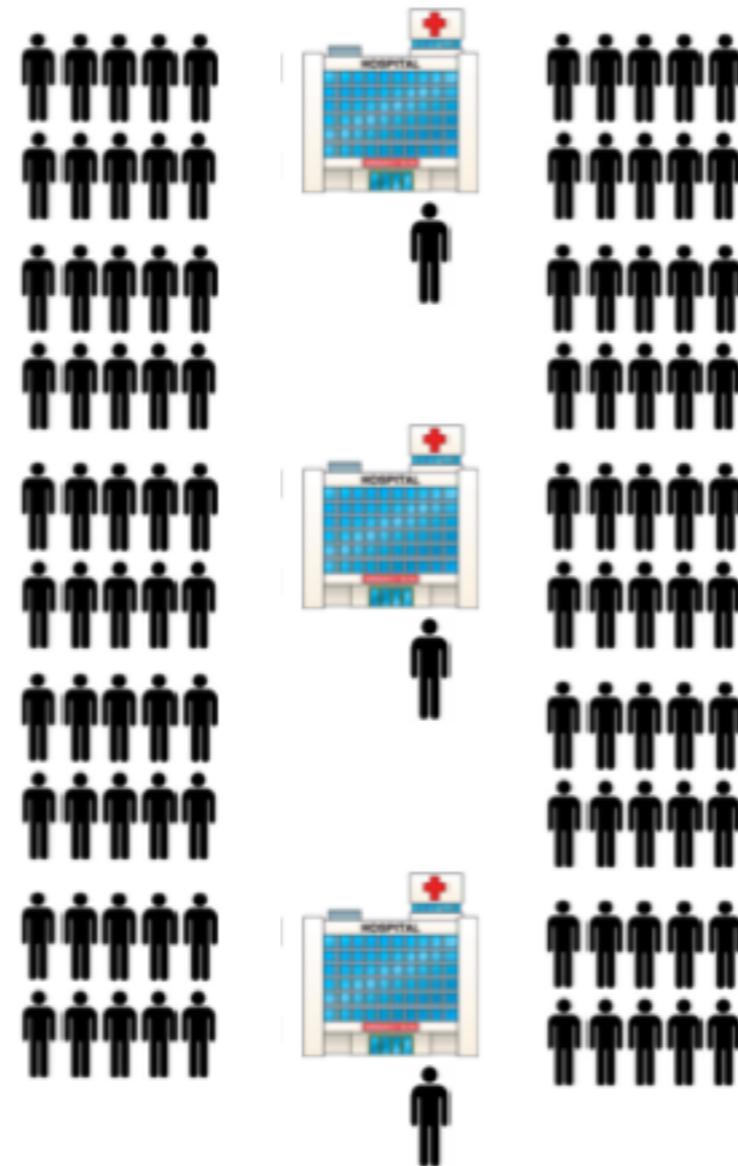
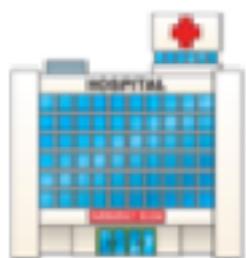


ED Crowding

ED Visits
+30,000



ED Facilities
-560



- Delayed Treatment
- Patient Elopement
- Prolonged Transport
- Increased Mortality
- Financial Losses

About the WRM C ED

- Susquehanna Health
- Current ED
 - 45,000 Patients Last Years
 - 52% of all WRM C admits
 - Very similar to UW ED
 - ED Opportunities - take this from case

Patients	Description
ESI 1	Patient requires immediate life-saving intervention
ESI 2	Patient is in severe pain, in a high risk situation, or is confused/disoriented
ESI 3	Patient requires many resources
ESI 4	Patient requires few resources
ESI 5	Patient requires limited resources
Mental Health	Patient is dealing with psychological issues and could potentially hurt oneself or others

A New Opportunity

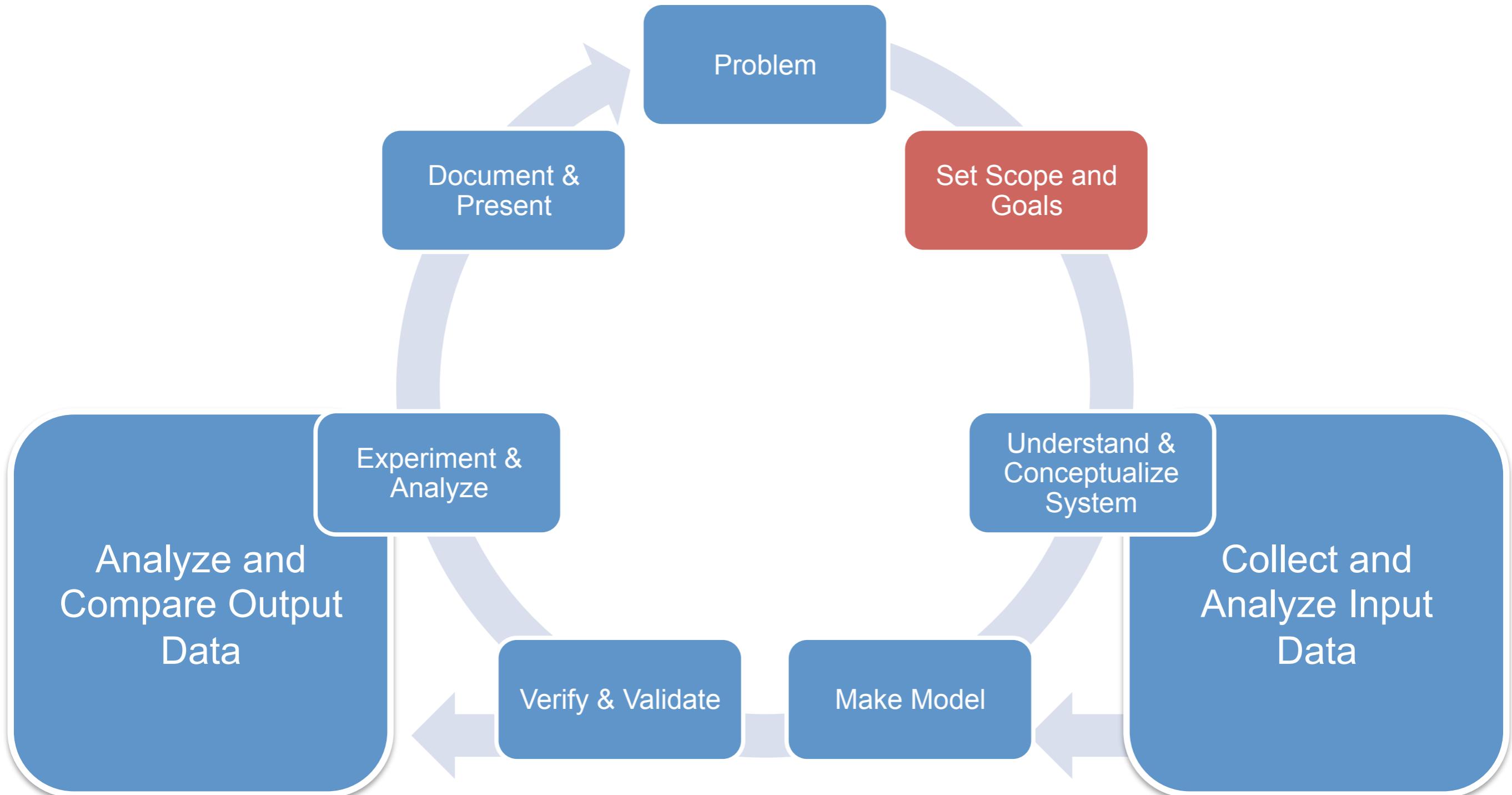
36 Bed ED

Fast Track Beds
Behavioral Health Pod
Cardiac Resuscitation
Room

X-ray & CT scanners



The Simulation Cycle



Goals

ED Leadership Deliverables

1. Delivery Methods

- Traditional Triage and Bed
- Provider in Triage Team (PITT)
- Super Fast Track/PITT (SFT/PITT)

2. Staffing Levels



HealthIE

HealthIE aimed to determine the most efficient and effective delivery model by producing process maps, building a representative FlexSim simulation model, and comparing alternatives.

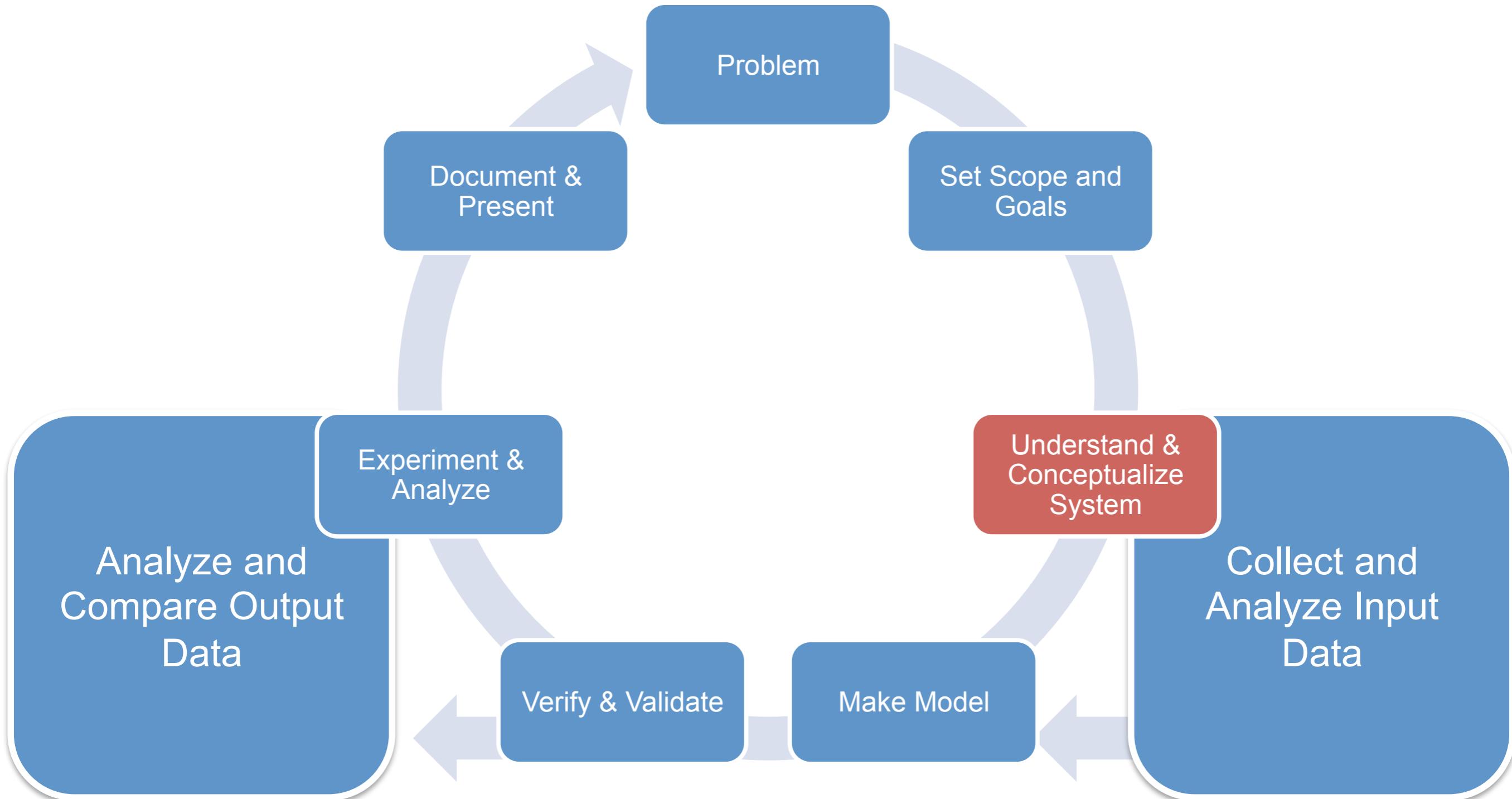
Scope

Two Team
Prioritized Work

Key Performance Indicators:
Length of Stay
Average Door to Provider Time
Leave Without Being Seen (LWBS)

Timeline

The Simulation Cycle

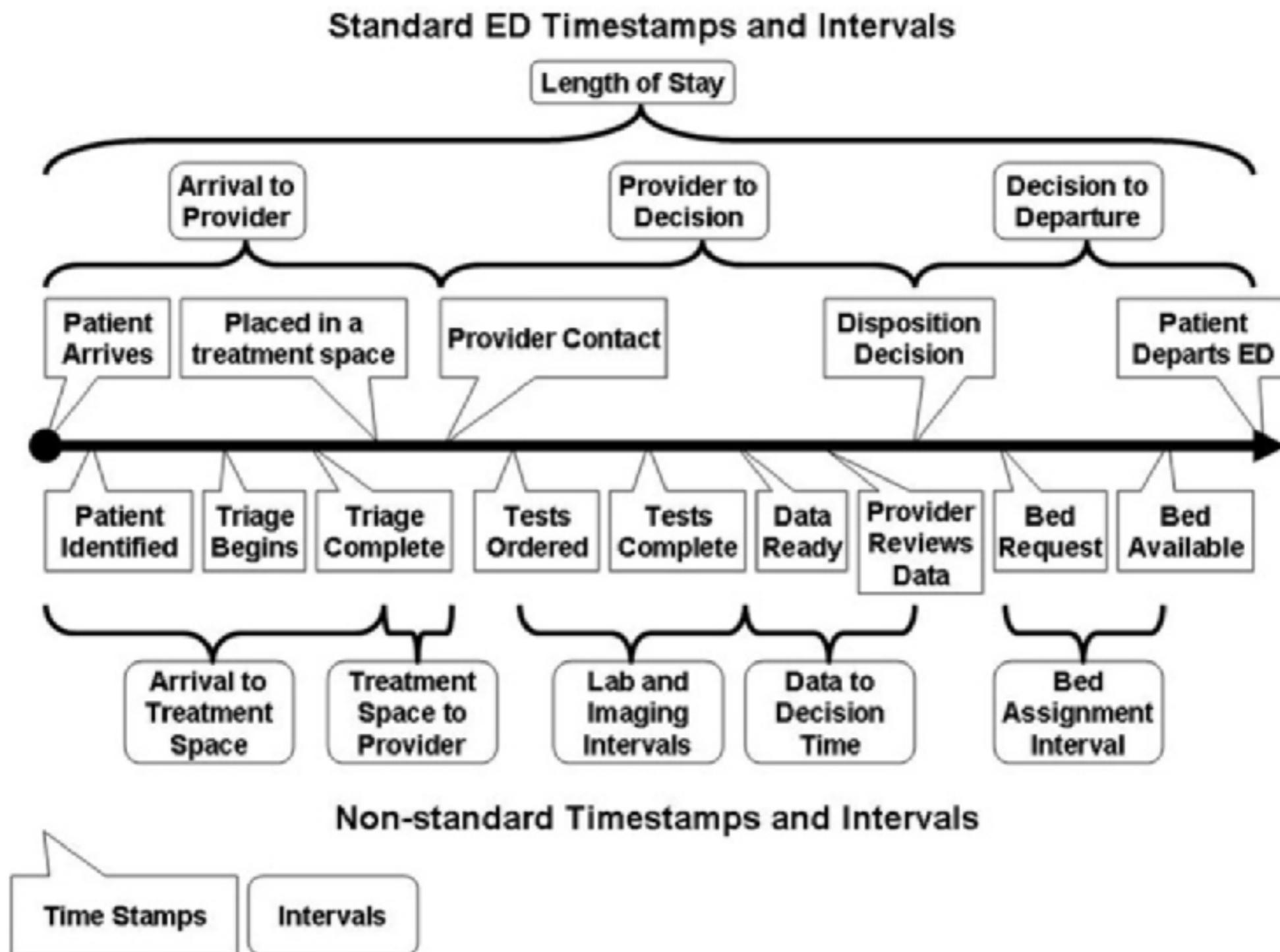


Understanding the System

- Case Study
- Literature Reviews
- Observations
- Collaborations
- We even checked a member in to the ED!



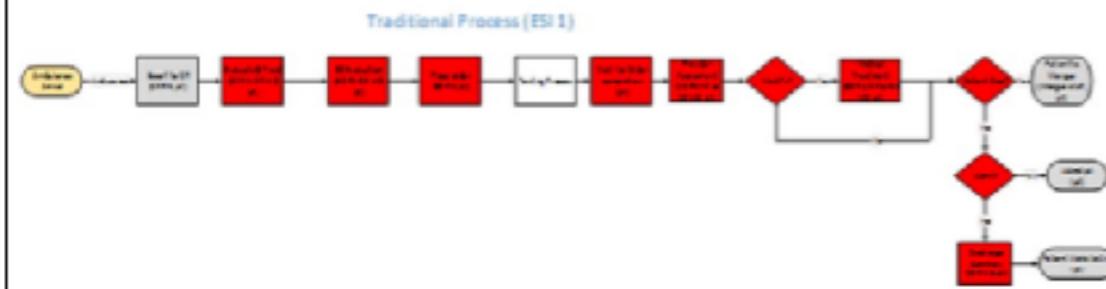
Process Mapping



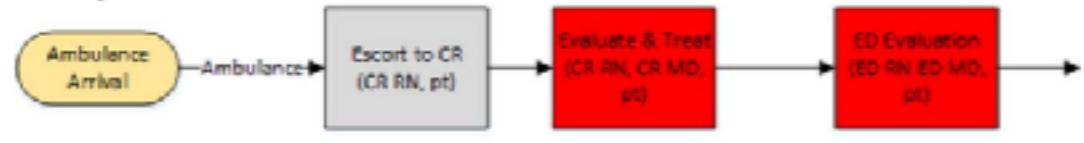


Traditional Triage & Bed

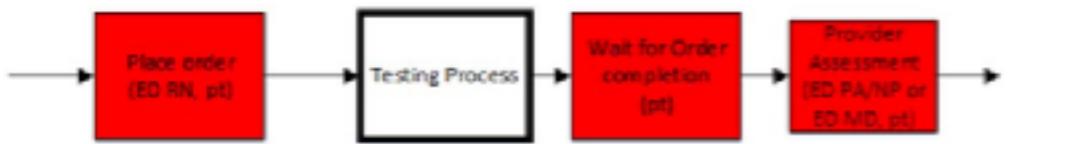
Overview Traditional Triage & Bed ESI 1



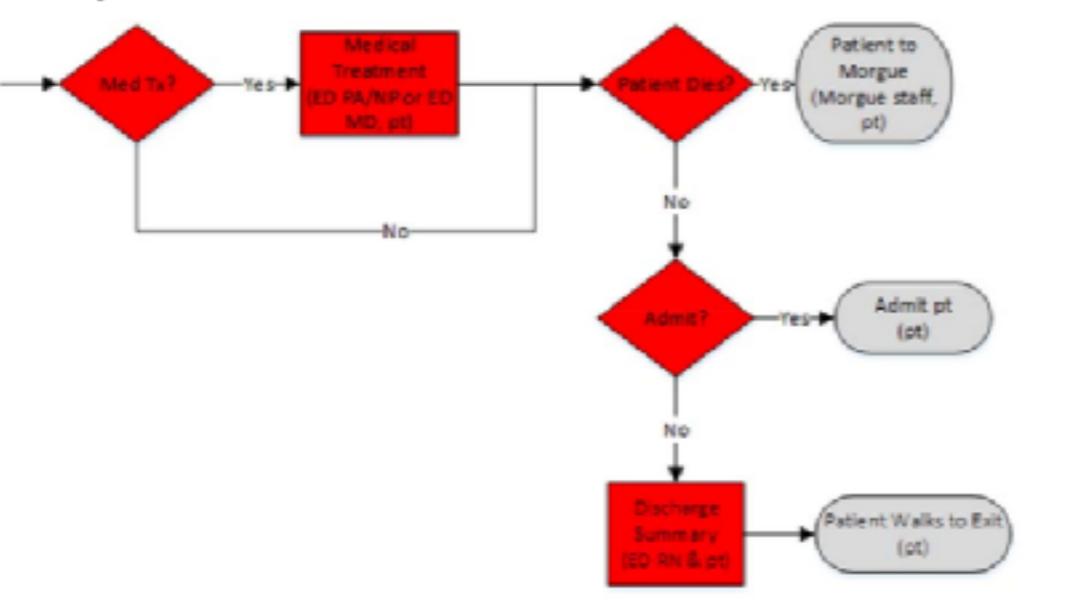
Close-Up



Close-Up



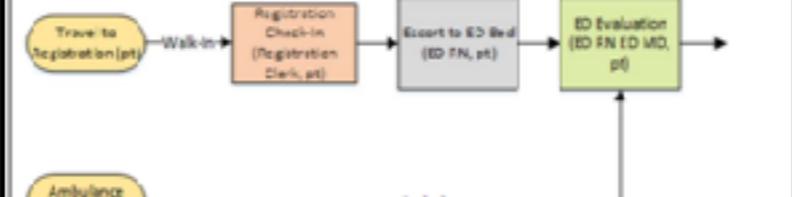
Close-Up



Overview Traditional Triage & Bed ESI 2



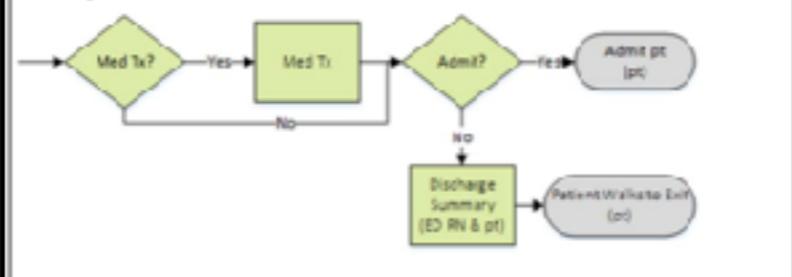
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Close-Up



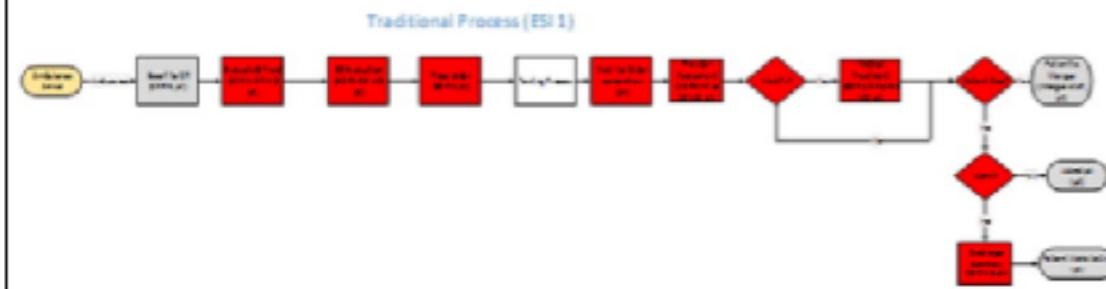
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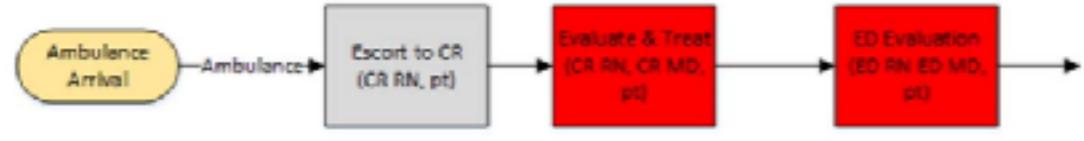


Traditional Triage & Bed

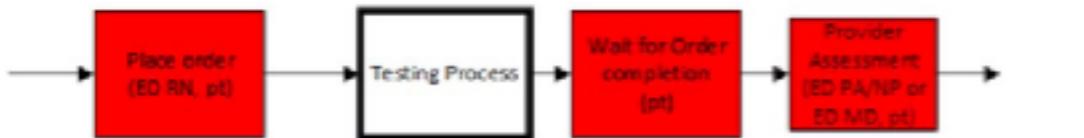
Overview Traditional Triage & Bed ESI 1



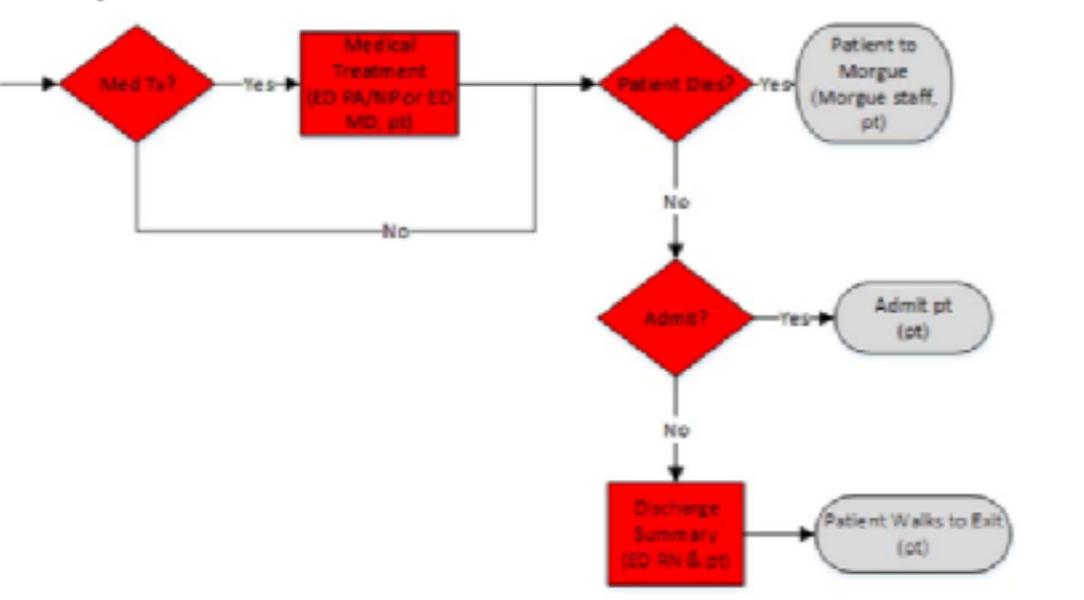
Close-Up



Close-Up



Close-Up



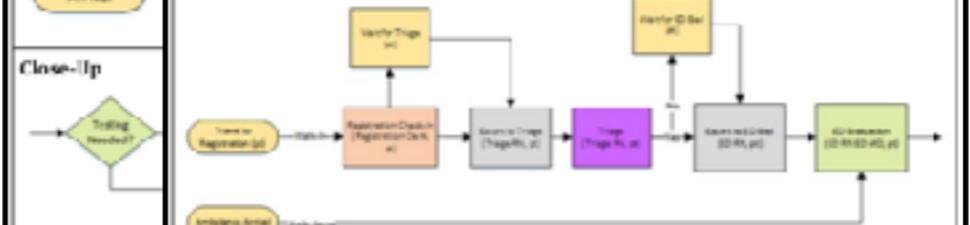
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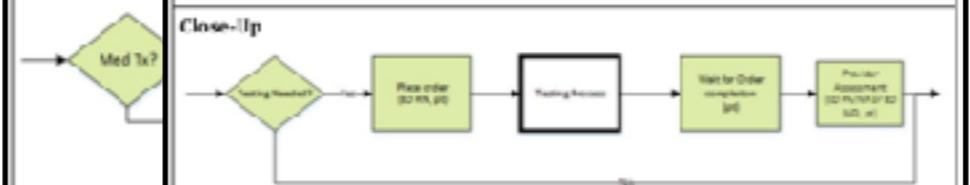
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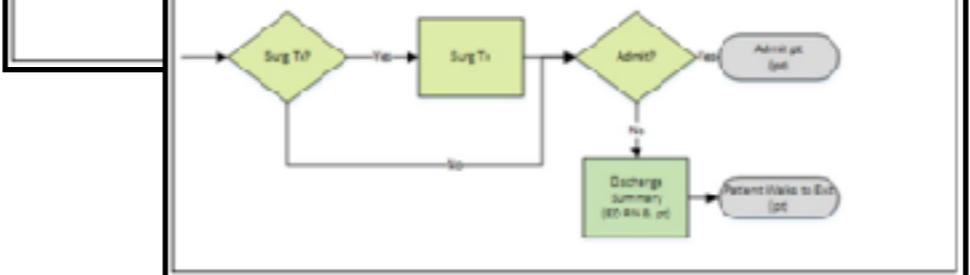
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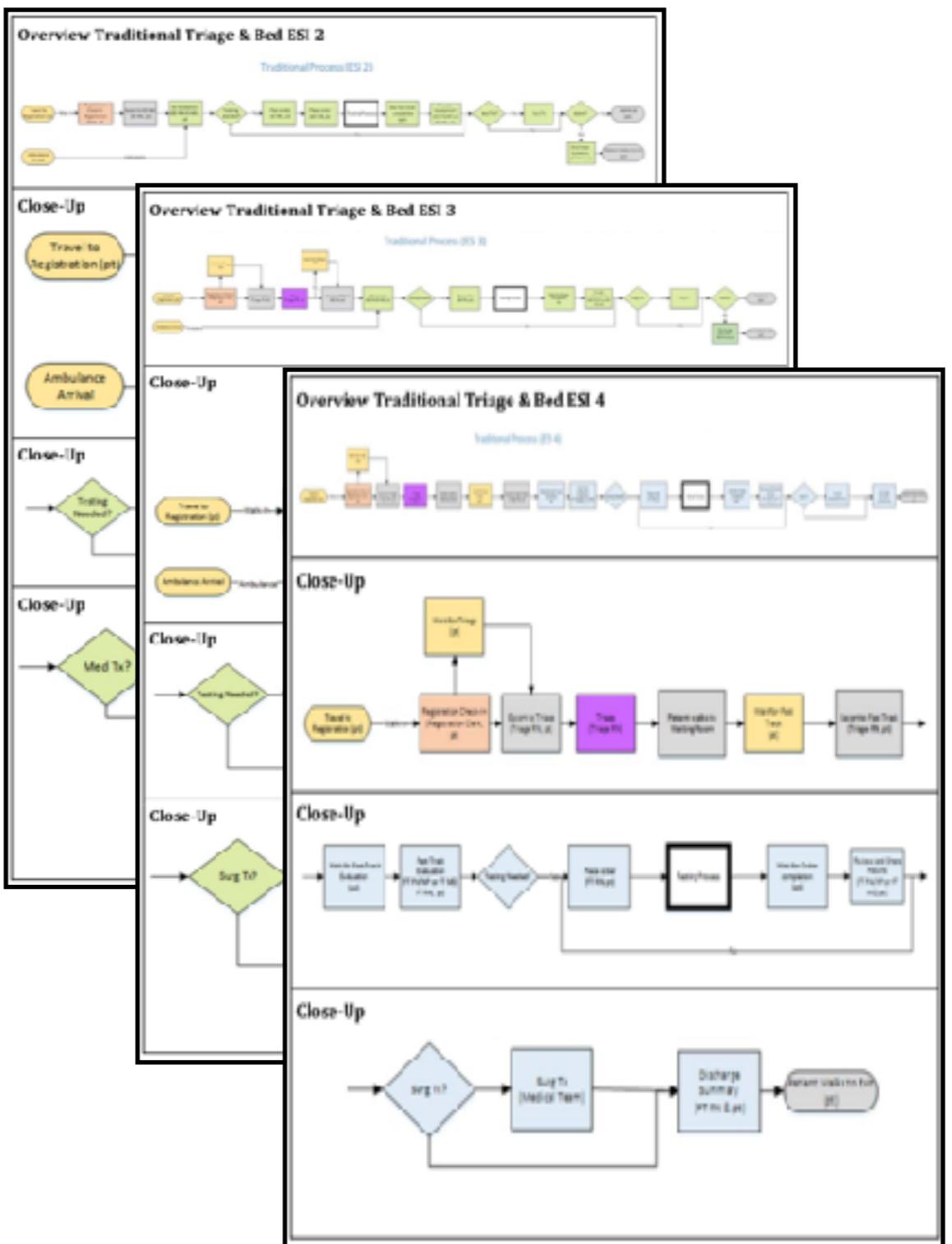
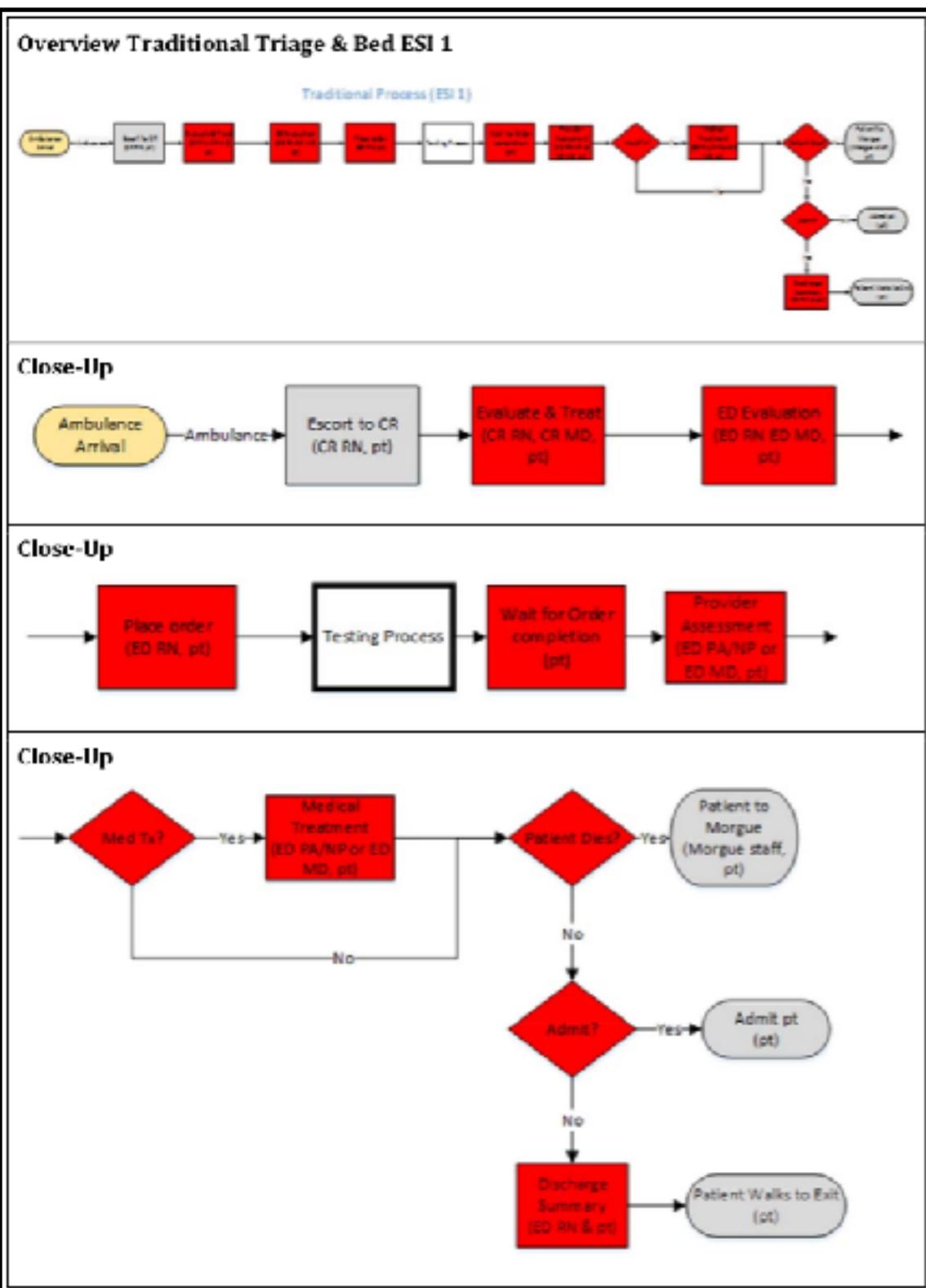
Close-Up



Close-Up



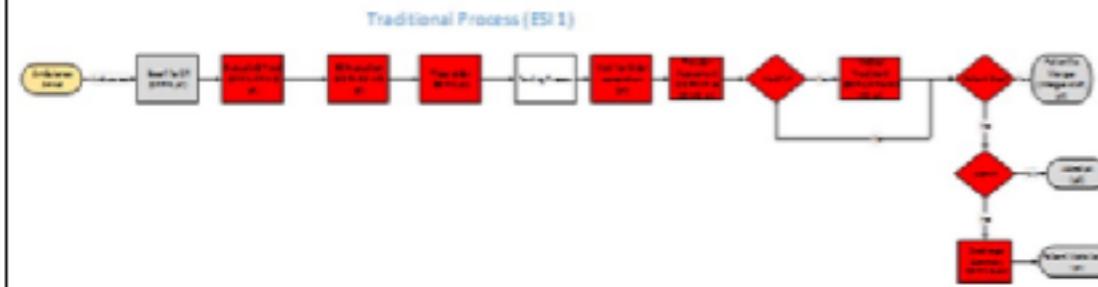
Traditional Triage & Bed



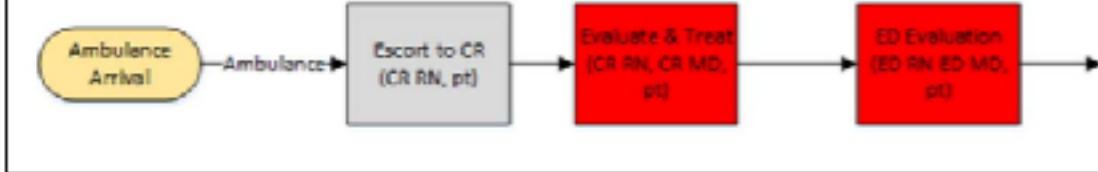


Traditional Triage & Bed

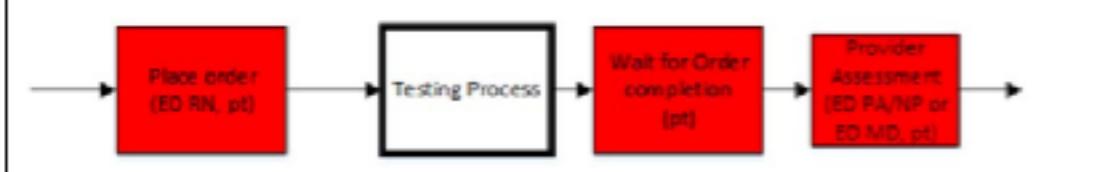
Overview Traditional Triage & Bed ESI 1



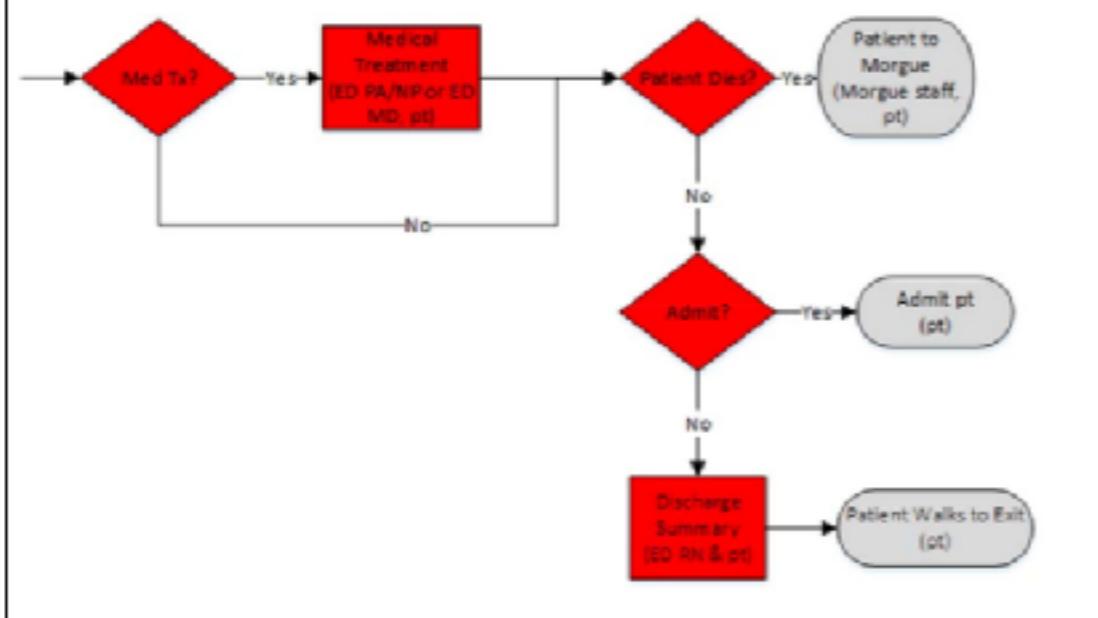
Close-Up



Close-Up



Close-Up



Overview Traditional Triage & Bed ESI 2



Close-Up



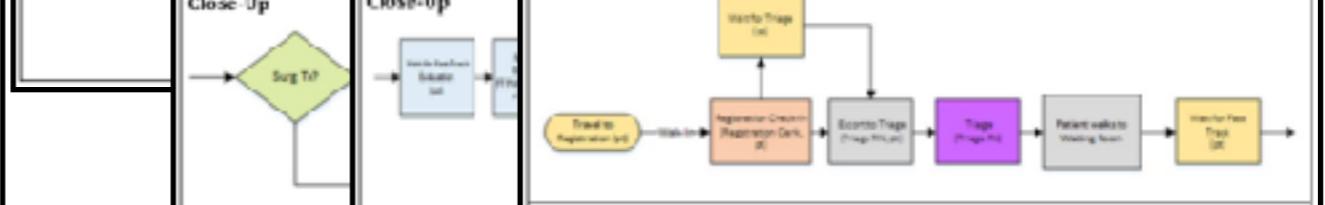
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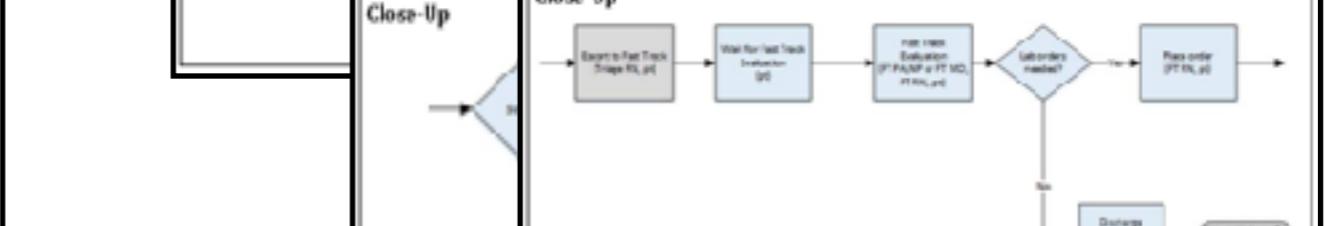
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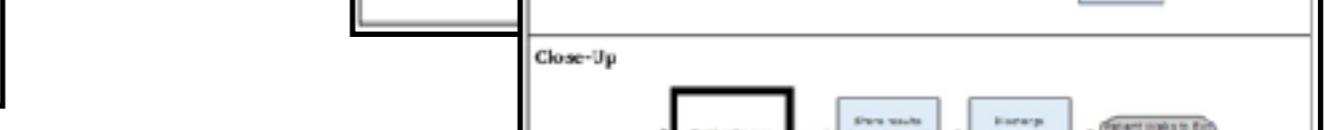
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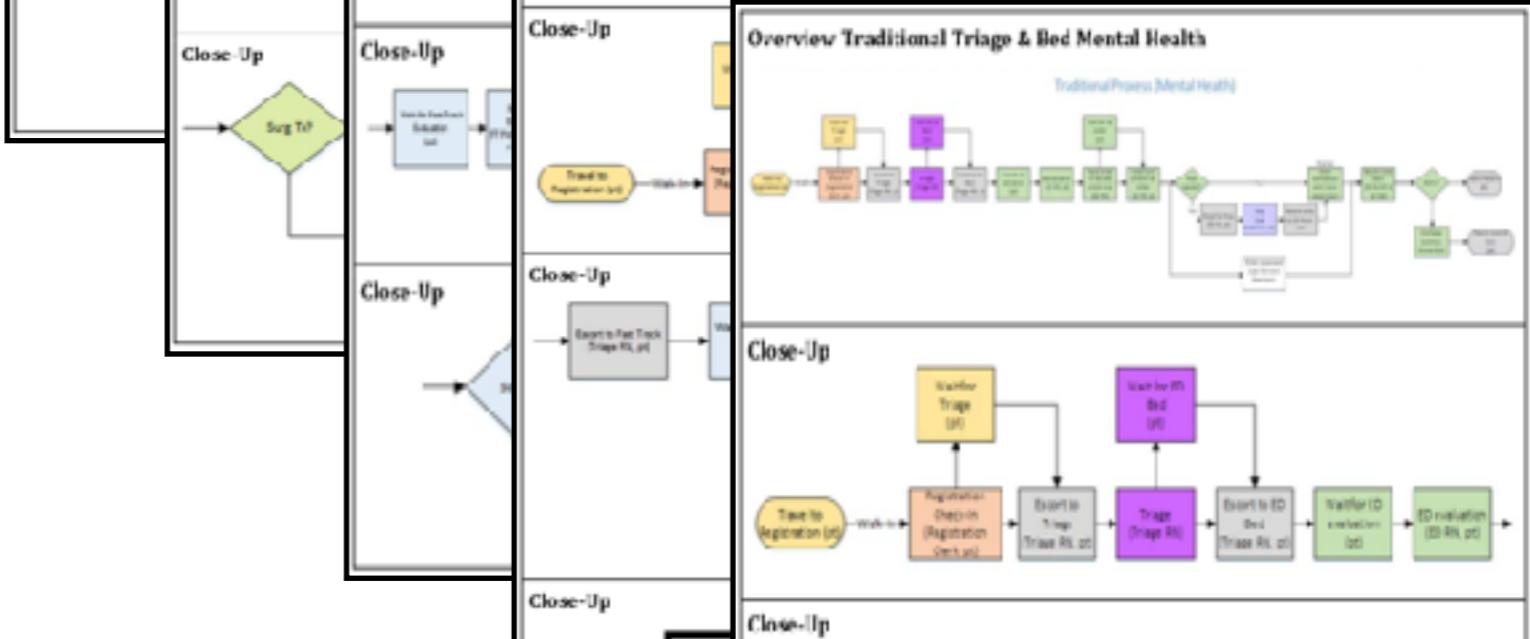
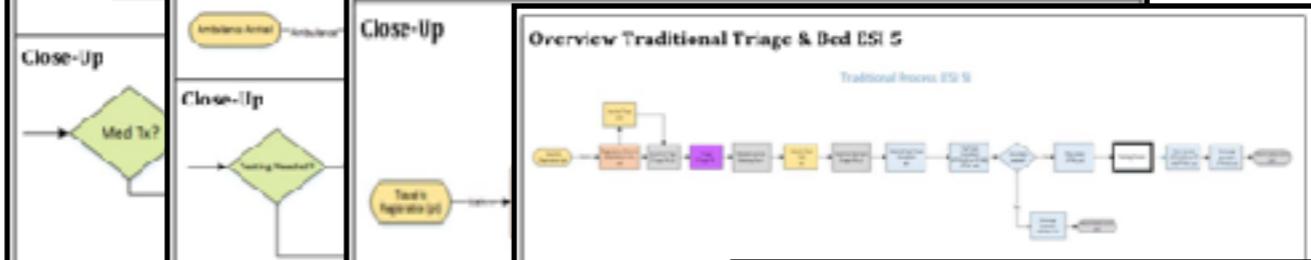
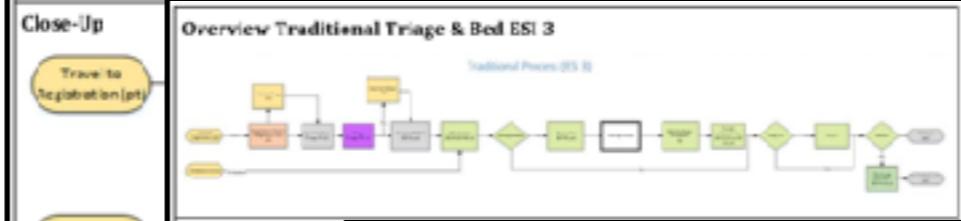
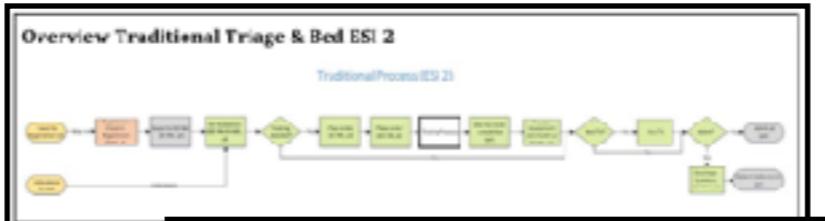
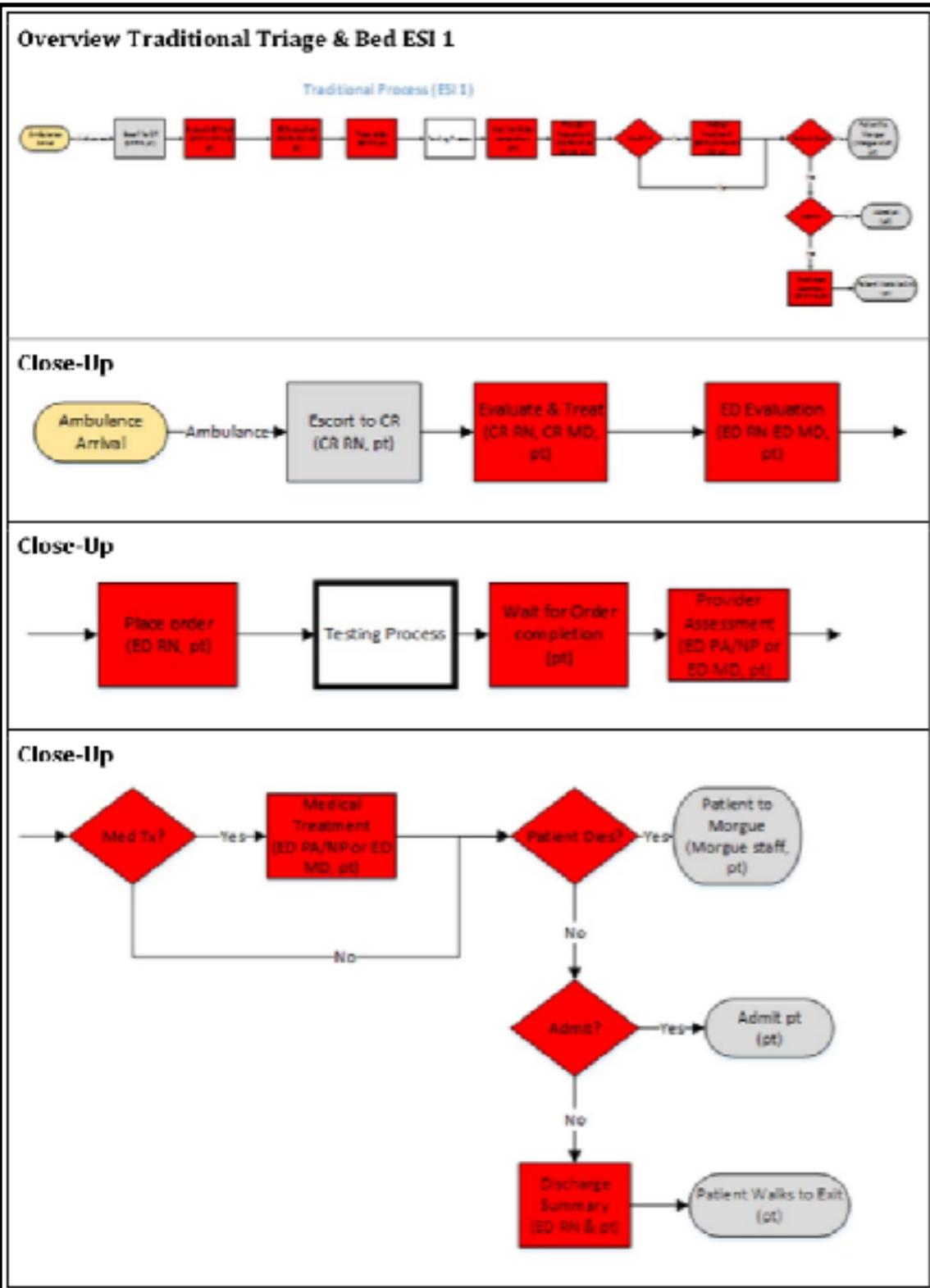
Close-Up

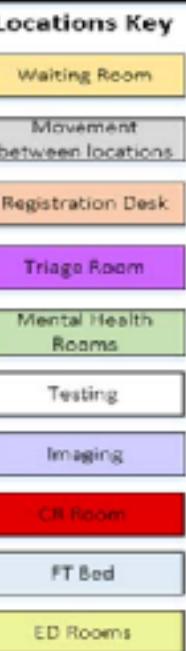


Close-Up



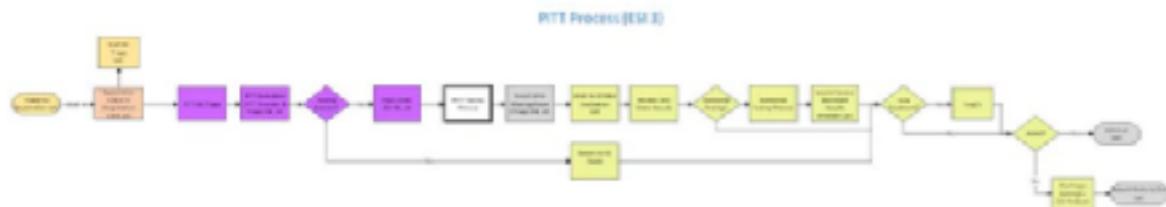
Traditional Triage & Bed



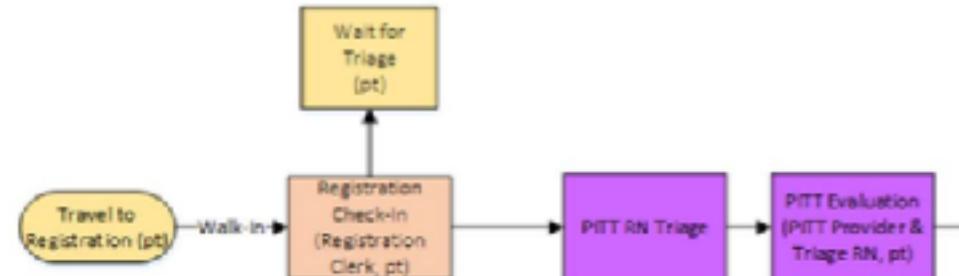


PITT

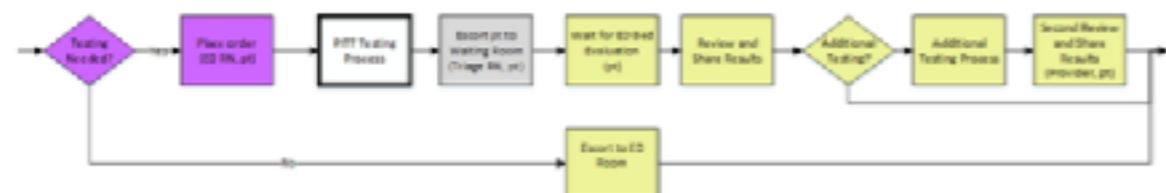
Overview PITT ESI 3



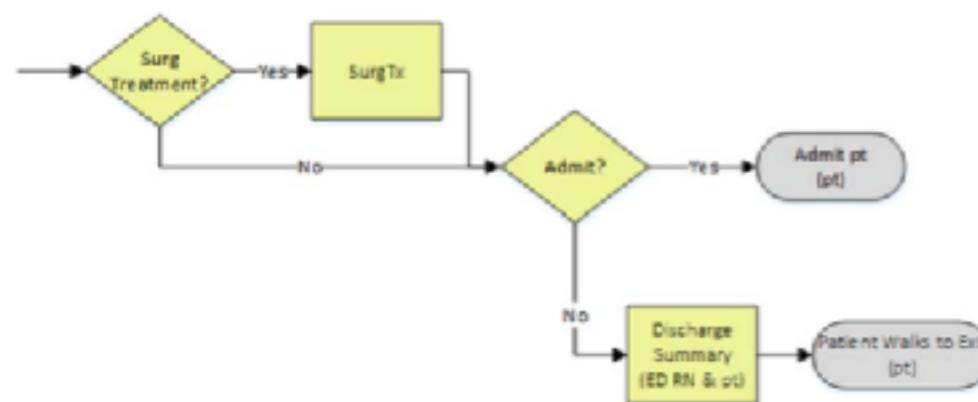
Close-Up



Close-Up

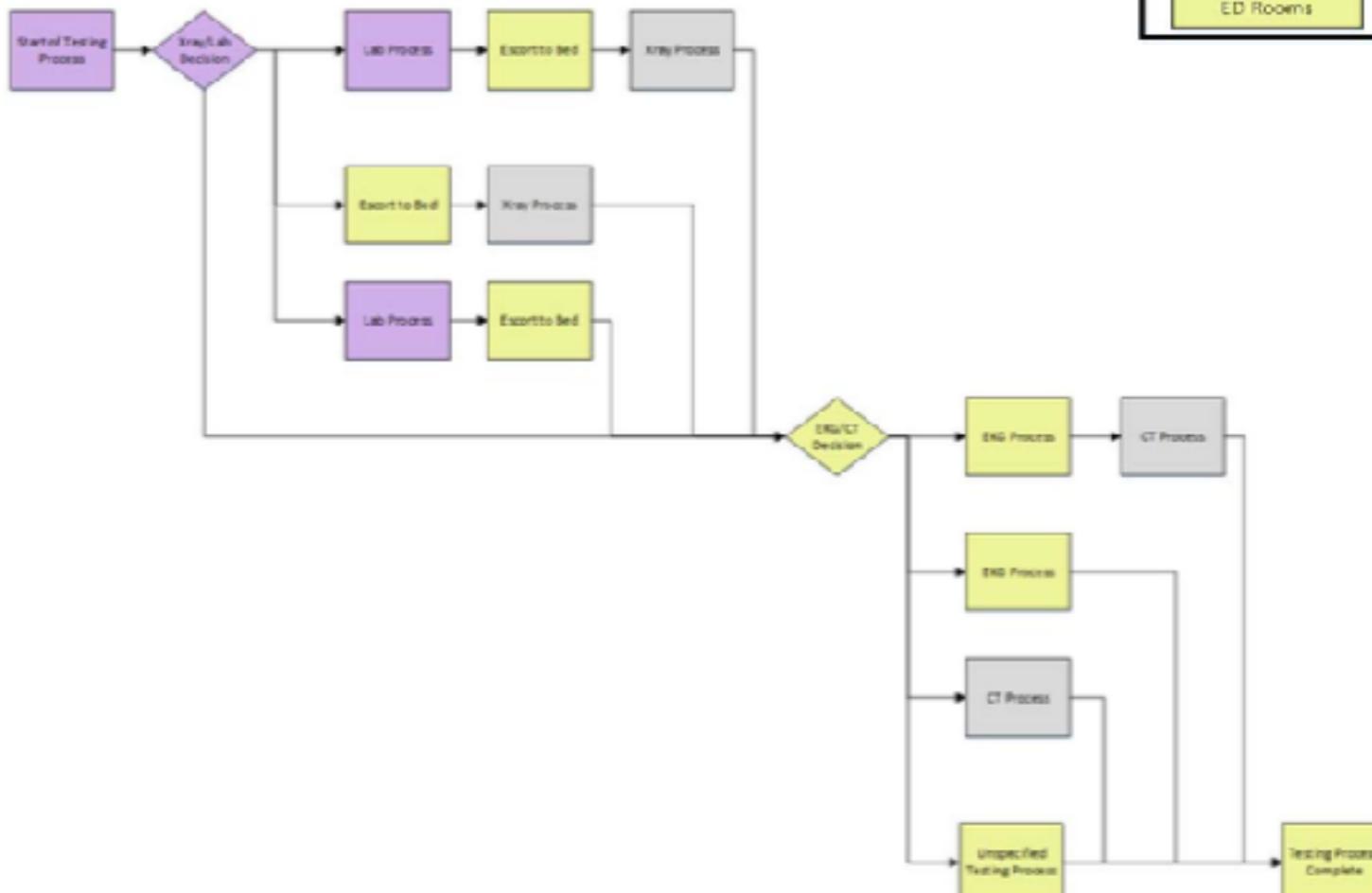


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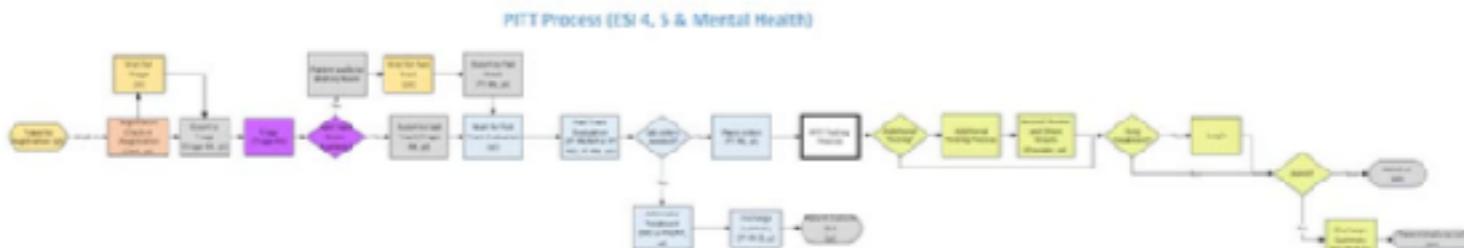


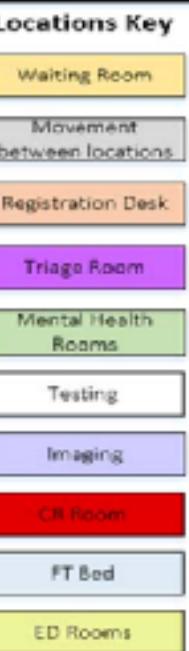
PITT Testing

*Subject to ESI probabilities



Overview PITT ESI 4, ESI 5 & Mental Health



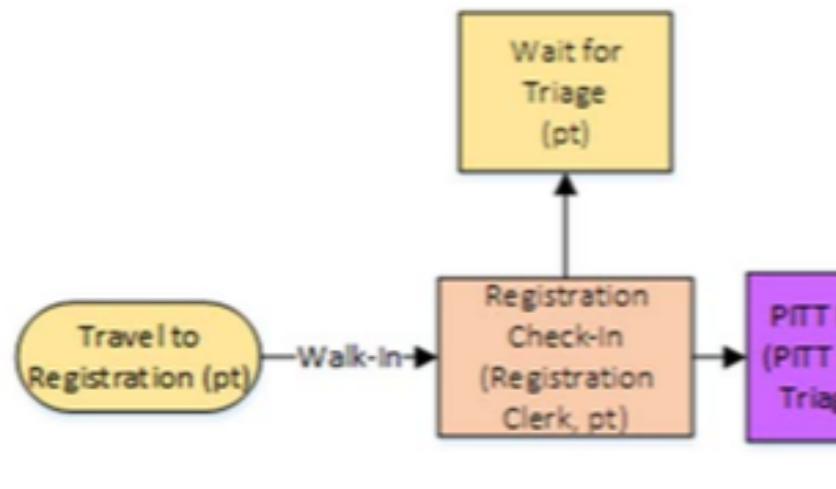


Super FT/PITT

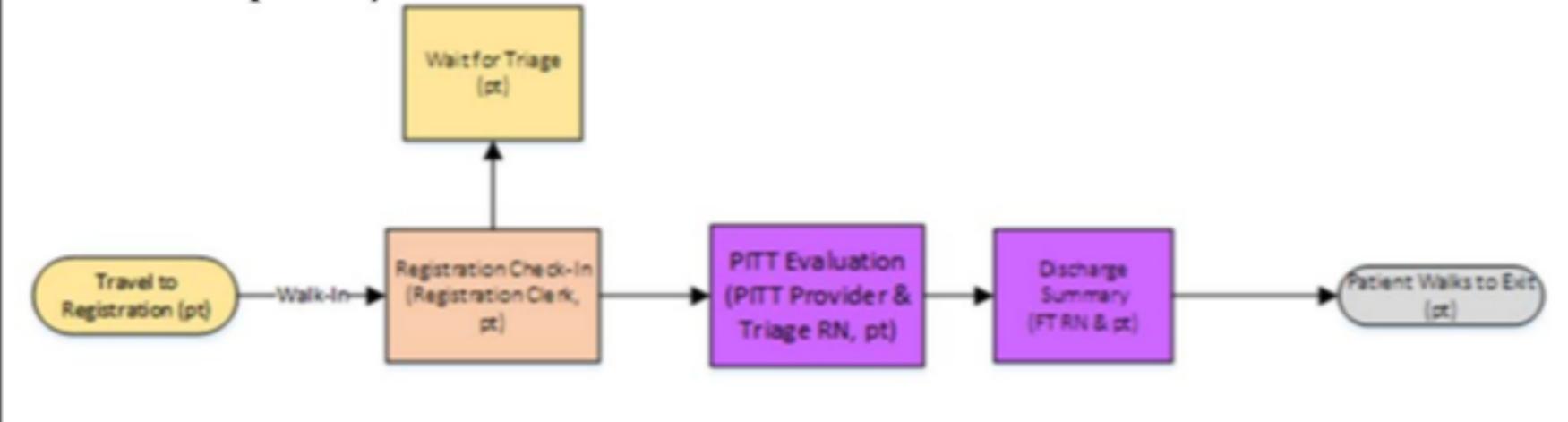
Overview Super FT/PITT ESI 4



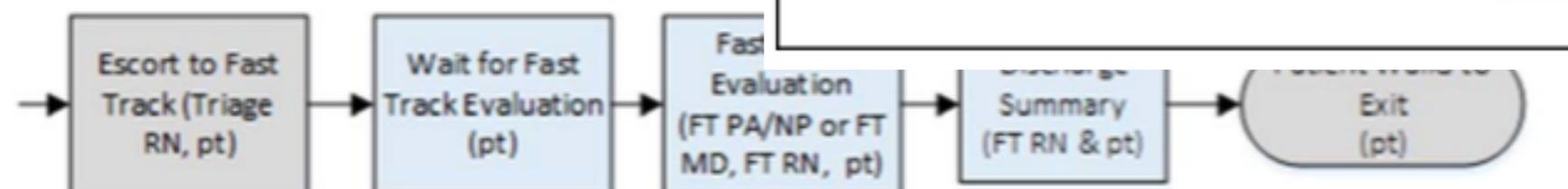
Close-Up



Overview Super FT/PITT ESI 5



Close-Up

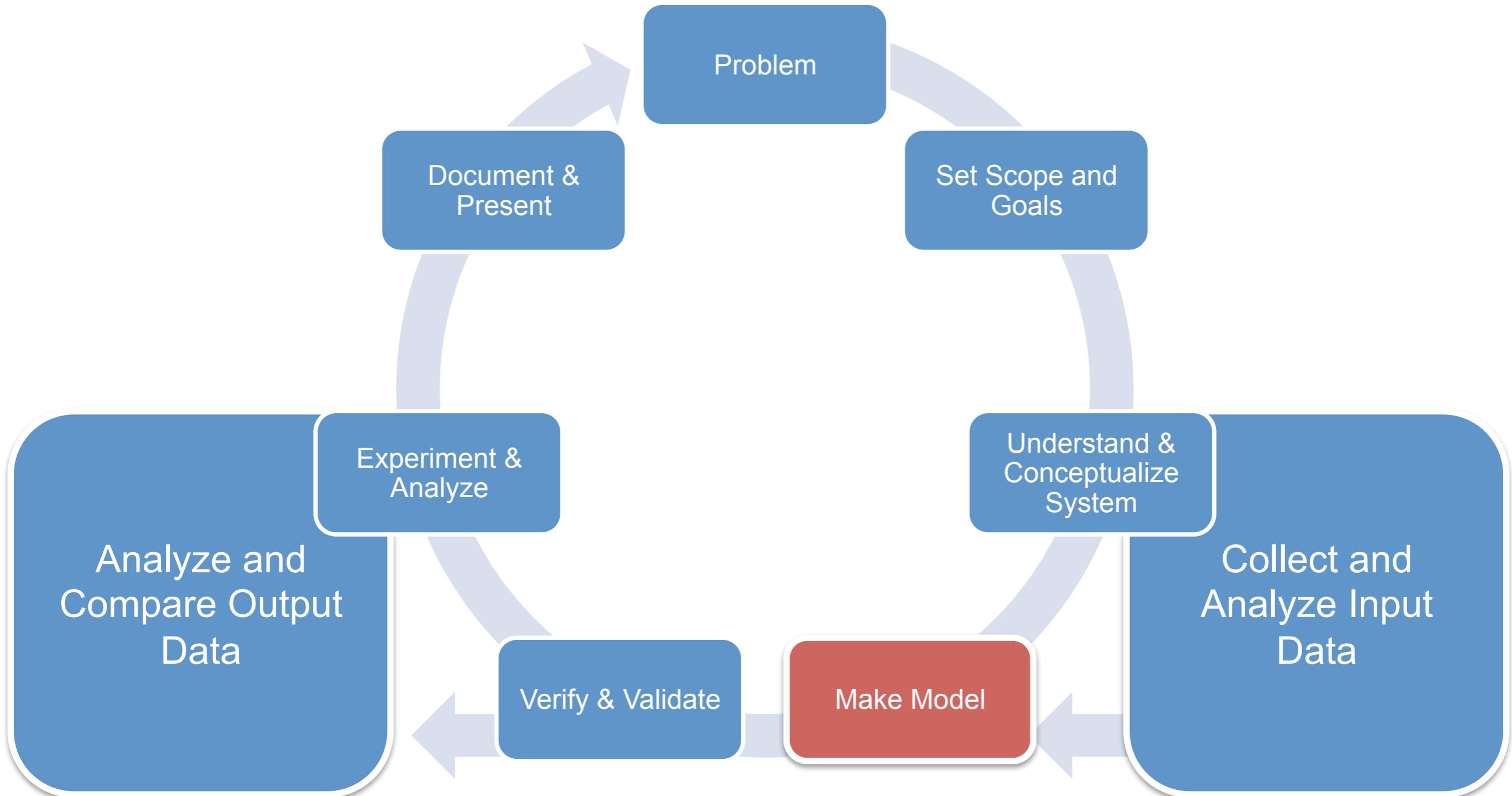


Key Differences

Assume Traditional Triage & Bed pathway unless specified:

- PITT
 - **ESI 3, 4, 5, & Mental Health:** PA evaluation takes place prior to rooming
- Super FT/PITT
 - **ESI 5:** Treated & Discharged immediately
 - **ESI 4:** PITT evaluation to FT bed with original PITT physician

The Simulation Cycle



“All models are wrong, but some are useful”

—George Box

Assumptions

Ambulance Arrivals

- Physicians are “preempted” from their current ED task to care for ambulance arrivals until they are “stabilized”
- Both physician and ED RN are needed to transport ESI 1 patients
- Any arrivals via ambulance receive higher priority than walk-ins
- There are a subset of ED nurses and ED physicians that handle ambulance arrivals
- Patients who arrive via ambulance are considered “stable” and have same priority as walk-ins after first provider contact
- Physician caring for patient needs to collect same information that an RN would when rooming a patient

Charting

- There are computers are in every room for bedside order entry
- Nurses watch for orders and respond immediately
- Time required to review and share results is always the same
- Provider reviews results in room and then shares them with the patient
- CR Room
- ESI 2 and 3 do not go to CR Room
- A patient that needs the CR room will use the CR room for their entire visit

Delivery Model 2 - PITT

- Nothing changes in the PITT process for ESI 1 and 2. Additional testing for other ESI levels is only because the triage evaluation is less accurate than traditional evaluation

Escorting

- While it is not shown in the model, all transportation groups use wheelchairs to escort patients and there is no delay in wheelchair retrieval

Equipment

- There are a sufficient number of EKG machines to ensure they are not a bottleneck
- ESI 1, 2, and 3 have IVs and equipment in room to do blood draws and stuff there
- Surg Tx doesn't require equipment because the patient only needs stitches
- Expiration
- Only ESI 1 patients can die, and they do so at the end of the process
- Patients who die are taken to a morgue exit and aren't counted as inpatients or outpatients

Lab Analysis

- All lab processing can occur in parallel because processing is done by machines and there are enough machines so that there is never a wait for lab analysis to begin
- Only the longest lab processing time is modeled. If a patient needs both ABC and Trop, only Trop is modeled because ABC would be completed during the same timeframe
- There is only one lab technician and he never becomes the bottleneck
- If neither Trop or ABC labs are needed, the “Other” processing time is used

Locations

- Nurses return to nurse stations when they are performing work unrelated to patient care
- Physicians stay in resident or nourishment areas when they are not caring for a patient
- Imaging
- There are different technicians for the X-ray and CT machines
- CT scans are ordered without contrast
- There is no wait time for radiologist to read imaging studies
- Metrics
- Assume “discharge” means discharged from the ED, which could be a death, admit, or discharge
- When patient sees Triage Provider in the PITT and SuperFT delivery models, it is considered “Door to Provider” time
- Mental Health
- The one-hour observation period for mental health patients starts after labs are drawn and X-rays are taken, but before results come back.
- The ED physician waits until the end of the one-hour observation period to review and share results with the mental health patient

Imaging

Metrics

- Assume “discharge” means discharged from the ED, which could be a death, admit, or discharge
- When patient sees Triage Provider in the PITT and SuperFT delivery models, it is considered “Door to Provider” time

Mental Health

- The one-hour observation period for mental health patients starts after labs are drawn and X-rays are taken, but before results come back.
- The ED physician waits until the end of the one-hour observation period to review and share results with the mental health patient

Medical Decision Making

- There is independence between testing processes and death
- The same percentage of patients are admitted regardless of what tests are performed
- Trop, ABC, and Other testing procedures are independent
- Lab samples are the first things that are done because a nurse can do them right away
- Unspecified testing occurs if no other testing occurs
- If a patient doesn't receive any testing, they can still receive MedTx or SurgTx

Process Flow

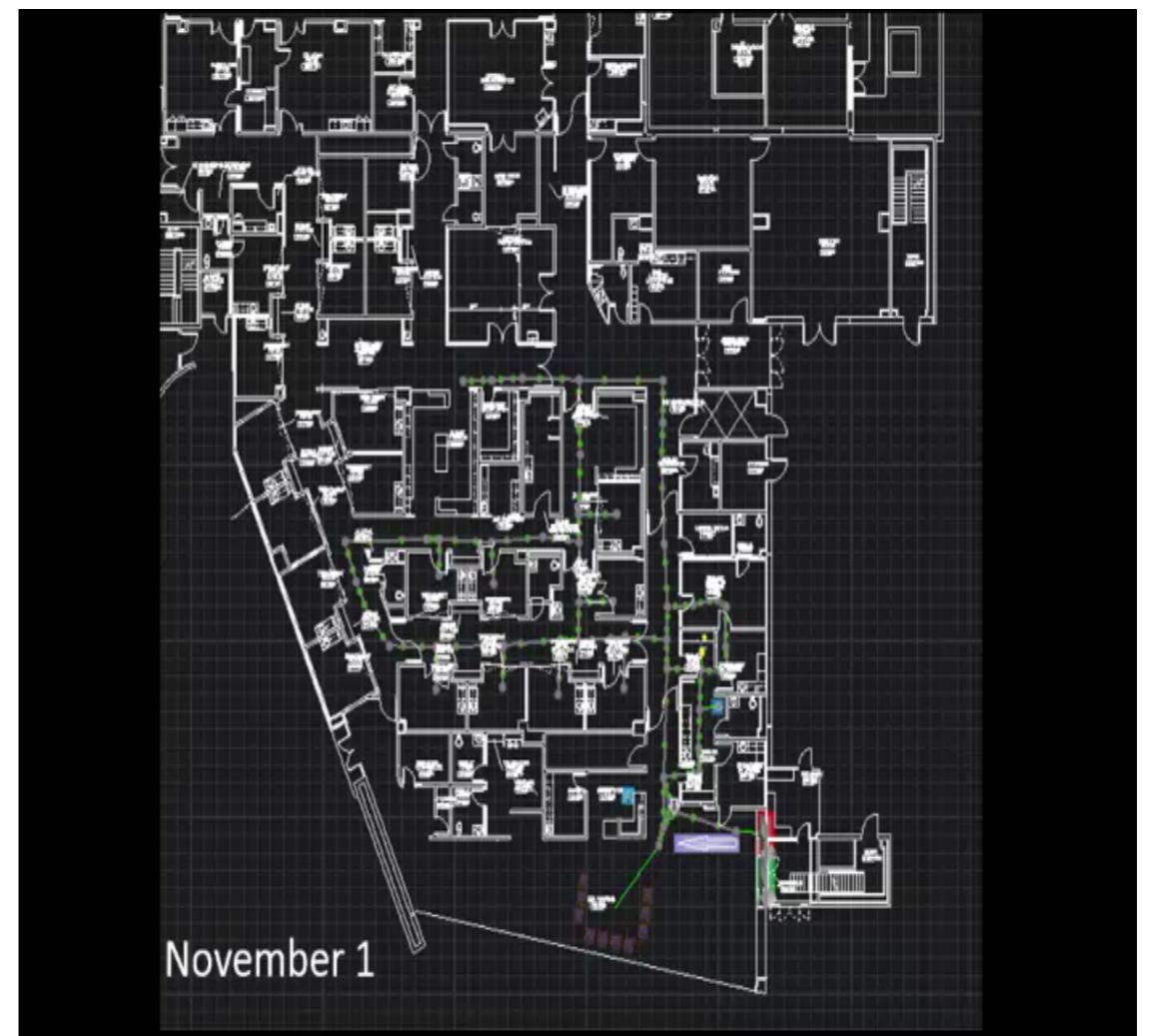
- MedTx occurs at the end of the process and doesn't require equipment to be brought to the room
- Surg Tx occurs at the end of the process in the patient's room
- If a patient needs more than one lab, both are drawn at the same time
- FT patients are taken to Room 2 to get labs drawn and then are taken back to their room before being escorted to X-ray or CT
- Lab draws occur in the patient's room for patients in ED beds, Mental Health Pods, or CR rooms
- ESI 5 patients are only escorted to FT beds
- Patients move to the triage waiting room without being escorted
- “Unspecified testing” is instant
- Inpatient beds are always available

Staffing

- Providers are designated to either ED or FT
- Prioritization of staffing is done by assigning the jobs to the roles that make the most sense. Cost is used as a secondary consideration
- If an employee can alternate for a process, they should be able to alternate for all other processes
- The RN Supervisor is not assigned clinical duties

Model Expansion

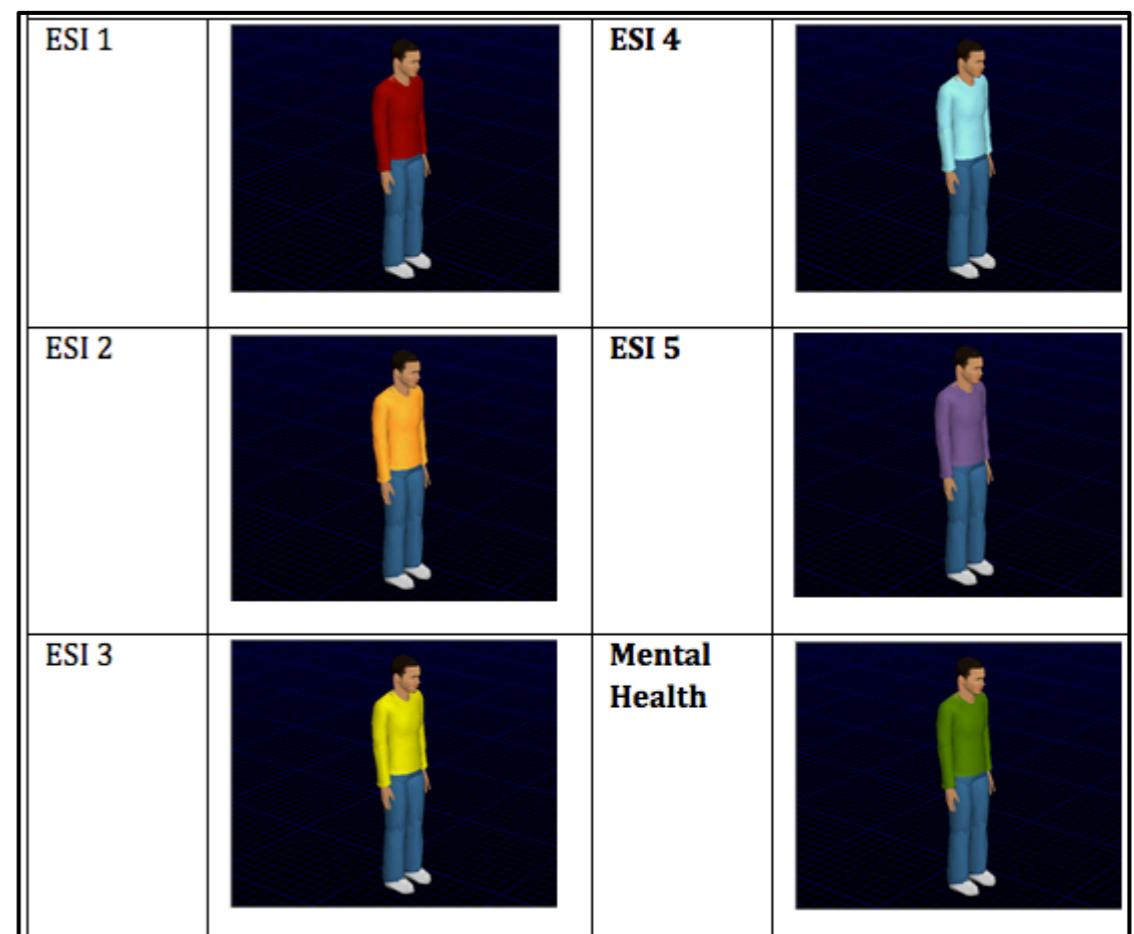
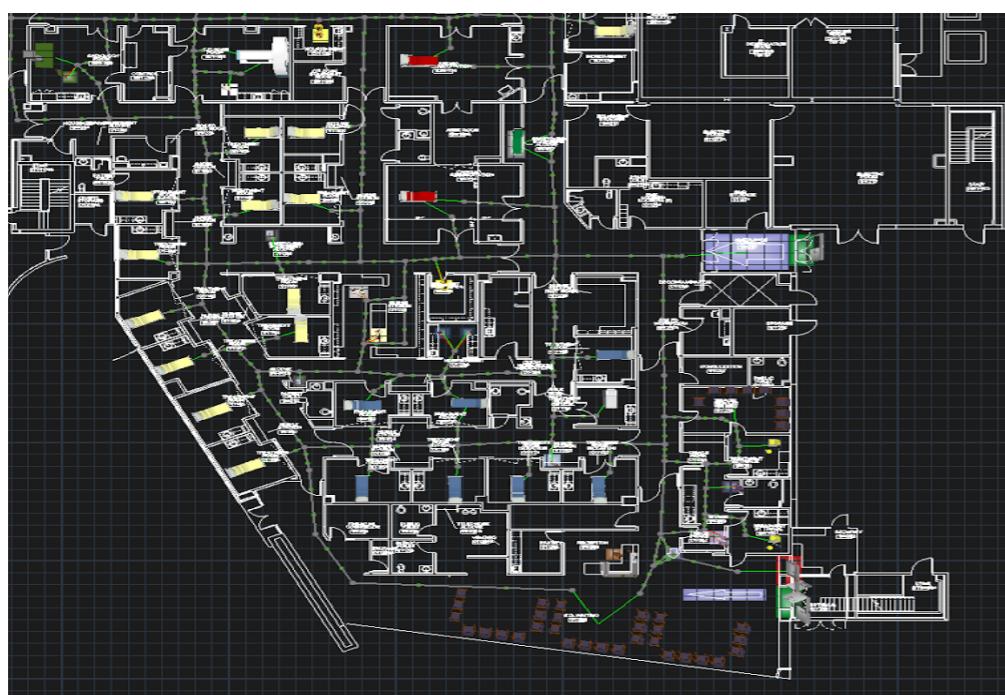
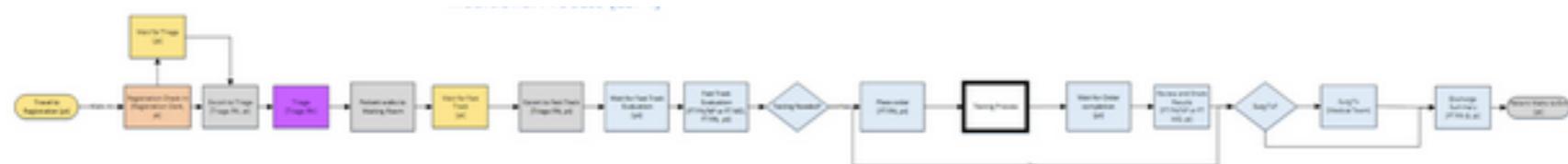
- Timelapse video



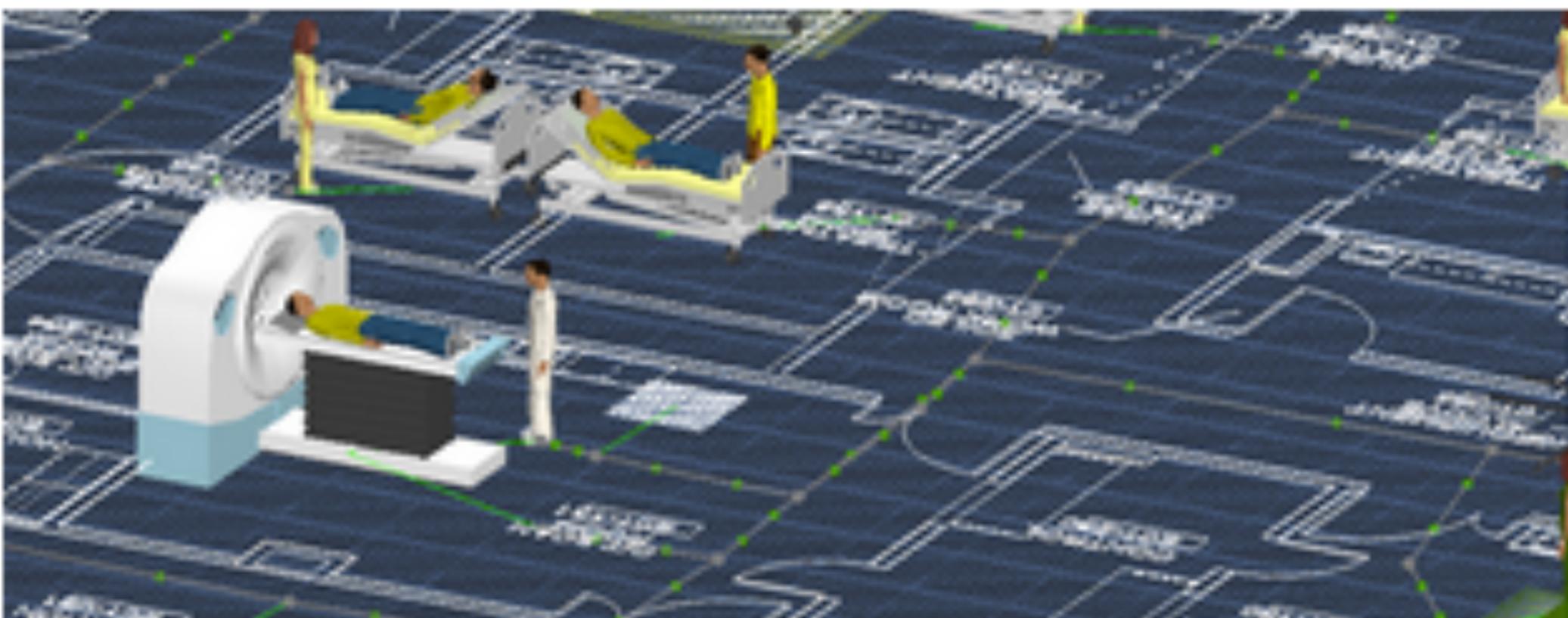
Traditional Triage Model

- Traditional Triage Model video
(Showing simulation running)

Model Features: Consistency



Model Features: Realism



Model Features: Collaboration



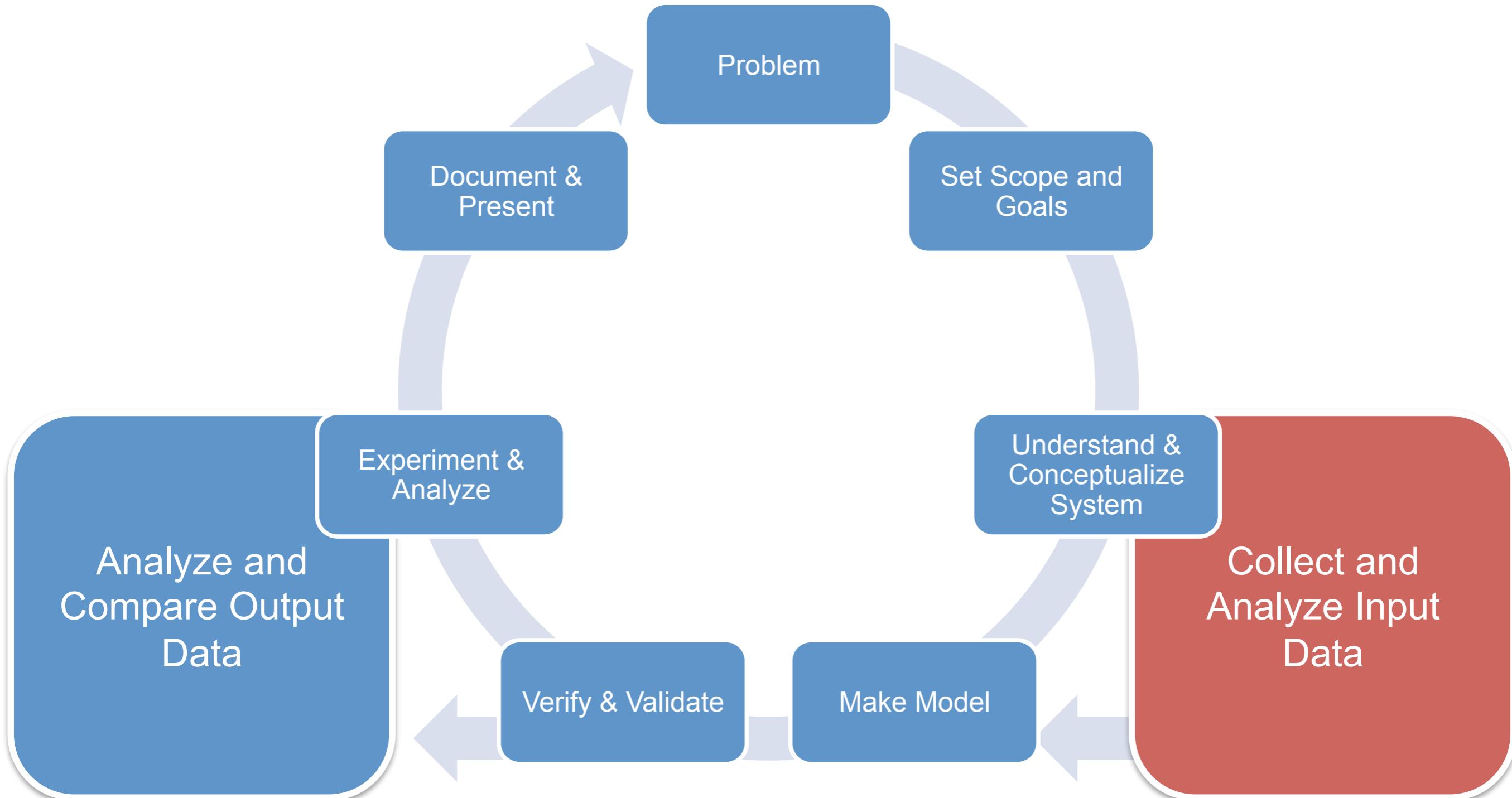
Brian W. Patterson, MD
UW Hospitals and Clinics
Emergency Department

UWHealth

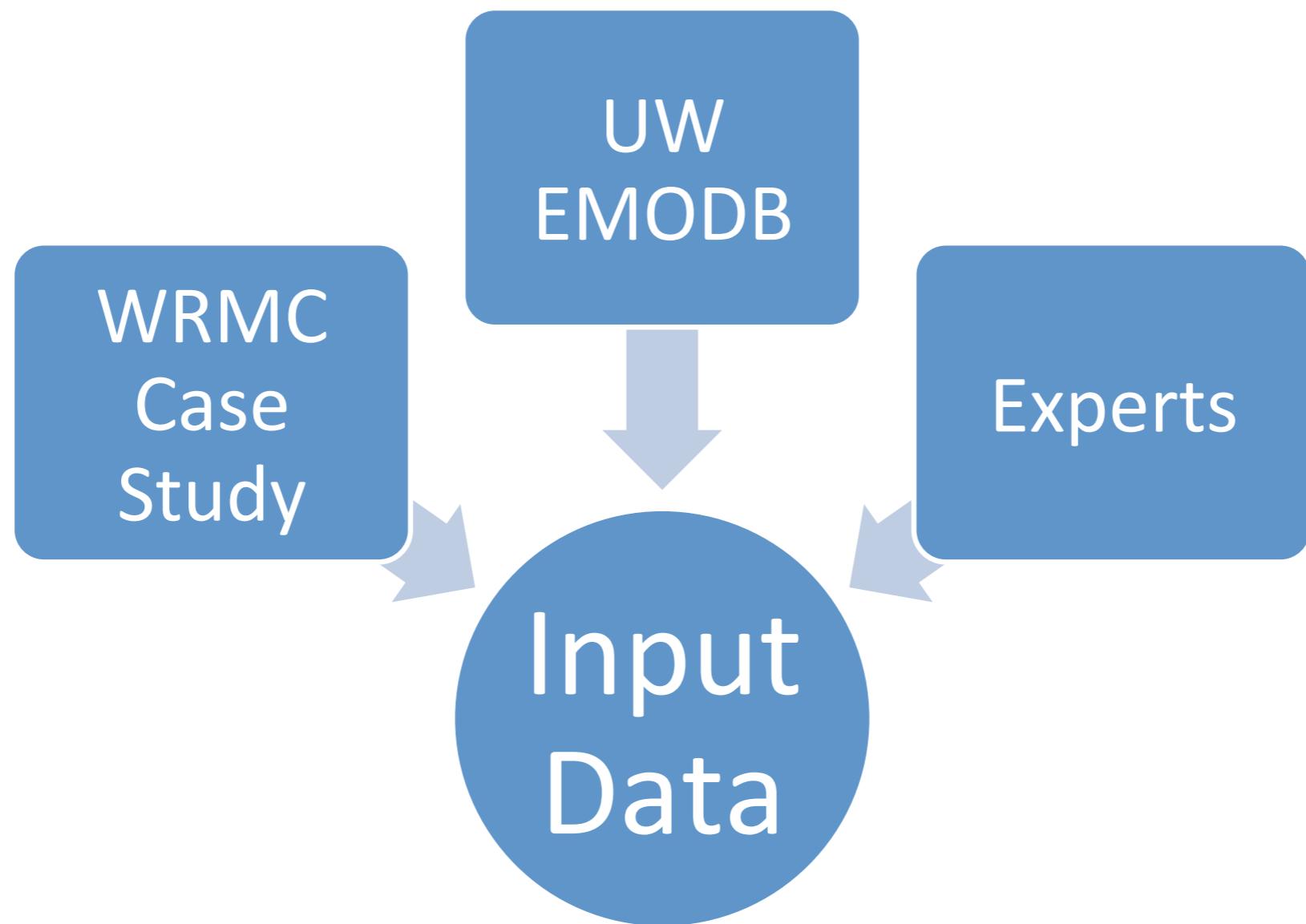
Future Improvements

1. Verify information accuracy by observing WRMC's ED operations
2. Make inpatient transfers more realistic

The Simulation Cycle



Input Data



Lots of data: Validation, Fill in gaps, Conflicts

Technical Note: Arrival Rates

Time	Sun	Mon	Tue	Wed	Thu	Fri	Sat
00 - 01	3.9(2.6)	2.8(1.5)	2.7(1.9)	4.1(1.5)	1.9(0.5)	2.4(1.7)	3.7(1.7)
01 - 02	3.9(0.9)	2.6(1.7)	2.4(1.3)	3.0(1.7)	3.5(1.3)	2.2(1.8)	3.7(1.9)
02 - 03	1.5(1.5)	2.4(0.8)	1.6(1.7)	0.3(0.5)	1.9(0.5)	3.0(1.7)	3.0(1.3)
03 - 04	3.7(0.9)	1.7(0.9)	1.9(1.7)	1.4(1.0)	2.4(1.3)	0.5(0.6)	1.9(1.9)
04 - 05	2.4(1.3)	1.3(1.1)	0.8(1.0)	1.4(1.0)	1.4(1.3)	1.6(1.0)	1.5(1.1)
05 - 06	1.9(1.3)	2.6(1.7)	1.6(1.3)	2.2(1.4)	0.5(1.0)	1.4(0.5)	2.4(1.8)
06 - 07	1.7(1.7)	2.6(1.7)	3.0(1.7)	1.6(1.3)	3.0(1.5)	1.1(0.8)	1.7(1.1)
07 - 08	1.7(1.5)	3.7(1.5)	4.1(3.6)	3.2(1.8)	5.7(2.5)	3.8(2.4)	3.9(2.1)
08 - 09	4.5(1.9)	5.0(2.1)	5.9(1.3)	6.8(2.1)	6.8(1.5)	6.2(2.6)	4.8(2.8)
09 - 10	6.7(2.3)	10.6(1.)	6.8(1.0)	7.8(2.9)	10.0(1.)	5.1(1.7)	7.1(1.8)
10 - 11	8.9(2.9)	8.2(2.7)	7.6(0.6)	7.8(3.3)	8.1(1.)	7.0(1.9)	8.0(0.9)
11 - 12	7.3(2.4)	7.6(2.3)	8.1(2.6)	9.2(2.4)	9.2(1.6)	8.9(3.0)	9.2(2.6)
12 - 13	8.6(2.5)	11.2(1.)	9.5(1.7)	7.0(0.6)	7.0(0.)	11.3(1.)	9.0(1.7)
13 - 14	9.7(4.8)	13.0(1.)	6.2(2.4)	7.3(1.0)	5.1(1.9)	11.1(3.)	8.2(2.0)
14 - 15	9.1(1.9)	7.8(2.9)	7.6(1.4)	7.6(1.4)	9.7(1.8)	8.9(2.9)	10.8(2.)
15 - 16	8.2(1.7)	9.5(3.1)	7.3(2.9)	10.0(3.)	8.6(1.8)	6.2(3.3)	7.1(1.9)
16 - 17	7.1(2.3)	9.9(1.6)	9.7(2.2)	6.2(1.3)	5.9(0.3)	5.7(1.0)	8.1(1.8)
17 - 18	6.7(3.1)	9.5(3.1)	10.3(3.)	10.8(3.)	5.9(0.2)	8.1(4.7)	7.1(1.8)
18 - 19	5.6(2.6)	7.3(2.6)	7.8(5.4)	7.6(2.2)	9.5(0.2)	11.6(3.)	6.9(1.9)
19 - 20	8.0(1.3)	6.9(1.5)	5.4(1.4)	6.5(2.4)	7.0(0.7)	6.2(1.3)	8.0(0.5)
20 - 21	8.0(3.8)	7.8(2.4)	5.7(1.3)	5.1(1.0)	7.6(0.4)	8.9(2.2)	6.0(1.5)
21 - 22	5.4(2.3)	5.4(2.9)	5.7(2.5)	4.6(3.7)	3.5(0.3)	6.8(0.5)	3.5(0.5)
22 - 23	5.2(2.3)	6.0(2.9)	3.8(1.7)	6.2(0.5)	5.7(0.2)	7.6(1.8)	6.9(1.8)
23 - 00	3.9(1.5)	2.4(1.3)	4.6(1.0)	2.4(2.1)	4.1(2.0)	4.6(1.0)	3.0(1.6)

Hourly
Arrival
Rates

Percent
Arrivals by
ESI

Arrival
Mode by
ESI

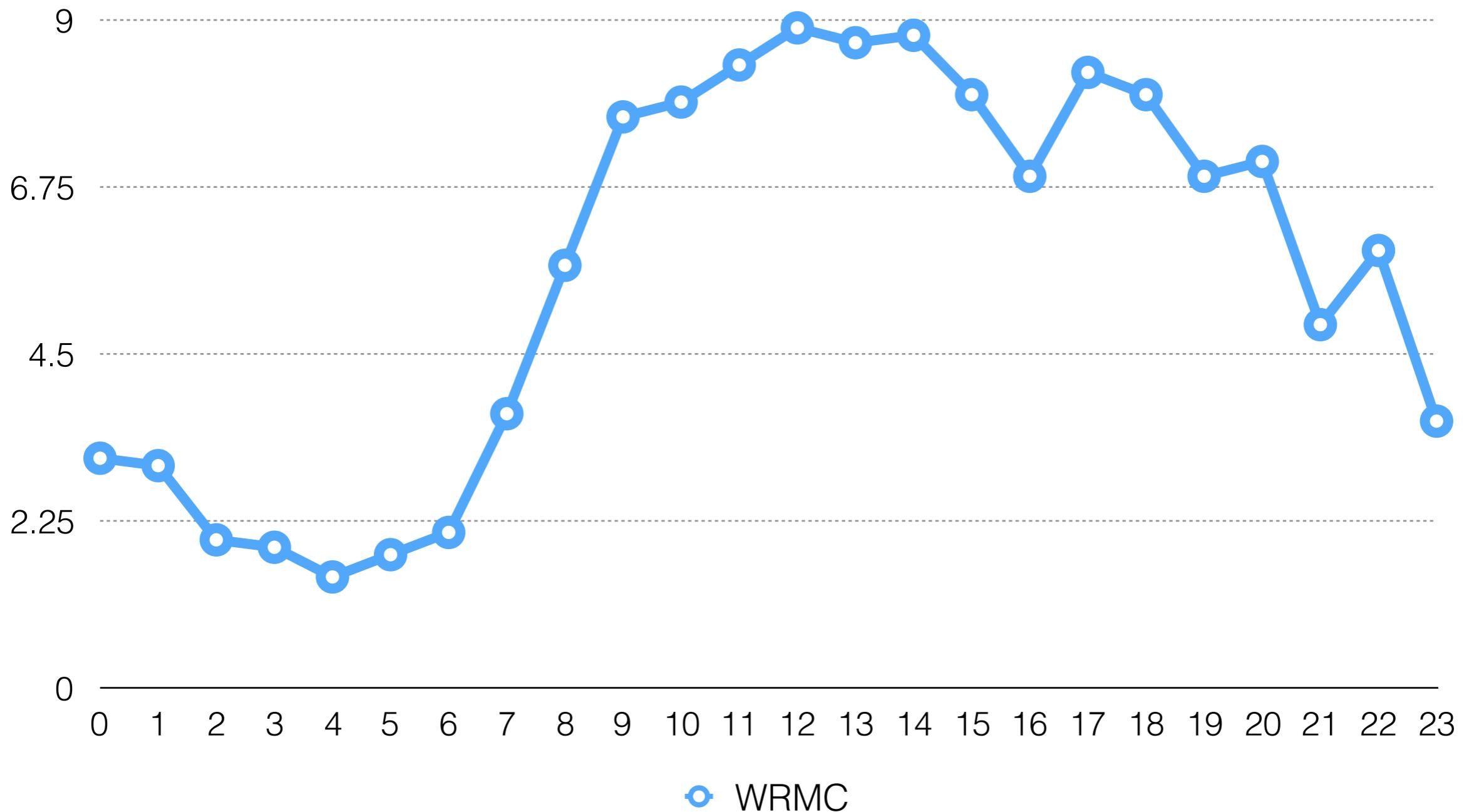
Arrival
Rate
Analyzer



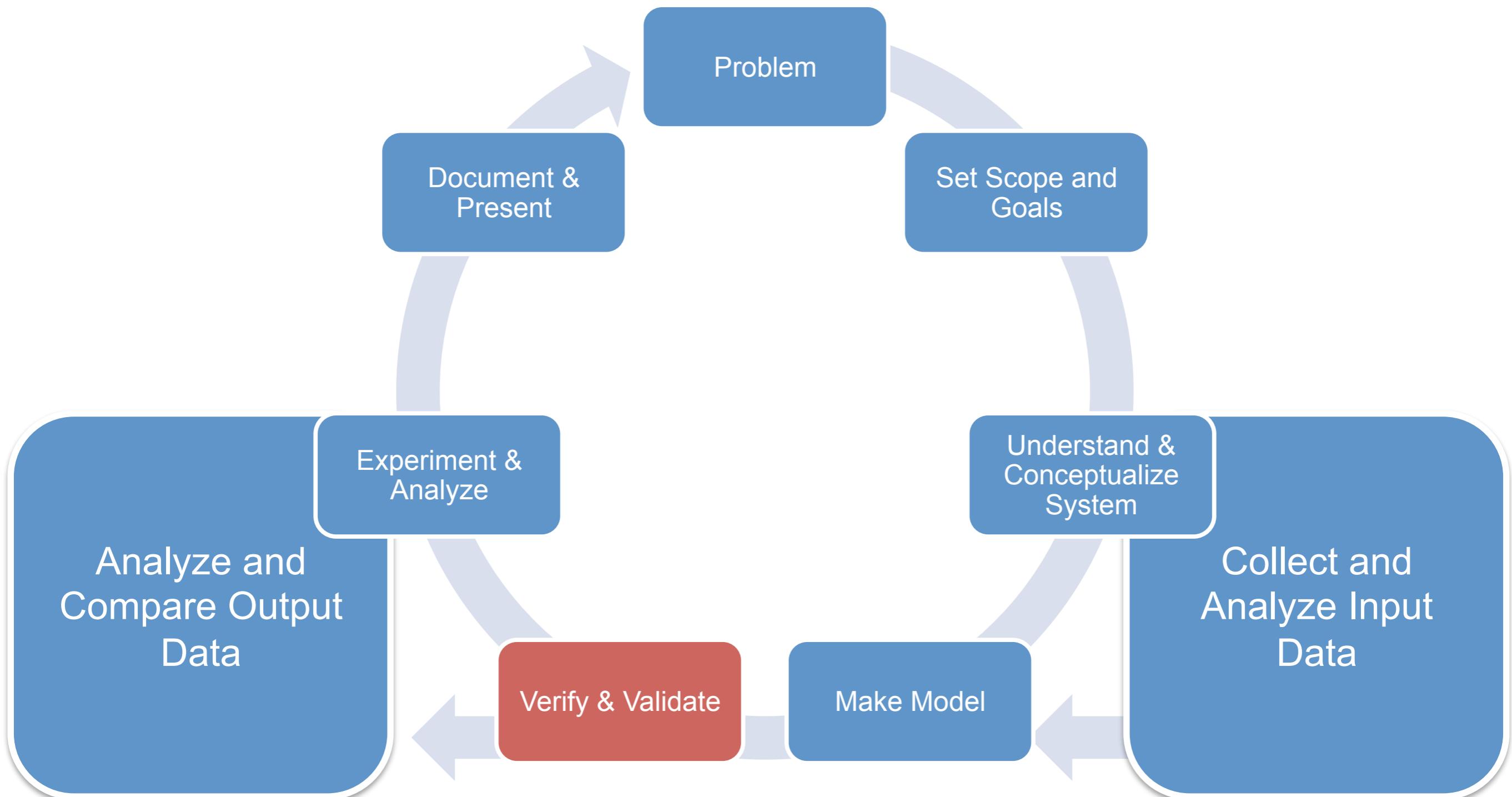
Time	ESI 1	ESI 2	ESI 3	ESI 4	ESI 5
00 - 02	0.3	12.2	53.3	31.1	3.1
02 - 04	0.6	15.3	55.3	26.1	2.7
04 - 06	0.2	13.8	58.7	25.6	1.7
	9.6	55.1	30.9	4.0	
06 - 08	15.8	45.2	30.9	7.8	
08 - 10	0.3	0.6	0.3	0.4	
10 - 12	17.7	45.1	27.6	8.9	
12 - 14	17.6	46.3	27.3	8.6	
14 - 16	17.7	44.7	28.6	8.5	
16 - 18	16.7	46.2	28.6	8.2	
18 - 20	14.6	44.4	34.6	6.3	
20 - 22	12.2	49.2	33.2	4.6	
22 - 00	11.6	47.2	37.3	3.8	

Mode	ESI 1	ESI 2	ESI 3	ESI 4	ESI 5	MH
EMS	100	32	32	0	0	0
Walk-in	0	68	68	100	100	100

Average Arrival Rate



The Simulation Cycle



Verification & Validation

Verification

Ensure model matches plan

Continuous process

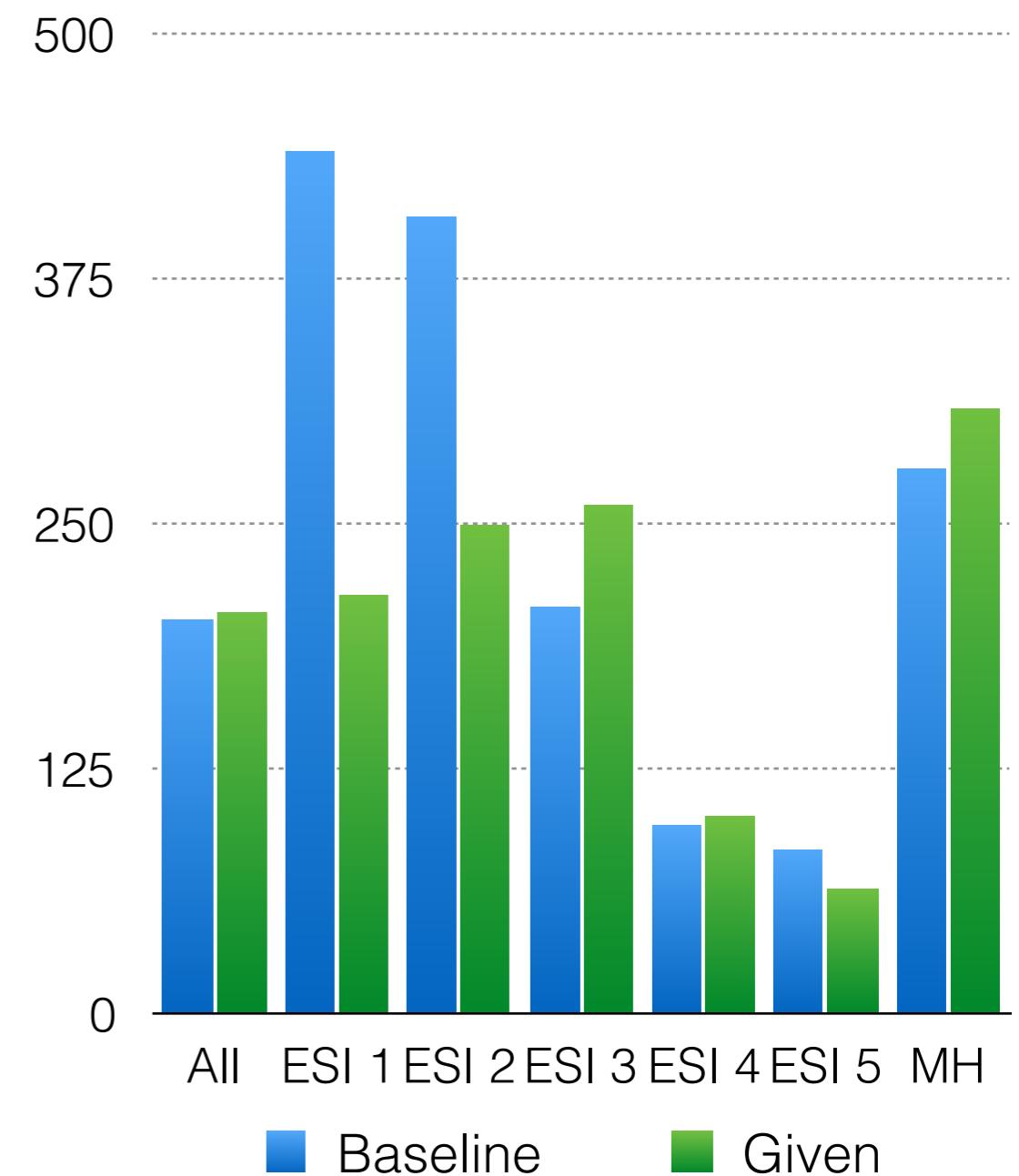
Ensure simulation matches maps

Validation

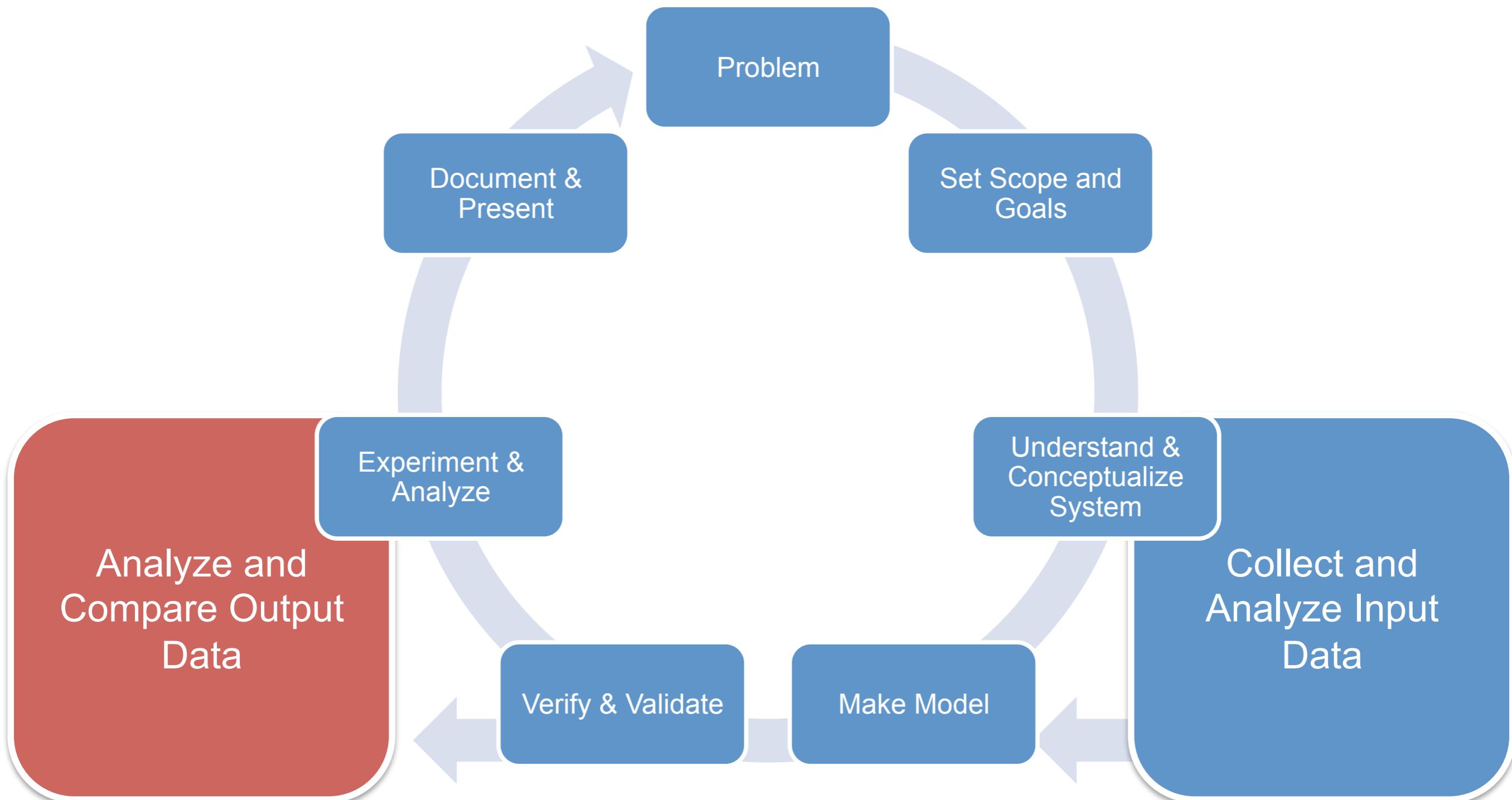
Ensure model matches reality

Tough to do for case study

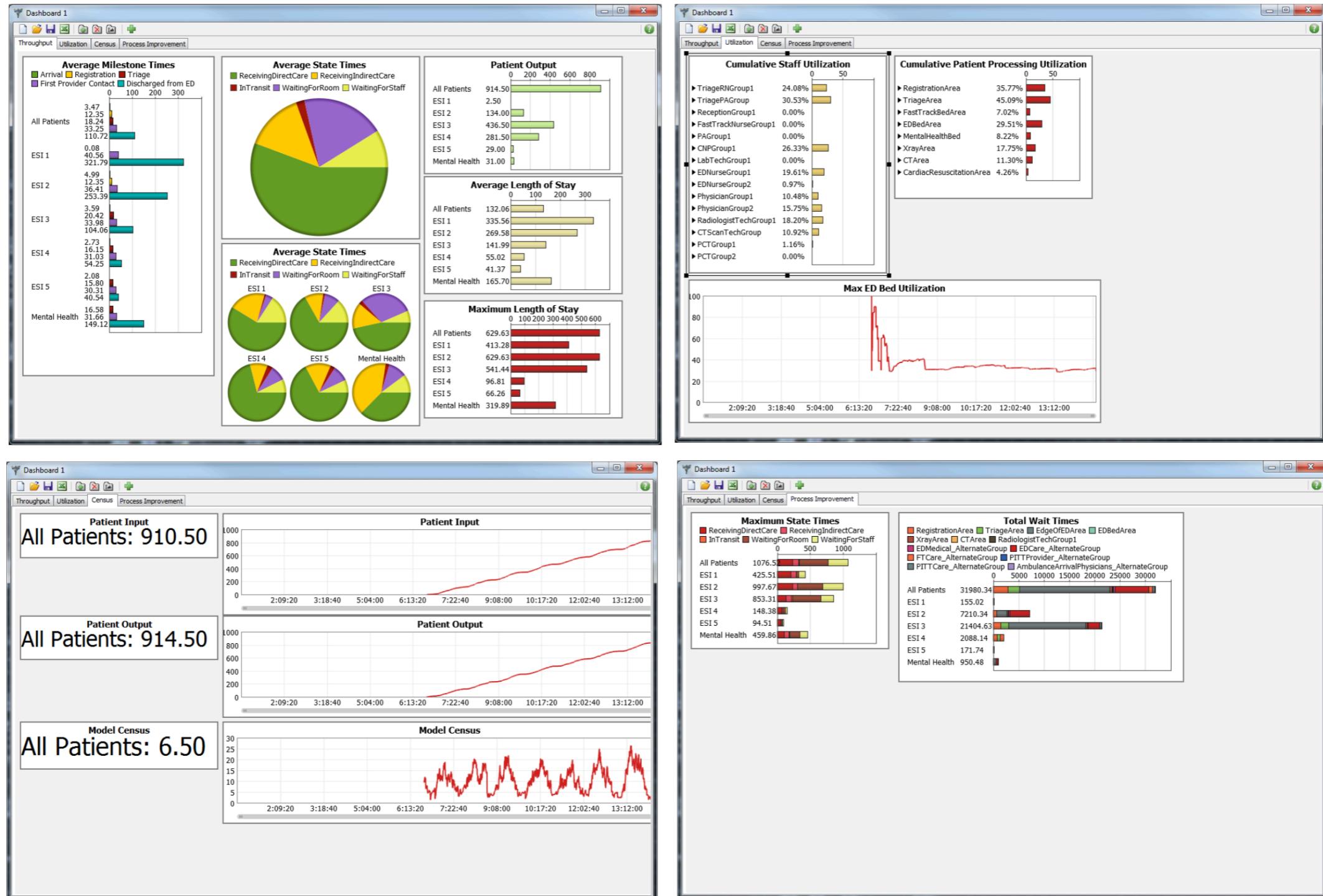
Had to find realistic baseline



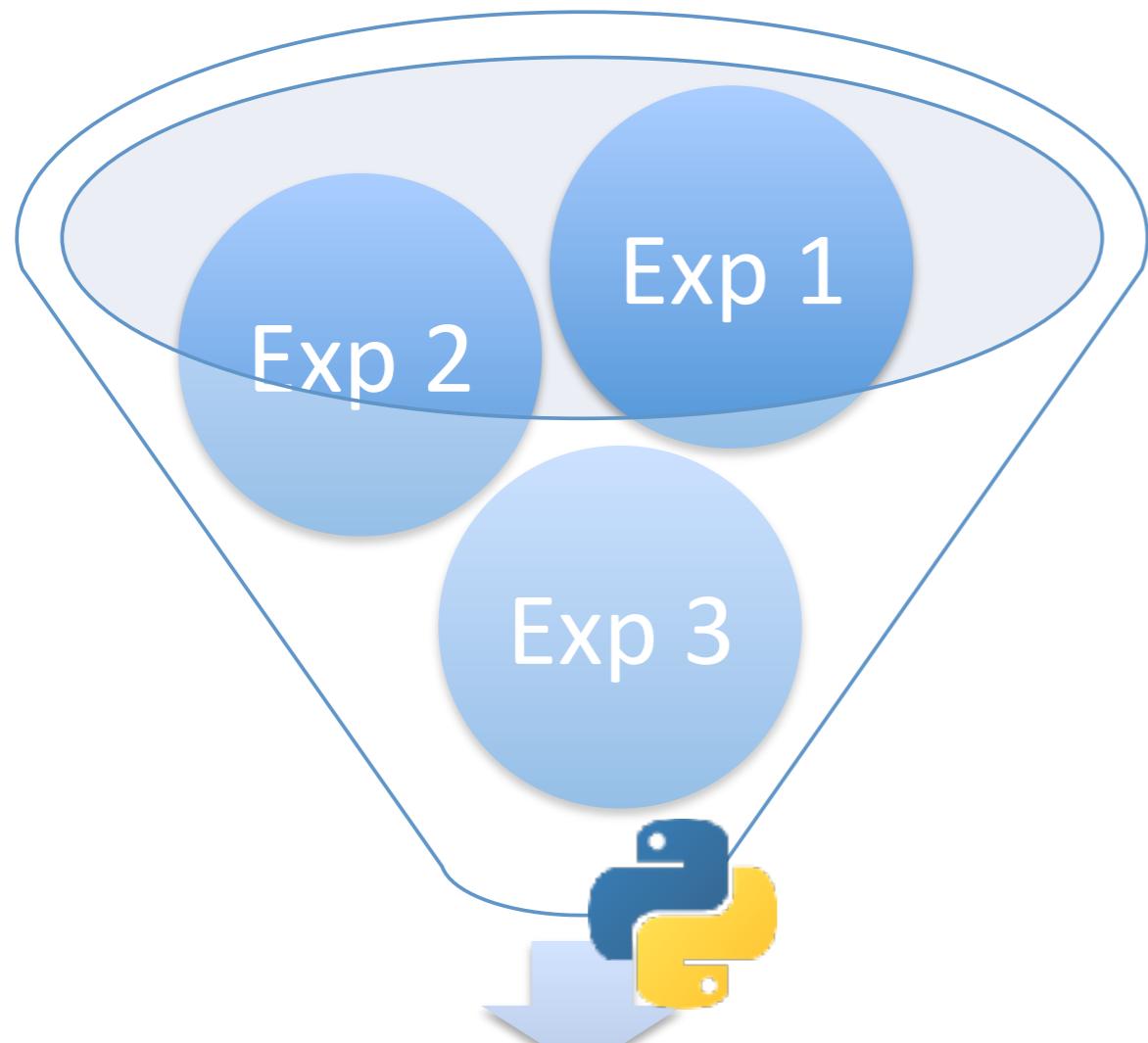
The Simulation Cycle



Clinic Manager Dashboard



Technical Note: Patient History Analyzer



Analyze multiple experimental results efficiently

Designate patient history files

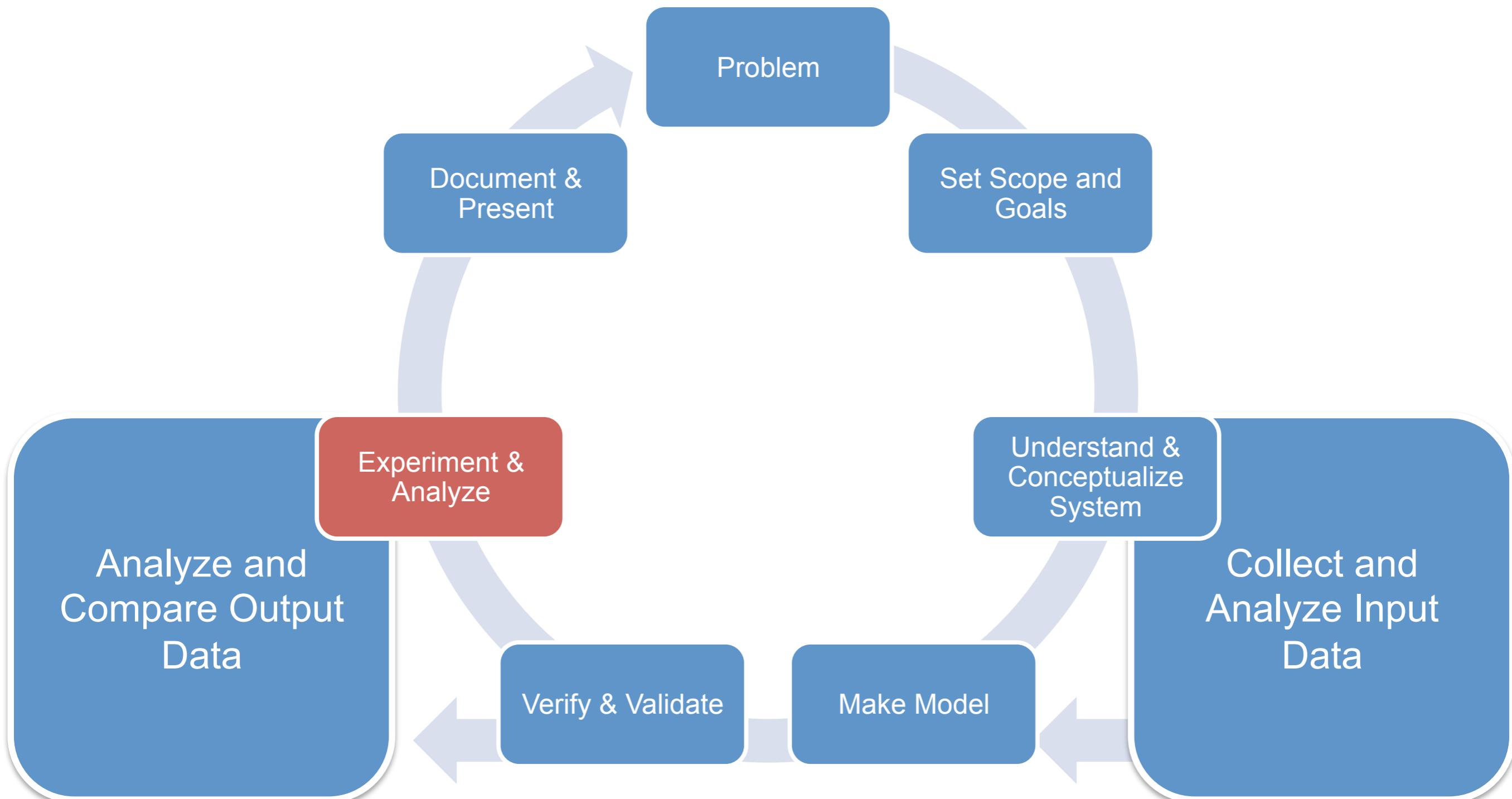
Write query

Runs same query over all files

Outputs report

Report

The Simulation Cycle



System Optimization

Mathematical Programming Approach

Objective:

Minimize LoS

$$\text{maximize } \mathbf{c}^T \mathbf{x}$$

Constraints:

Staffing Requirements

$$\text{subject to } A\mathbf{x} \leq \mathbf{b}$$

$$\text{and } \mathbf{x} \geq \mathbf{0}$$

Variables:

Delivery Method

Staffing Levels

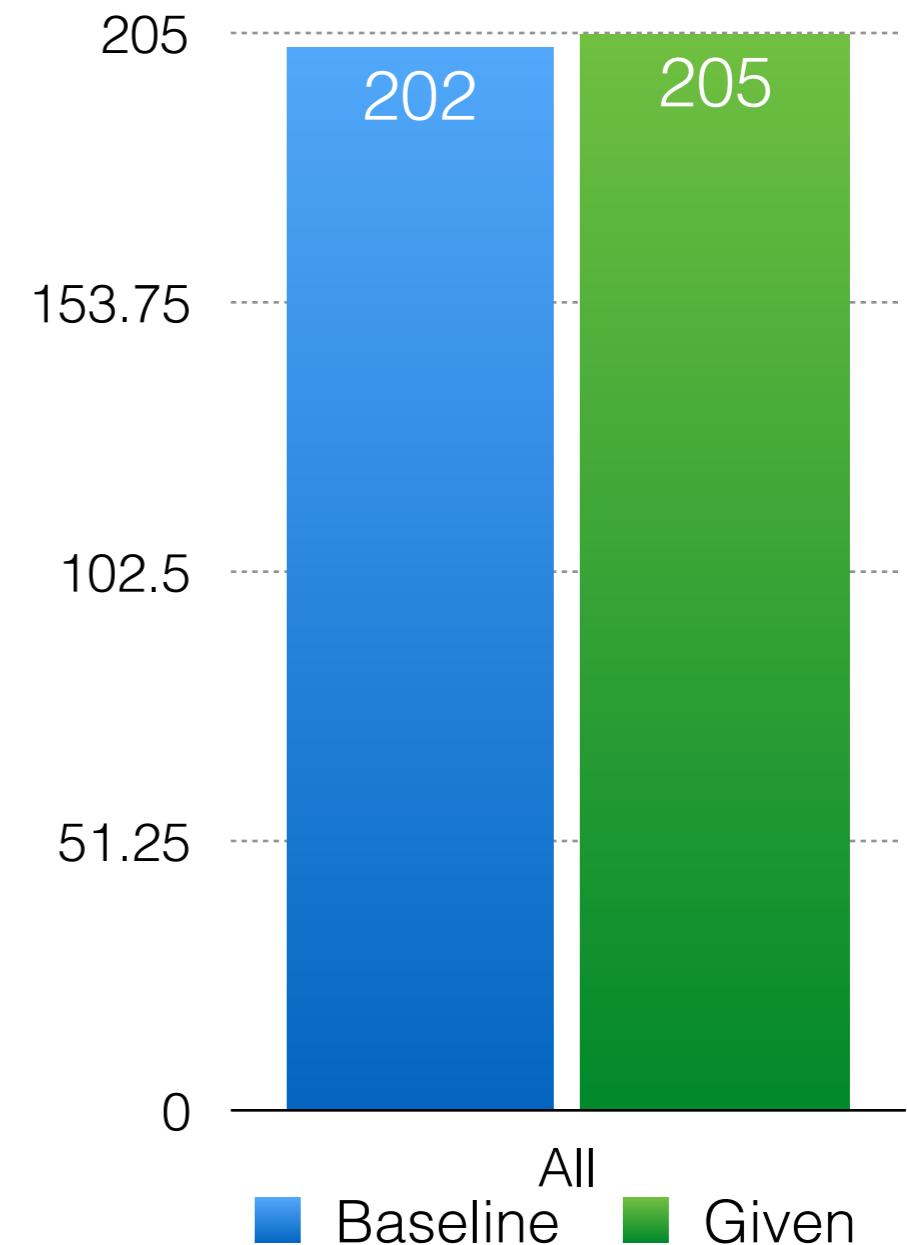
Finding Baseline

Objective: find staffing level for trad that closely matches LoS of WRMC

Designed small factorial experiment

Used R to find staffing level that matched best

	tRN	tPA	ftRN	ftPA	edRN	edMD	PCT
Trad Base	1	0	1	1	3	3	8
All	202	205	205	205	205	205	205



Initial Experimentation Goal

Determine the best delivery method and staffing model for each hour of every day.

Feasibility?!

At least 5000 different runs

Group by similar times

Unrealistic - times unlikely to be same

Modeling breaks down

Sequential Experiment

Find best delivery method

Use baseline for each delivery method

Pick whichever has smallest LoS

Find best staffing

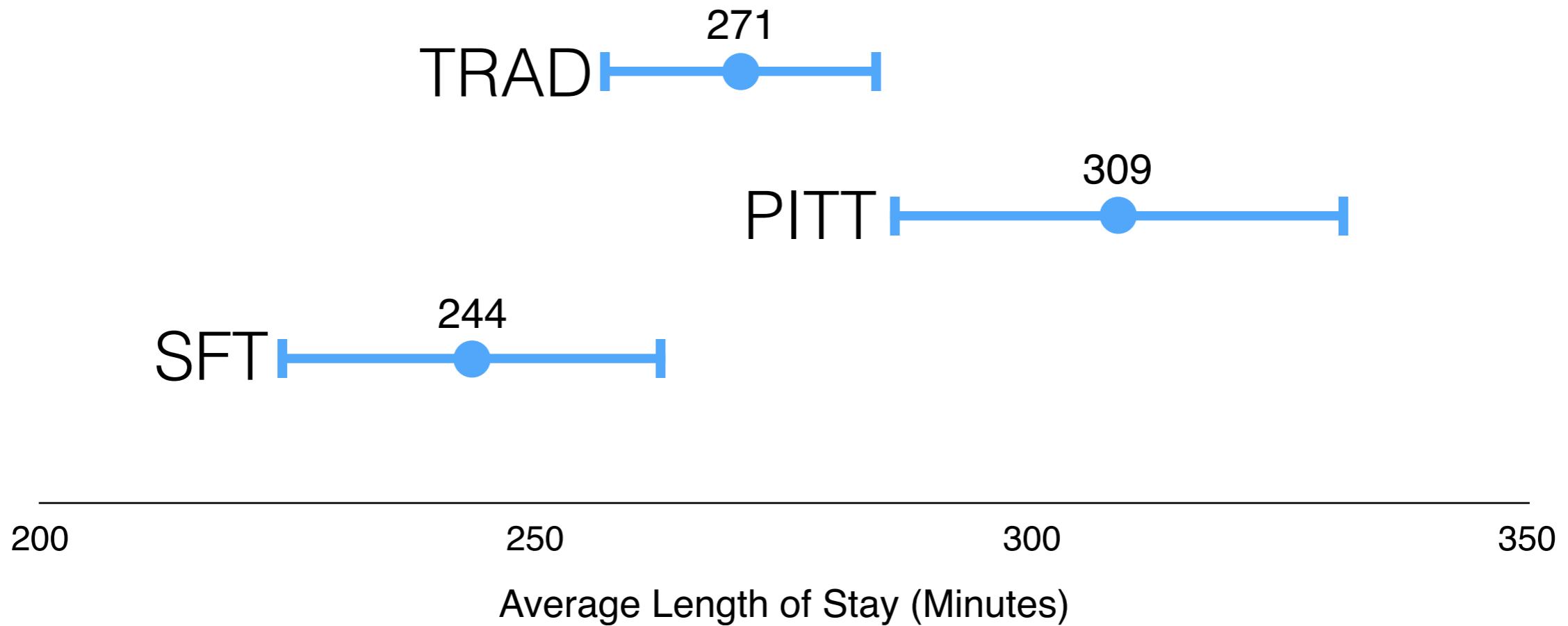
Pseudo factorial experiment

First optimize front of house (SFT)

Then optimize back of house (E)

Pick based on LoS

Best Delivery Method: LoS

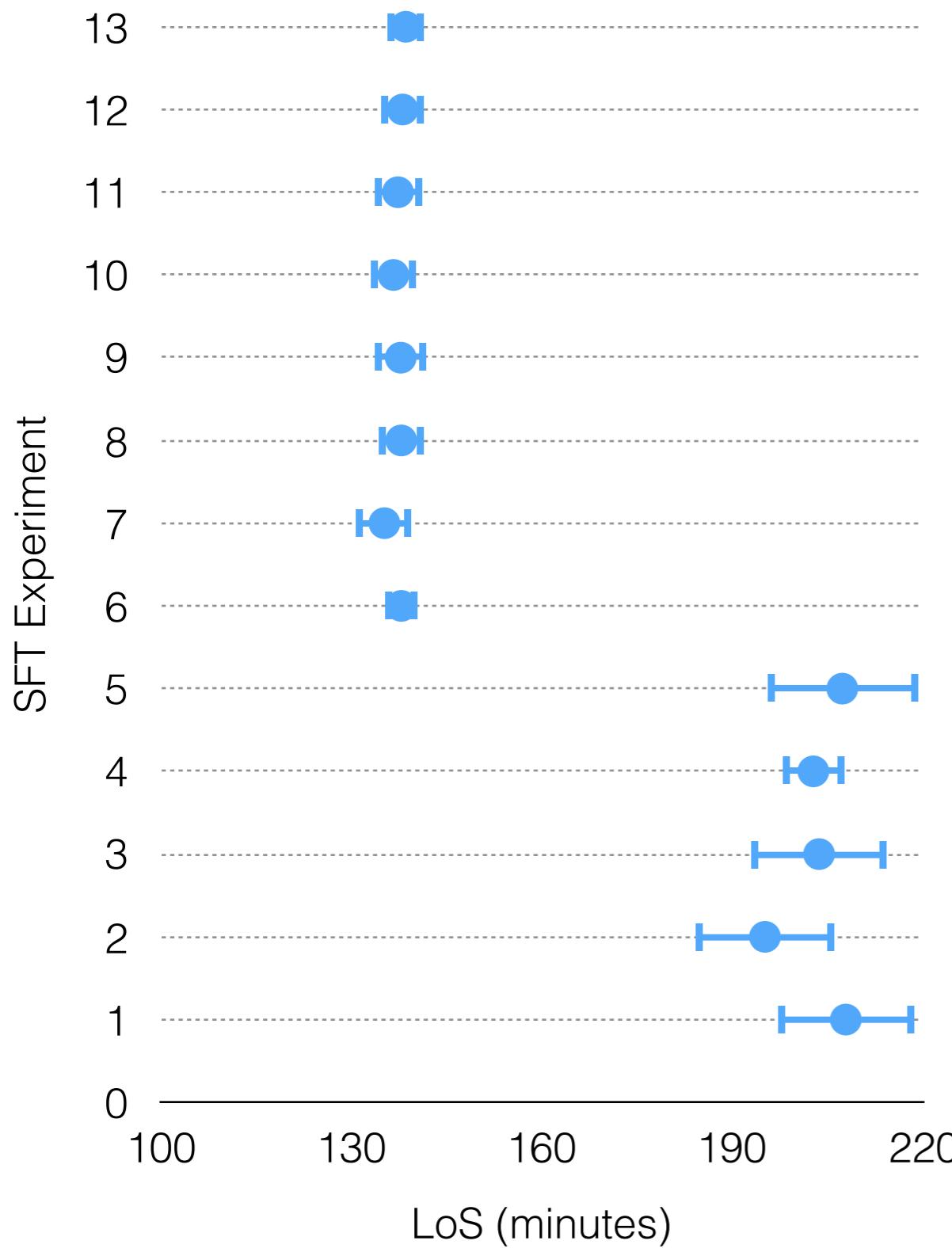


Best Staffing: Pseudo Factorial Design

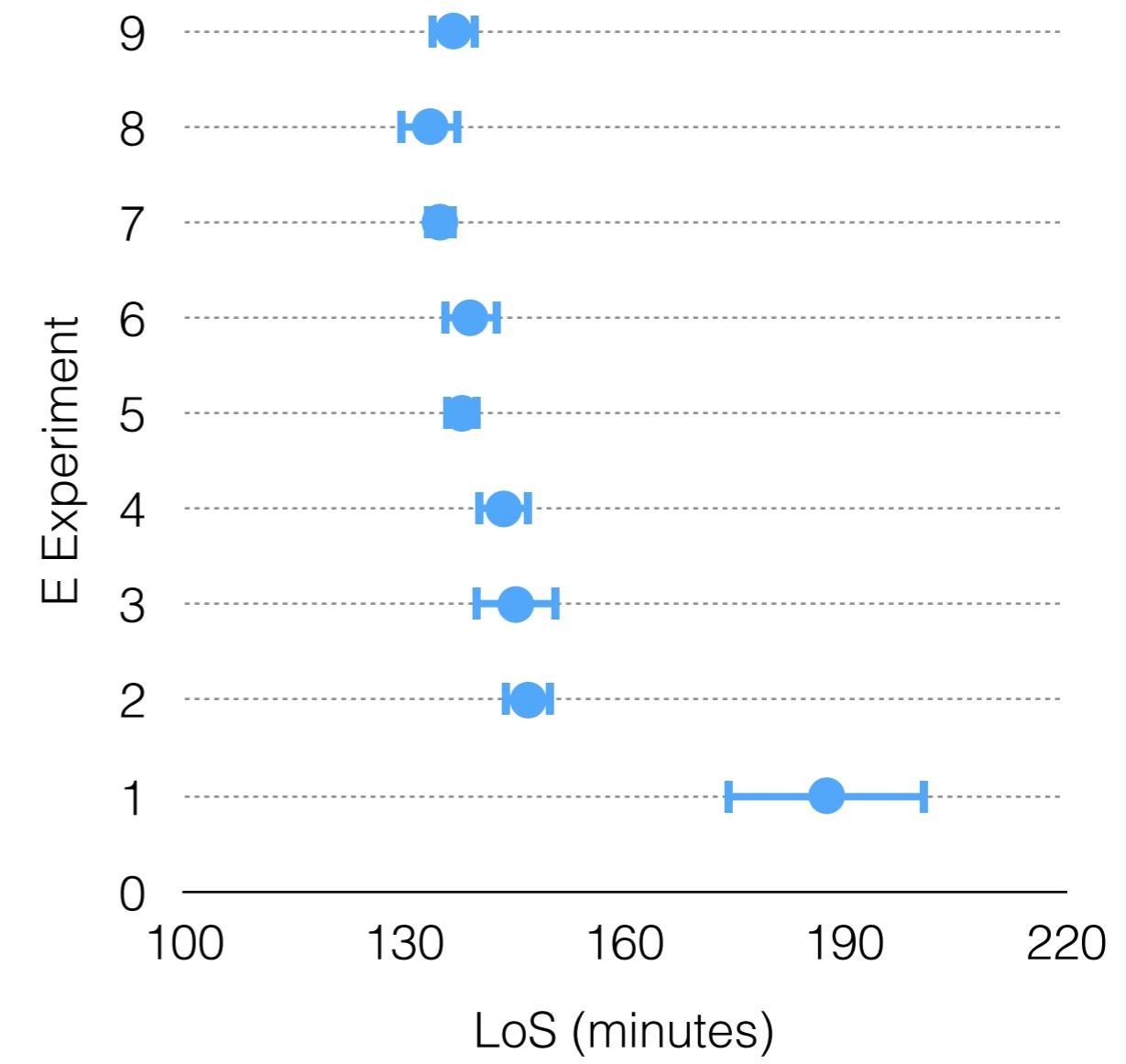
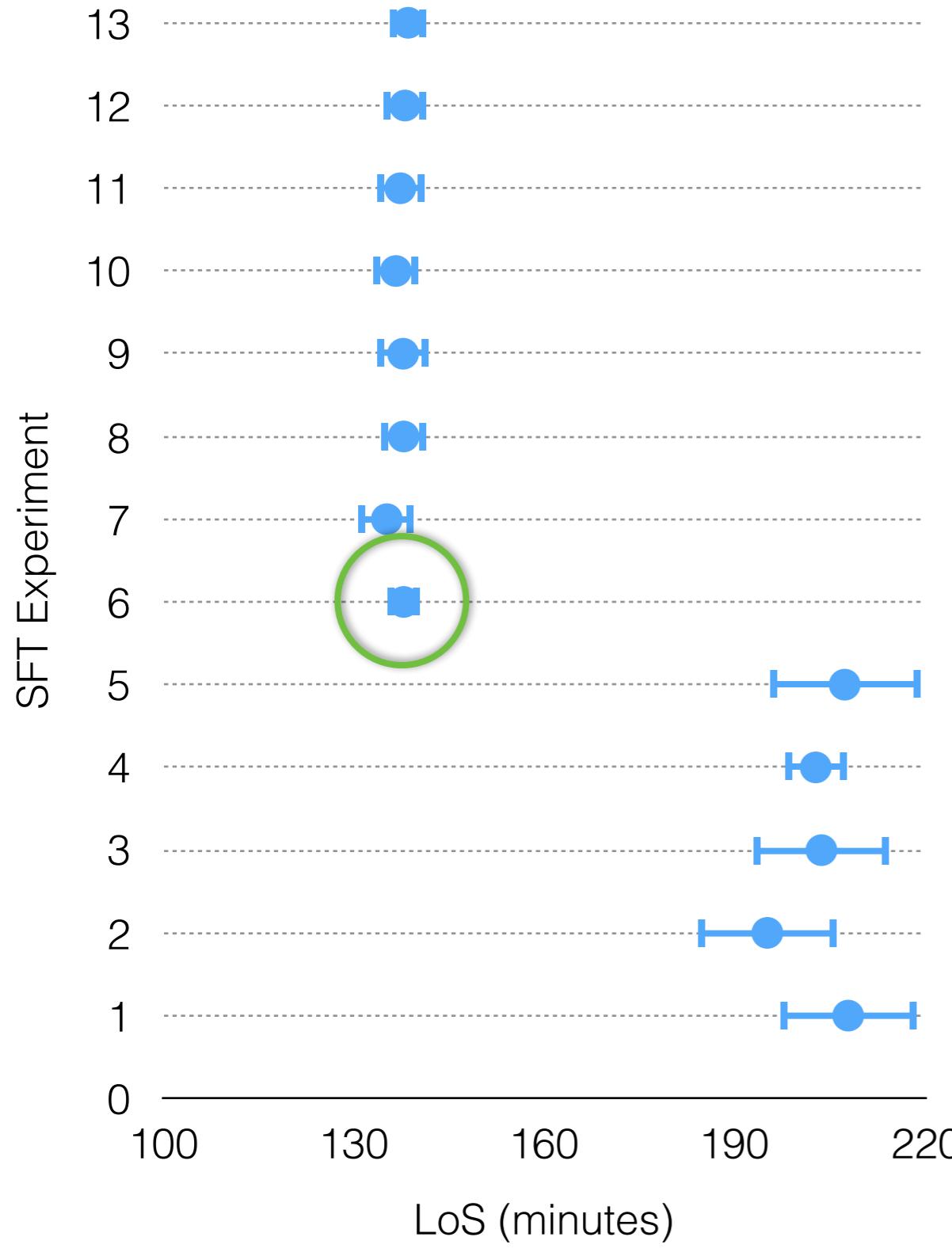
	tRN	tPA	ftRN
sft_1	1	2	1
sft_2	1	2	2
sft_3	1	3	2
sft_4	1	3	3
sft_5	1	4	3
sft_6	2	2	1
sft_7	2	3	1
sft_8	2	2	2
sft_9	2	3	2
sft_10	2	4	2
sft_11	2	3	3
sft_12	2	4	3
sft_13	2	5	3

	tRN	tPA	edRN	edMD
e_1	opt tRN	opt tPA	4	4
e_2	opt tRN	opt tPA	7	4
e_3	opt tRN	opt tPA	7	7
e_4	opt tRN	opt tPA	11	4
e_5	opt tRN	opt tPA	11	7
e_6	opt tRN	opt tPA	11	11
e_7	opt tRN	opt tPA	14	7
e_8	opt tRN	opt tPA	14	11
e_9	opt tRN	opt tPA	14	14

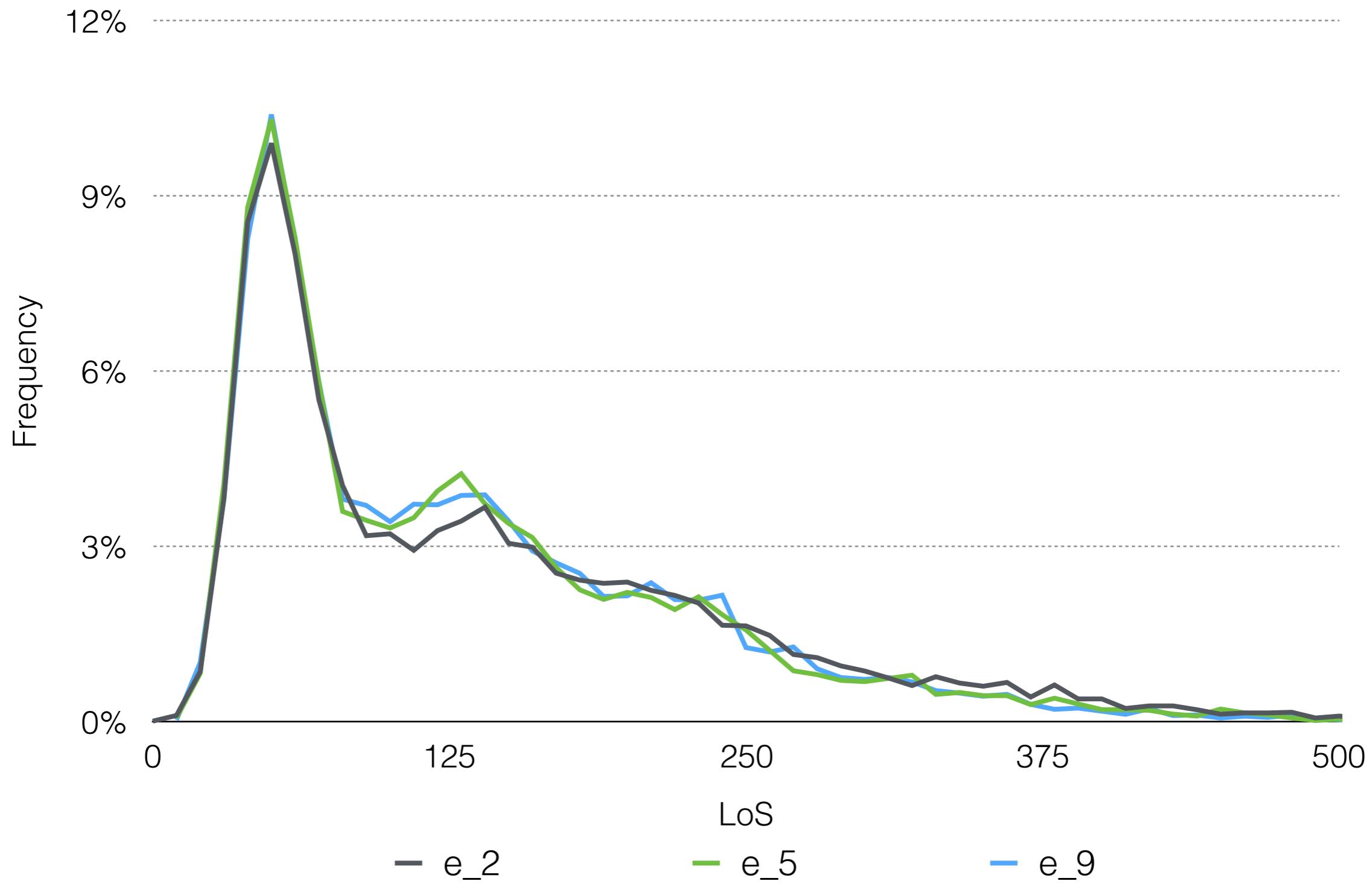
Best Staffing: LoS



Best Staffing: LoS



Best Staffing: LoS



Delivery Method & Staffing

	tRN	tPA	ftRN	ftPA	edRN	edMD	PCT
Choice	2	2	1	1	7	4	8

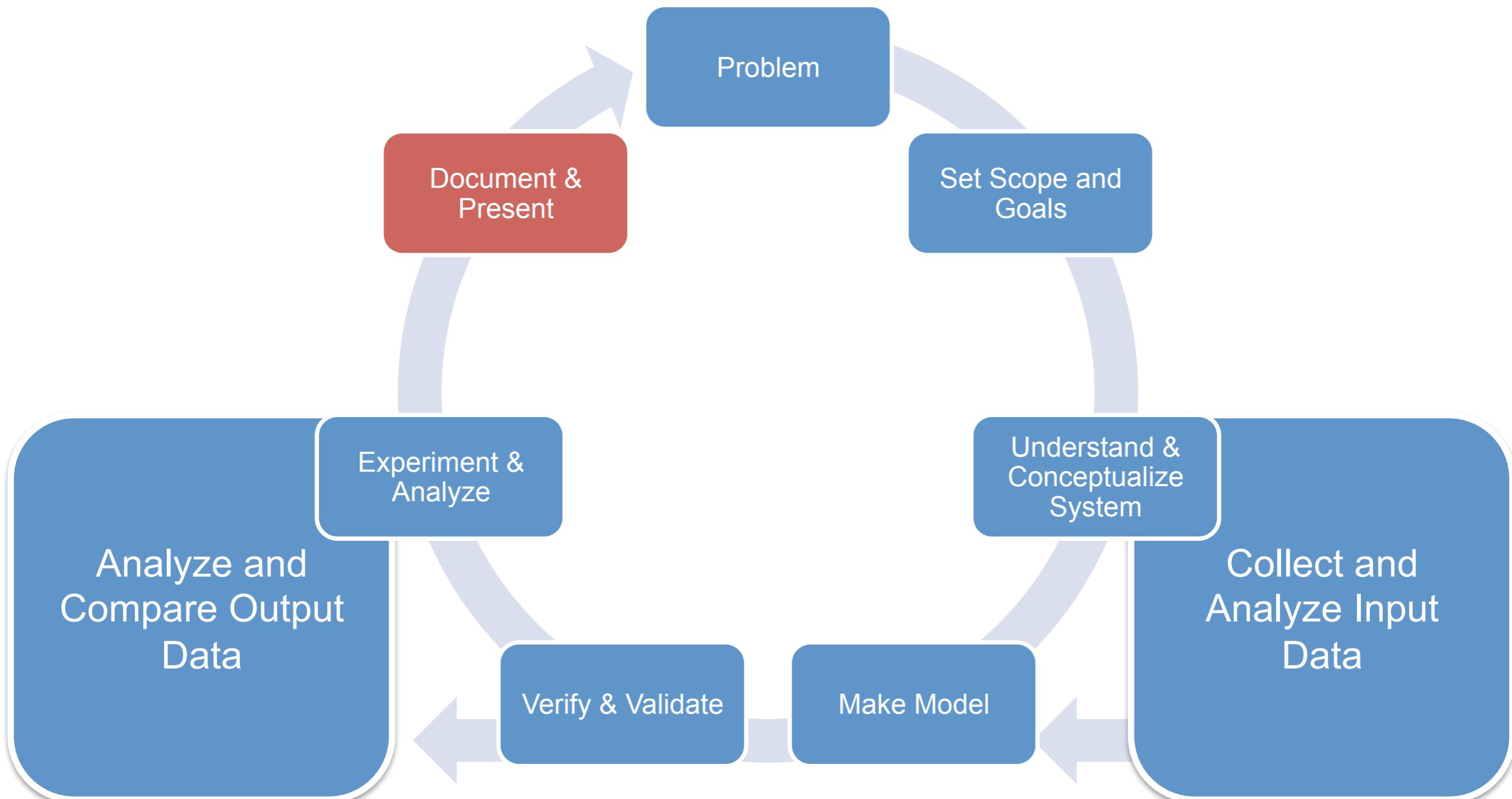
Delivery Method: Super Fast Track

Staffing: sft_6 & e_2

Choice should be thoroughly evaluated before implemented

	Mean	SD
LoS	146	5
TtP	40	3
Prod (MD)	1.3	0.7
Prod (RN/PA)	1.7	0.9

The Simulation Cycle



Future Work

Project

Additional Work To Strengthen Recommendation

Economic analysis

Work system analysis

Increasing Model Realism

Treatment processes

Modeling based on pathologies

Using Simulation In General

Many opportunities

Big upfront cost, big payoff down the line

Modeling is amazing

Thank You!

Society for Health Systems

FlexSim

Patti Brennan

Dr. Brian Patterson

Laura McLay

UW ISyE Department
UW EM Department



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Appendix

Arrival Rate Distribution

Hourly Arrival Rate Distributions

Time	Sun	Mon	Tue	Wed	Thu	Fri	Sat
00 - 01	3.9(2.6)	2.8(1.5)	2.7(1.9)	4.1(1.5)	1.9(0.5)	2.4(1.7)	3.7(1.7)
01 - 02	3.9(0.9)	2.6(1.7)	2.4(1.3)	3.0(1.7)	3.5(1.3)	2.2(1.8)	3.7(1.9)
02 - 03	1.5(1.5)	2.4(0.8)	1.6(1.7)	0.3(0.5)	1.9(0.5)	3.0(1.7)	3.0(1.3)
03 - 04	3.7(0.9)	1.7(0.9)	1.9(1.7)	1.4(1.0)	2.4(1.3)	0.5(0.6)	1.9(1.9)
04 - 05	2.4(1.3)	1.3(1.1)	0.8(1.0)	1.4(1.0)	1.4(1.3)	1.6(1.0)	1.5(1.1)
05 - 06	1.9(1.3)	2.6(1.7)	1.6(1.3)	2.2(1.4)	0.5(1.0)	1.4(0.5)	2.4(1.8)
06 - 07	1.7(1.7)	2.6(1.7)	3.0(1.7)	1.6(1.3)	3.0(1.5)	1.1(0.8)	1.7(1.1)
07 - 08	1.7(1.5)	3.7(1.5)	4.1(3.6)	3.2(1.8)	5.7(2.5)	3.8(2.4)	3.9(2.1)
08 - 09	4.5(1.9)	5.0(2.1)	5.9(1.3)	6.8(2.1)	6.8(1.5)	6.2(2.6)	4.8(2.8)
09 - 10	6.7(2.3)	10.6(1.9)	6.8(1.0)	7.8(2.9)	10.0(1.5)	5.1(1.7)	7.1(1.8)
10 - 11	8.9(2.9)	8.2(2.7)	7.6(0.6)	7.8(3.3)	8.1(2.1)	7.0(1.9)	8.0(0.9)
11 - 12	7.3(2.4)	7.6(2.3)	8.1(2.6)	9.2(2.4)	9.2(0.6)	8.9(3.0)	8.2(1.8)
12 - 13	8.6(2.5)	11.2(1.9)	9.5(1.7)	7.0(0.6)	7.0(1.0)	11.3(1.3)	8.0(4.4)
13 - 14	9.7(4.8)	13.0(1.6)	6.2(2.4)	7.3(1.0)	5.1(2.9)	11.1(3.0)	8.2(3.0)
14 - 15	9.1(1.9)	7.8(2.9)	7.6(1.4)	7.6(1.4)	9.7(0.8)	8.9(2.9)	10.8(2.2)
15 - 16	8.2(1.7)	9.5(3.1)	7.3(2.9)	10.0(3.3)	8.6(0.8)	6.2(3.3)	6.5(1.9)
16 - 17	7.1(2.3)	9.9(1.6)	9.7(2.2)	6.2(1.3)	5.9(1.3)	5.7(1.0)	4.1(1.8)
17 - 18	6.7(3.1)	9.5(3.1)	10.3(3.0)	10.8(3.6)	5.9(4.2)	8.1(4.7)	7.1(3.5)
18 - 19	5.6(2.6)	7.3(2.6)	7.8(5.4)	7.6(2.2)	9.5(3.2)	11.6(3.5)	6.9(1.9)
19 - 20	8.0(1.3)	6.9(1.5)	5.4(1.4)	6.5(2.4)	7.0(3.7)	6.2(1.3)	8.0(2.5)
20 - 21	8.0(3.8)	7.8(2.4)	5.7(1.3)	5.1(1.0)	7.6(3.4)	8.9(2.2)	6.9(1.5)
21 - 22	5.4(2.3)	5.4(2.9)	5.7(2.5)	4.6(3.7)	3.5(1.3)	6.8(0.5)	3.2(2.8)
22 - 23	5.2(2.3)	6.0(2.9)	3.8(1.7)	6.2(0.5)	5.7(2.2)	7.6(1.8)	6.9(1.8)
23 - 00	3.9(1.5)	2.4(1.3)	4.6(1.0)	2.4(2.1)	4.1(2.1)	4.6(1.0)	3.0(1.6)

Arrival Rate by ESI Class

Percent Arrivals by ESI Classification

Time	ESI 1	ESI 2	ESI 3	ESI 4	ESI 5
00 - 02	0.3	12.2	53.3	31.1	3.1
02 - 04	0.6	15.3	55.3	26.1	2.7
04 - 06	0.2	13.8	58.7	25.6	1.7
06 - 08	0.4	9.6	55.1	30.9	4.0
08 - 10	0.3	15.8	45.2	30.9	7.8
10 - 12	0.6	17.7	45.1	27.6	8.9
12 - 14	0.3	17.6	46.3	27.3	8.6
14 - 16	0.4	17.7	44.7	28.6	8.5
16 - 18	0.4	16.7	46.2	28.6	8.2
18 - 20	0.1	14.6	44.4	34.6	6.3
20 - 22	0.2	12.2	49.2	33.2	4.6
22 - 00	0.1	11.6	47.2	37.3	3.8

Arrival Mode

Arrival Mode by ESI

Mode	ESI 1	ESI 2	ESI 3	ESI 4	ESI 5	MH
EMS	100	32	32	0	0	0
Walk-in	0	68	68	100	100	100

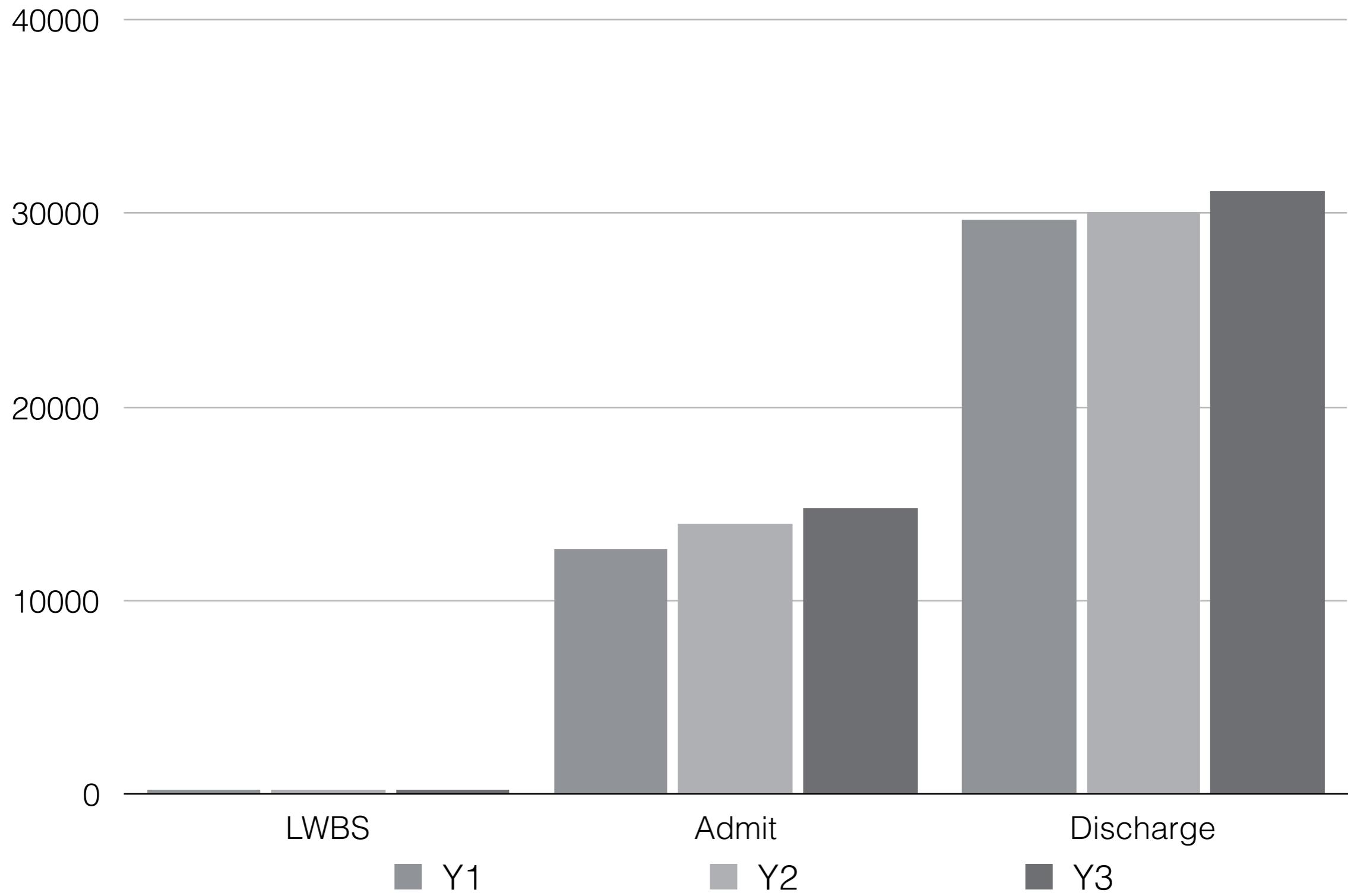
Percent of Arrivals by ESI

	ESI 1	ESI 2	ESI 3	ESI 4	ESI 5	MH
% of Arr	0.3	15.3	44	26.8	6.7	6.9

Testing

Testing	ESI 1	ESI 2	ESI 3	ESI 4	ESI 5	MH
Lab	10	22	31	19	17	99
Xray	6	2	12	27	0	0
L/X	79	67	33	2	0	1
CT	22	22	17	2	0	0
None	0	7	18	52	83	0

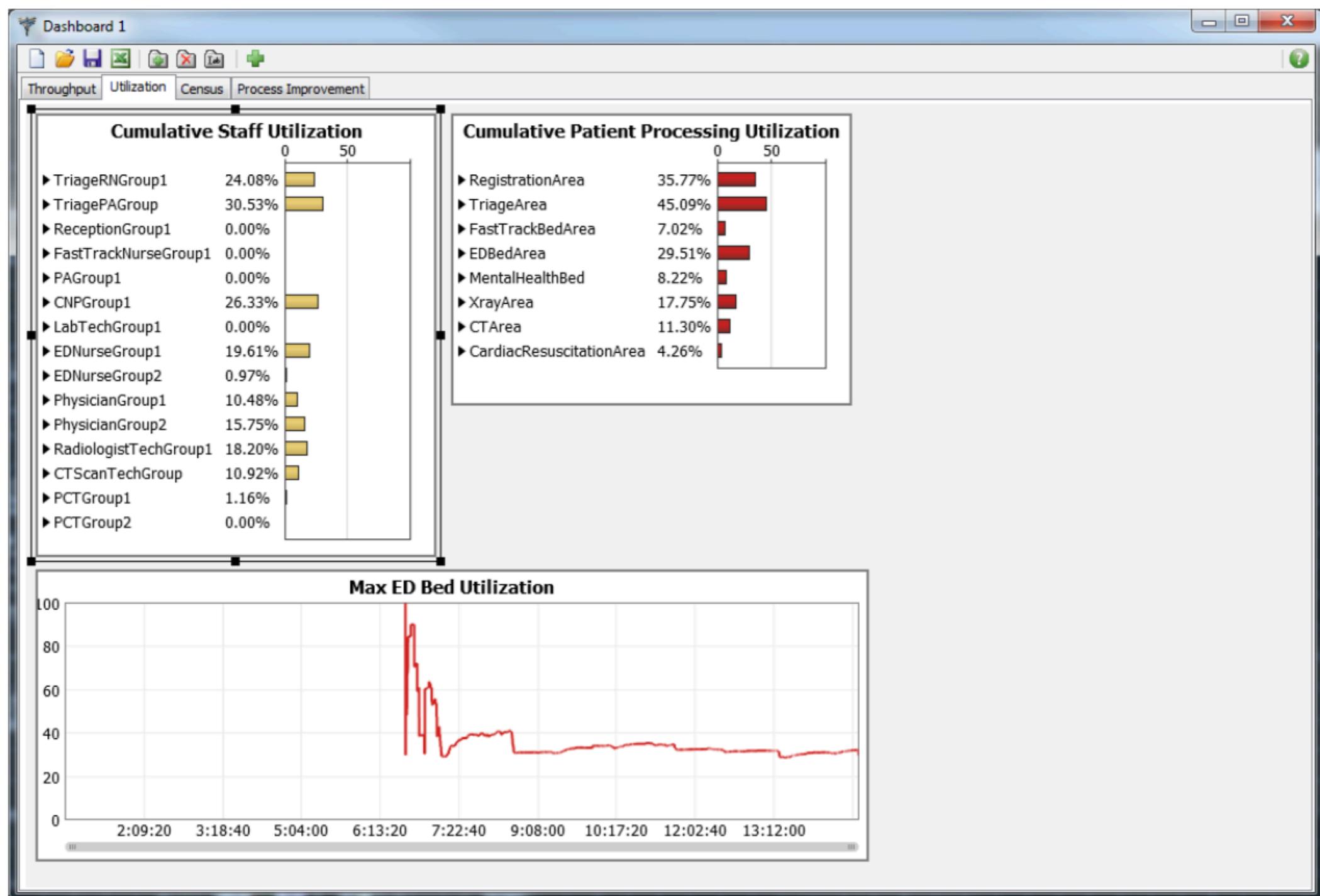
LWBS Out of Scope



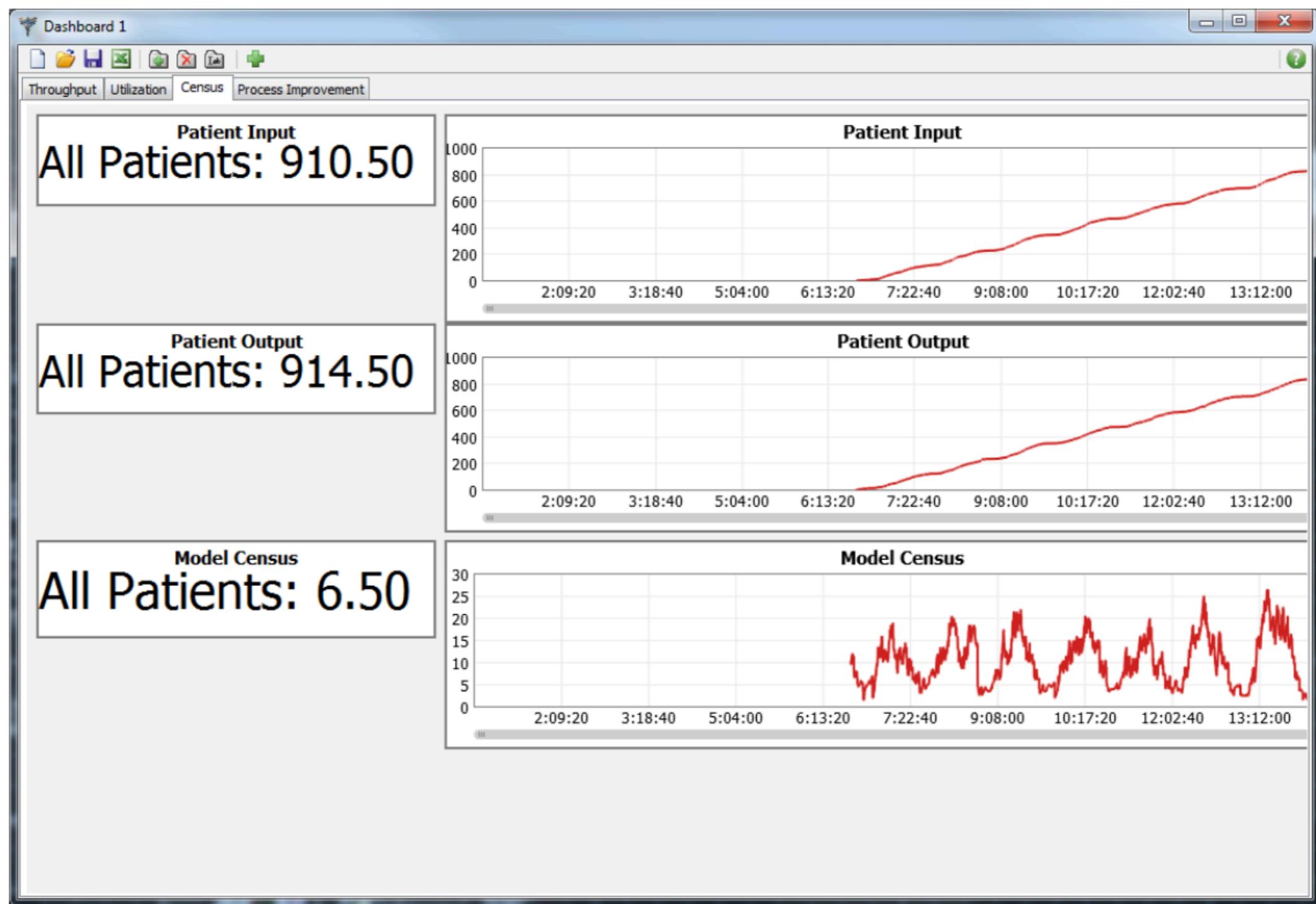
CMD: LoS & Milestones



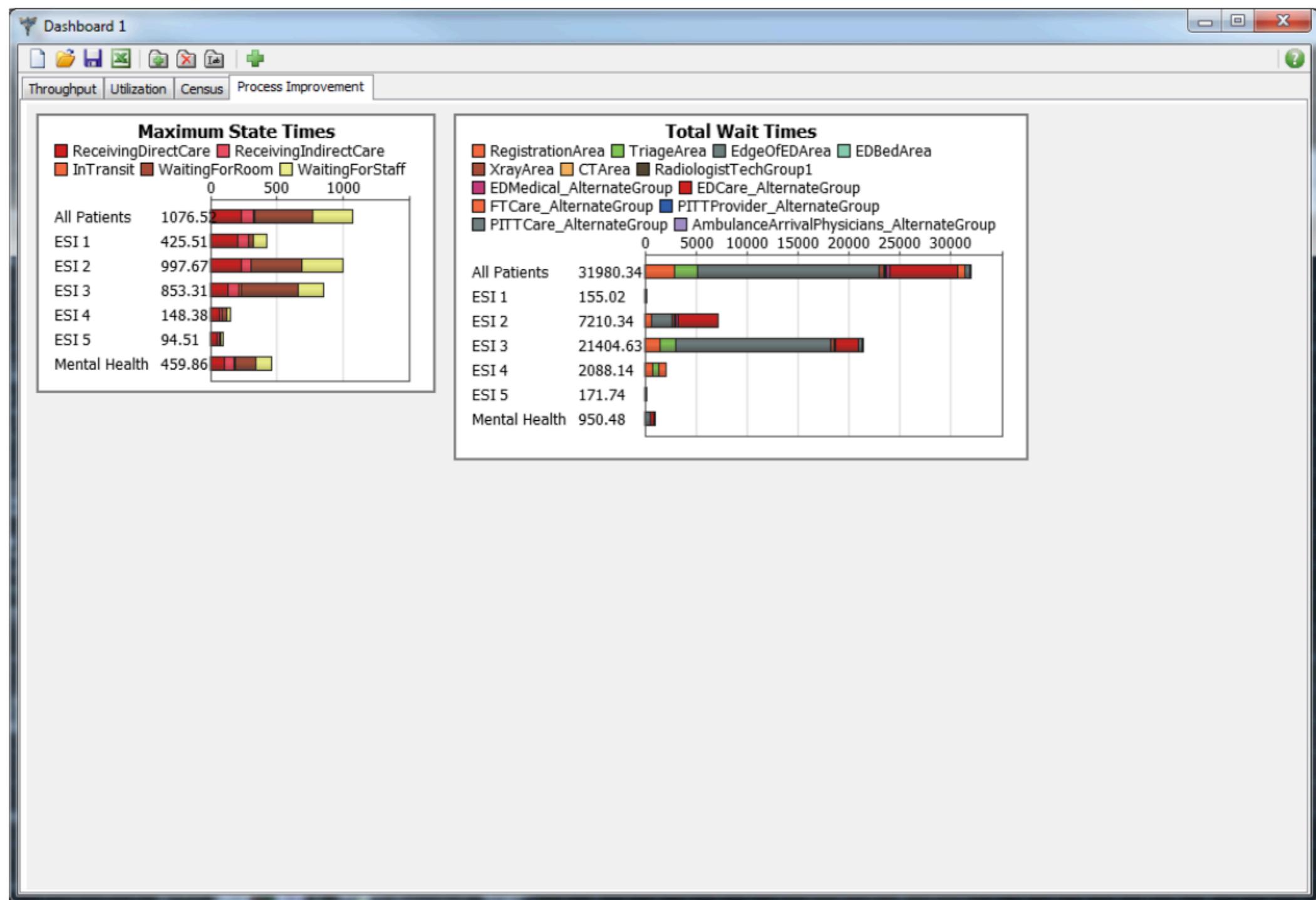
CMD: Utilization



CMD: Census

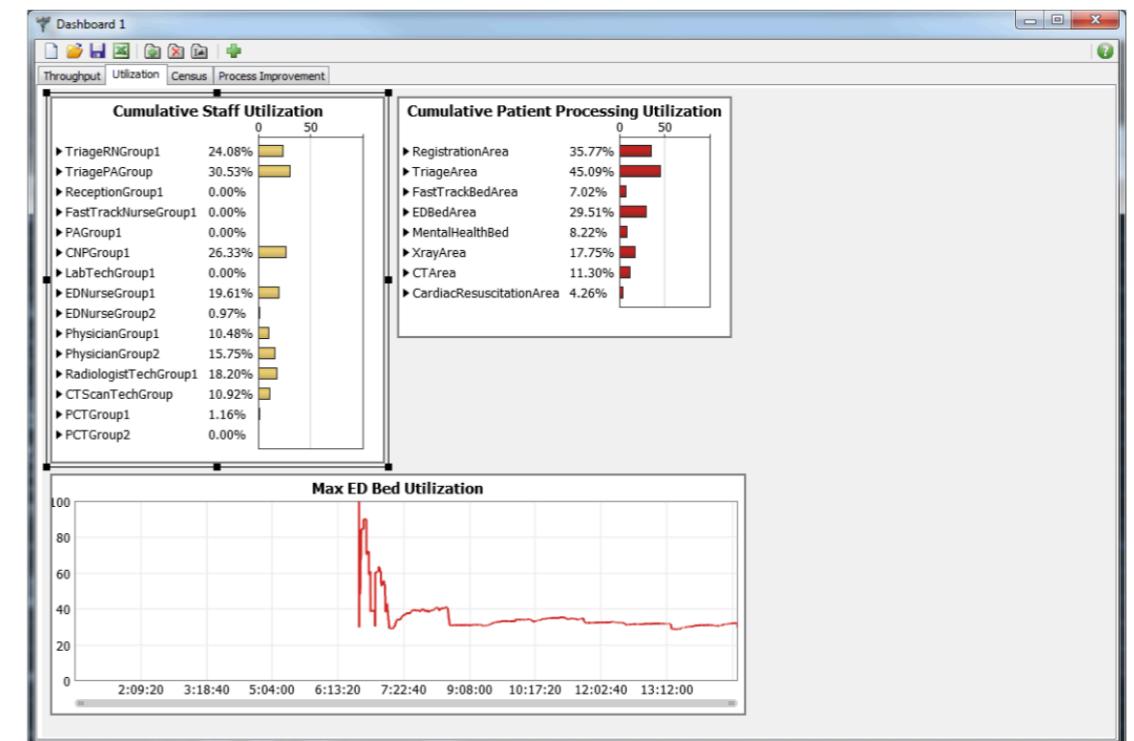


CMD: Process Improvement



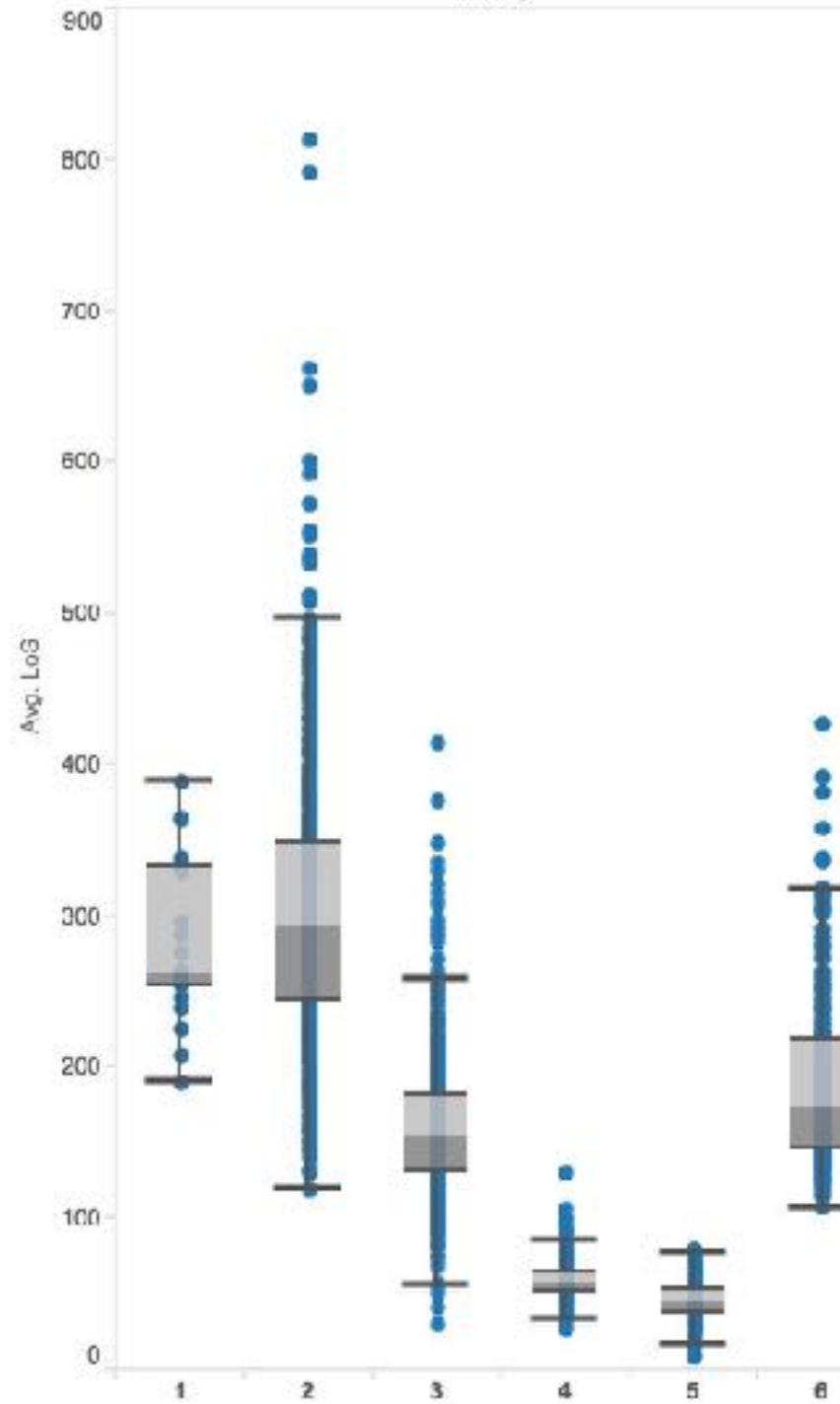
Experimental Runs

- 1 week warm-up time
- Run for a week



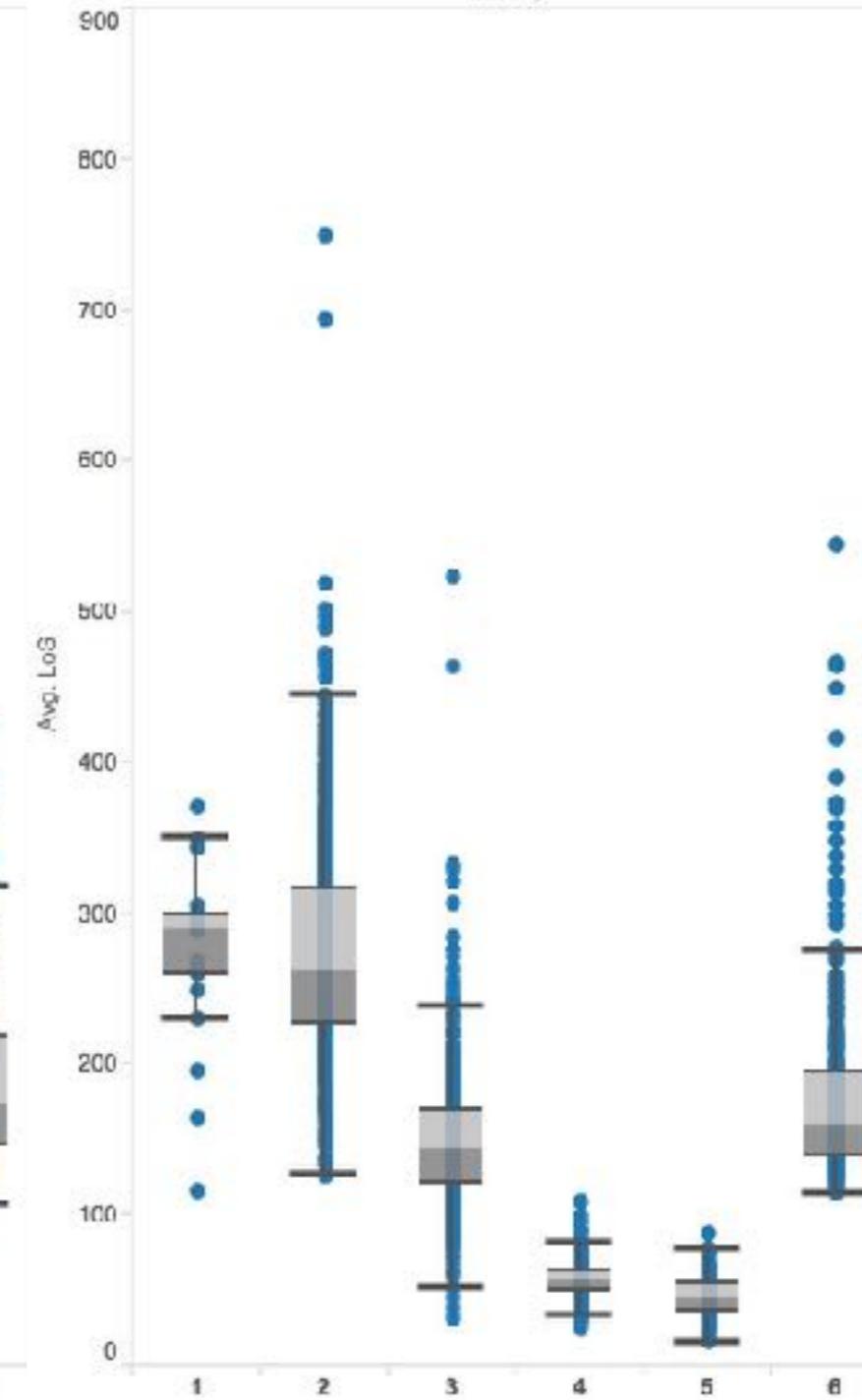
e_2 LoS Ac

Acuity



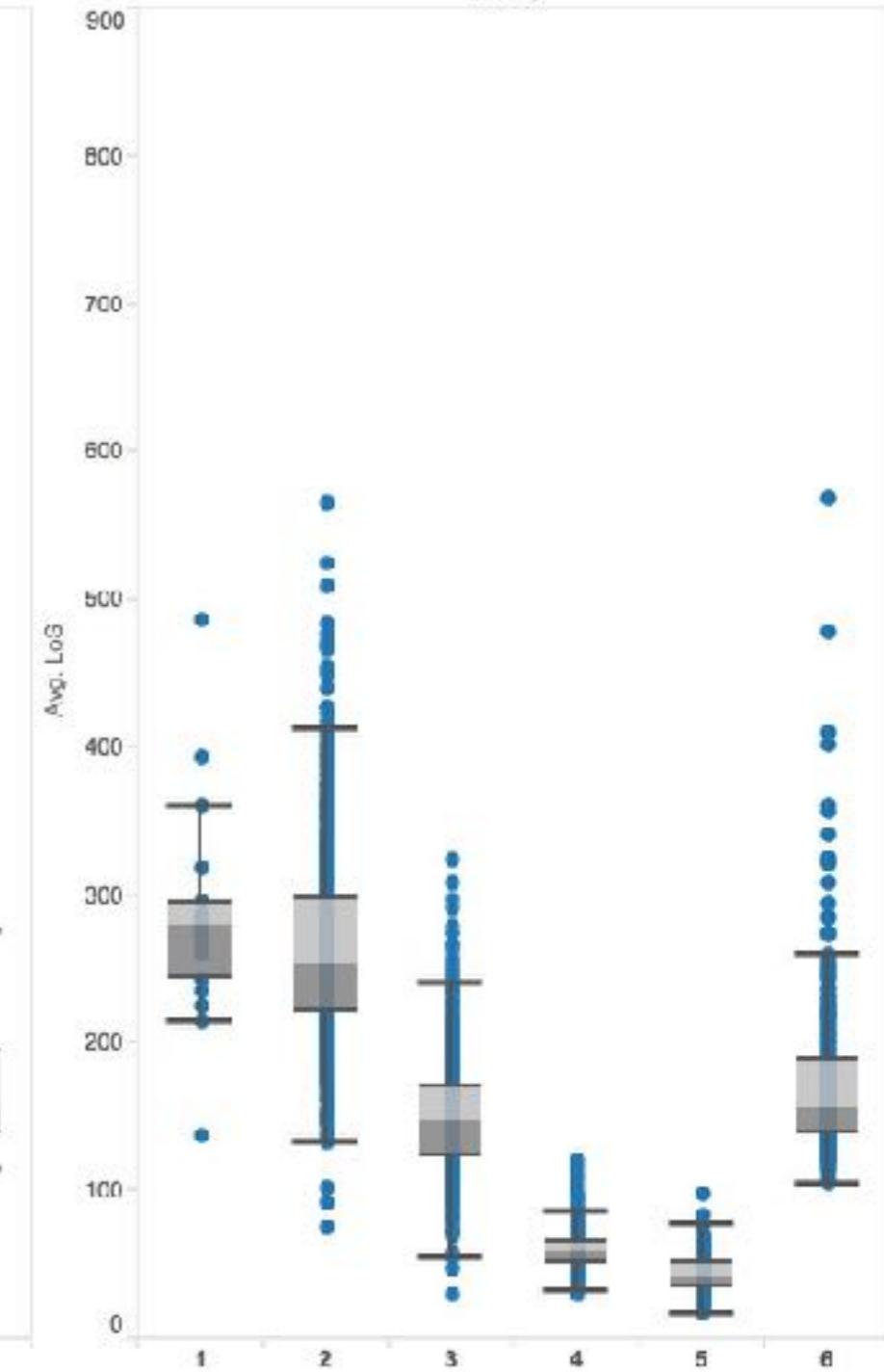
e_5 LoS Ac

Acuity



e_9 LoS Acc

Acuity



Average of LcS for each Acuity. Details are shown for Patent ID.

Average of LcS for each Acuity. Details are shown for Patent ID.

Average of LcS for each Acuity. Details are shown for Patent ID.