

## Simulating a Medical Observation Unit for Pediatric Emergency Department

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### Problem Statement

#### What is an Observation Unit?

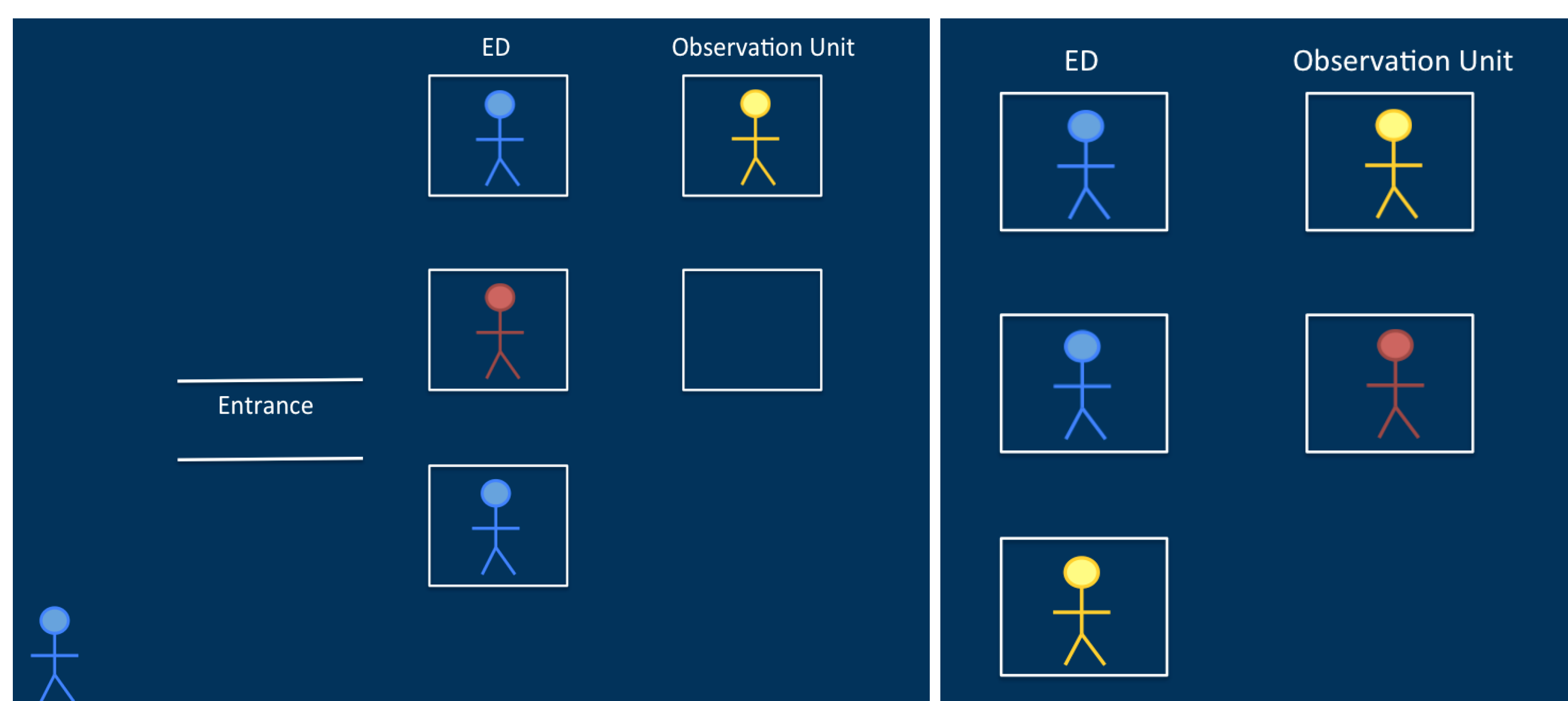
- Dedicated area for patients in the Emergency Department that need an extended stay (more than 24 hours)
- Doctors use additional time to gather more information, evaluate and monitor patients, and treat patients, generally resulting in more informed decision-making

#### Why is this important?

- The benefits of observation units include:
  - ↑ quality of care
  - ↓ ED revisits
  - ↓ readmission rates
  - ↓ lengths of stay
  - ↓ health care costs

### Observation Unit Policies

- Tradeoffs between waiting time to first treatment and waiting time to enter the observation unit can be assessed using the following policies:
  - Observation patients only (left)
  - Flexible use for regular ED Patients (right)



### Solution Approach

#### Simulation

- We created a Matlab simulation that ran 400 iterations 20 scenarios which had the following parameters
  - Number of ED beds
  - Number of Observation beds
  - ED Threshold (for boarding)
  - Beds in observation unit for boarding

#### Tradeoffs

- Observation units** can decrease both the *waiting time to first treatment* and the *waiting time to enter the observation unit*
- Restricted observation beds** can decrease the *waiting time to enter the observation unit*
- Flexible observation beds** can decrease the *waiting time to first treatment* but increase the *waiting time to enter the observation unit*

### Boarding Threshold

- When the ED is full and patients are waiting, you can free up a bed by “boarding a patient” in the observation unit
- Lower threshold parameters enable you to send ED patients into the observation unit to make room for new ED patients at the cost of increases in waiting time to enter the observation unit

### Future Work

- We only showed three scenarios, but there were 20 scenarios that we simulated. More scenarios would allow for a better understanding of which and how parameters change the waiting times most significantly
- Other simulation software might enable additional analyses. A simulation using ProModel could visually display the observation unit to better inform staffing decisions

### Results

- Baseline Results (in min): ED Beds: 20 Observation Beds: 2  
ED Threshold: 18 Beds for Boarding: 0

Time to First Treatment

Hour of Day	Sun	Mon	Tue	Wed	Thu	Fri	Sat
0	1.72	3.55	2.16	4.23	1.26	2.49	2.47
1	0.84	1.89	0.65	1.78	0.51	1.35	0.89
2	0.27	0.64	0.25	0.65	0.21	0.62	0.37
3	0.13	0.25	0.09	0.19	0.03	0.12	0.12
4	0.04	0.07	0.04	0.10	0.03	0.05	0.06
5	0.00	0.04	0.03	0.02	0.01	0.00	0.02
6	0.00	0.02	0.00	0.00	0.01	0.01	0.01
7	0.00	0.01	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.01	0.00	0.00	0.00	0.00	0.00
11	0.00	0.02	0.01	0.01	0.02	0.01	0.02
12	0.01	0.06	0.04	0.06	0.11	0.04	0.05
13	0.08	0.25	0.08	0.12	0.20	0.18	0.18
14	0.22	0.46	0.13	0.36	0.35	0.41	0.31
15	0.30	0.41	0.22	0.70	0.34	0.65	0.59
16	0.59	0.85	0.46	1.00	0.57	0.89	1.20
17	1.44	1.47	0.97	1.45	1.04	1.19	2.35
18	2.83	2.46	1.86	2.15	1.51	2.40	3.42
19	5.17	3.29	4.14	3.20	2.81	4.25	3.70
20	7.22	3.88	7.52	3.50	5.00	5.78	4.04
21	8.19	5.06	9.92	3.66	6.25	6.30	4.42
22	8.45	5.37	9.71	3.64	5.38	5.88	3.92
23	6.15	4.02	7.64	2.60	4.10	4.26	2.68

Wait Time to Enter Observation Unit

Hour of Day	Sun	Mon	Tue	Wed	Thu	Fri	Sat
0	51.12	35.49	54.00	53.36	52.03	50.27	53.74
1	47.48	52.02	48.75	55.05	47.47	48.56	53.65
2	48.64	50.17	48.79	48.03	46.84	50.99	46.24
3	43.94	44.93	41.32	45.19	38.86	48.72	45.49
4	37.33	41.76	42.38	41.50	41.17	41.76	42.10
5	35.68	39.19	38.54	38.30	38.24	38.66	37.12
6	37.07	35.44	36.88	35.16	38.20	34.72	35.98
7	31.04	30.91	32.55	31.43	25.25	31.03	26.98
8	20.66	31.65	26.41	24.02	22.40	27.46	26.16
9	24.49	22.53	21.68	20.78	21.29	26.15	26.11
10	20.21	24.08	21.97	23.52	22.45	25.59	19.27
11	19.36	24.41	20.63	20.53	20.01	19.42	23.40
12	23.73	21.22	24.37	24.65	22.28	24.02	24.04
13	21.49	25.64	26.07	22.02	22.63	23.57	25.40
14	26.76	26.91	26.42	26.46	26.83	28.66	30.21
15	26.50	31.74	30.70	28.74	31.19	30.18	31.29
16	30.73	36.85	32.57	37.51	31.41	35.25	37.36
17	33.65	37.12	33.30	37.35	38.08	39.12	37.70
18	39.74	39.49	38.92	40.68	41.22	39.59	39.46
19	41.35	44.23	41.46	46.55	42.24	42.20	46.26
20	46.44	47.65	45.12	46.11	45.06	46.00	45.89
21	51.57	48.60	51.34	47.47	47.92	49.13	48.29
22	53.65	52.32	51.92	49.86	52.03	53.86	50.26
23	56.58	53.64	51.99	50.56	50.74	52.88	51.15

- Scenario #1 (in min): ED Beds: 20 Observation Beds: 4  
ED Threshold: 18 Beds for Boarding: 0

Time to First Treatment

Hour of Day	Sun	Mon	Tue	Wed	Thu	Fri	Sat
0	0.84	2.22	1.30	2.64	0.69	1.53	1.30
1	0.40	0.96	0.40	0.84	0.22	0.69	0.55
2	0.14	0.42	0.12	0.25	0.06	0.32	0.11
3	0.04	0.10	0.02	0.05	0.01	0.08	0.05
4	0.01	0.03	0.00	0.00	0.00	0.00	0.00
5	0.00	0.01	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	0.01	0.02	0.02	0.01	0.05	0.02	0.02
13	0.06	0.15	0.05	0.08	0.12	0.09	0.05
14	0.12	0.31	0.07	0.23	0.16	0.26	0.16
15	0.22	0.31	0.09	0.49	0.19	0.45	0.36
16	0.43	0.47	0.27	0.64	0.28	0.65	0.77
17	1.05	0.91	0.62	0.82	0.63	0.87	1.67
18	2.21	1.66	1.35	1.45	1.12	1.74	2.54
19	3.87	2.28	2.99	2.15	2.03	3.29	2.47
20	5.49	2.71	5.61	2.32	3.90	4.55	2.69
21	5.93	3.61	7.45	2.33	4.54	4.72	2.85
22	5.94	3.87	7.09	2.37	3.73	4.05	2.64
23	4.32	2.57	5.27	1.46	2.61	2.78	1.77

Wait Time to Enter Observation Unit

Hour of Day	Sun	Mon	Tue	Wed	Thu	Fri	Sat
0	6.43	7.01	6.82	6.80	6.89	7.00	6.83
1	7.08	7.23	7.56	6.73	5.89	7.14	6.46
2	6.84	6.91	5.78	7.36	5.85	5.95	7.35
3	5.96	5.95	4.71	6.72	3.99	5.80	5.60
4	4.68	4.68	4.24	4.40	3.92	3.91	4.52
5	3.11	3.64	4.27	3.49	3.49	4.07	4.22
6	3.05	2.95	2.12	2.87	1.97	2.48	1.75
7	2.63	3.33	1.88	1.96	1.73	3.60	1.78
8	0.80	2.64	1.38	2.99	3.12	1.86	2.13
9	1.17	0.96	1.01	1.33	1.00	0.91	1.12
10	1.45	0.96	0.69	1.76	0.29	1.57	1.36
11	0.23	0.56	0.50	1.06	1.04	0.90	0.40
12	0.26	1.57	0.83	1.32	0.76	1.26	1.35
13	1.28	1.16	1.00	1.16	0.96	1.23	0.84
14	1.18	2.05	0.98	1.09	1.33	1.15	1.16
15	1.09	2.43	1.31	1.72	1.27	1.86	1.70
16	1.33	2.16	1.31	1.95	1.73	2.60	2.11
17	2.13	3.01	1.41	2.38	1.63	2.36	2.85
18	2.85	3.03	1.80	3.89	2.31	3.39	3.54
19	3.48	3.60	2.74	3.53	3.62	3.35	3.81
20	4.45	4.11	3.69	4.80	4.27	5.50	3.93
21	4.82	4.57	4.75	6.66	3.42	5.23	5.46
22	5.12	5.53	5.87	5.25	6.41	7.11	5.91
23	7.67	5.70	6.95	5.44	6.27	6.06	6.78

- Scenario #2 (in min): ED Beds: 20 Observation Beds: 4  
ED Threshold: 18 Beds for Boarding: 4

Time to First Treatment

Hour of Day	Sun	Mon	Tue	Wed	Thu	Fri	Sat
0	0.33	1.10	0.64	1.23	0.31	0.68	0.49
1	0.12	0.42	0.13	0.37	0.07	0.27	0.13
2	0.02	0.08	0.04	0.07	0.01	0.12	0.03
3	0.01	0.01	0.01	0.00	0.00	0.02	0.01
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	0.01	0.02	0.01	0.00	0.03	0.02	0.02
13	0.02	0.08	0.02	0.03	0.06	0.07	0.03
14	0.06	0.12	0.03	0.10	0.11	0.17	0.10
15	0.12	0.14	0.05	0.28	0.09	0.28	0.22
16	0.23	0.27	0.17	0.35	0.14	0.36	0.52
17	0.57	0.57	0.37	0.46	0.40	0.46	1.10
18	1.29	1.06	0.81	0.80	0.57	1.04	1.56
19	2.51	1.32	1.92	1.20	1.10	1.97	1.34
20	3.35	1.53	3.66	1.37	2.26	2.61	1.44
21	3.52	1.99	4.67	1.28	2.61	2.59	1.59
22	3.44	2.21	4.29	1.28	1.94	2.35	1.40
23	2.25	1.56	2.82	0.70	1.31	1.29	0.81

Wait Time to Enter Observation Unit

Hour of Day	Sun	Mon	Tue	Wed	Thu	Fri	Sat
0	7.53	9.60	9.22	10.50	7.57	7.61	8.36
1	5.76	8.04	8.08	7.90	6.21	8.31	7.85
2	5.58	7.38	6.28	7.90	6.08	6.93	6.78