This presenter has nothing to disclose

Evidence-based Staffing and Scheduling

Jody Crane, MD, MBA
Chief Medical Officer
jody_crane@teamhealth.com

Outline

- Academic Principles
- Case Study – 75,000-visit ED
- Approach to Staffing Optimization
  - Define Demand
  - Define Capacity
  - Contextualize
- Conclusions

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Queuing Theory - Agner Krarup Erlang

Copenhagen Telephone Company (KTAS), 1908

"Solution of some Problems in the Theory of Probabilities of Significance in Automatic Telephone Exchanges," 1917

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A Simple Queue

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A Simple Queue

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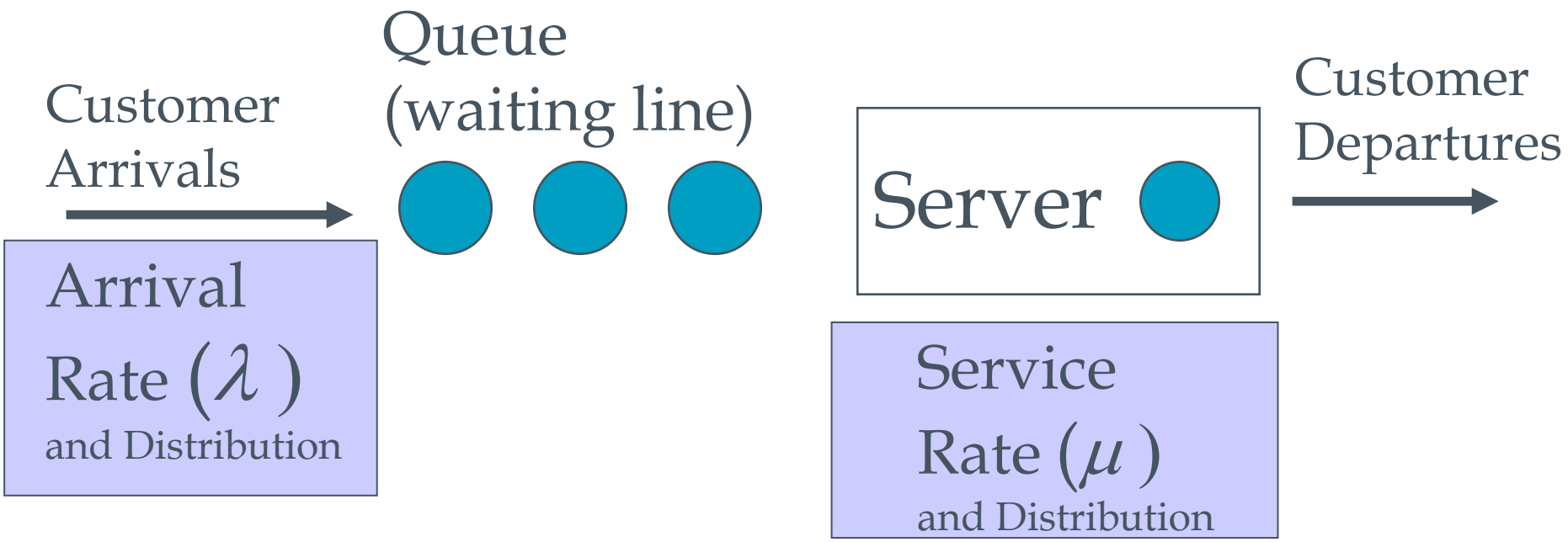
A Simple Queue



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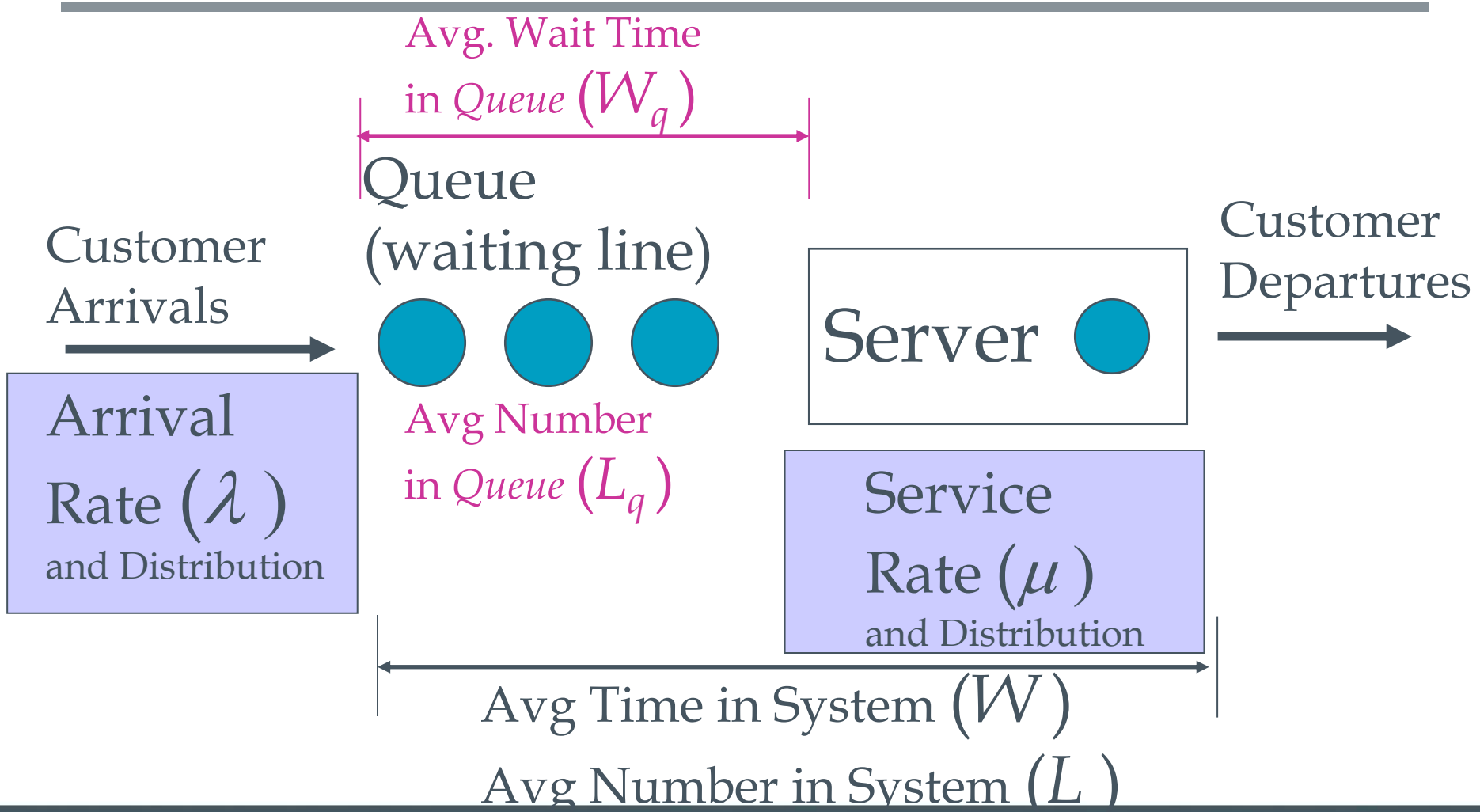
A Simple Queue



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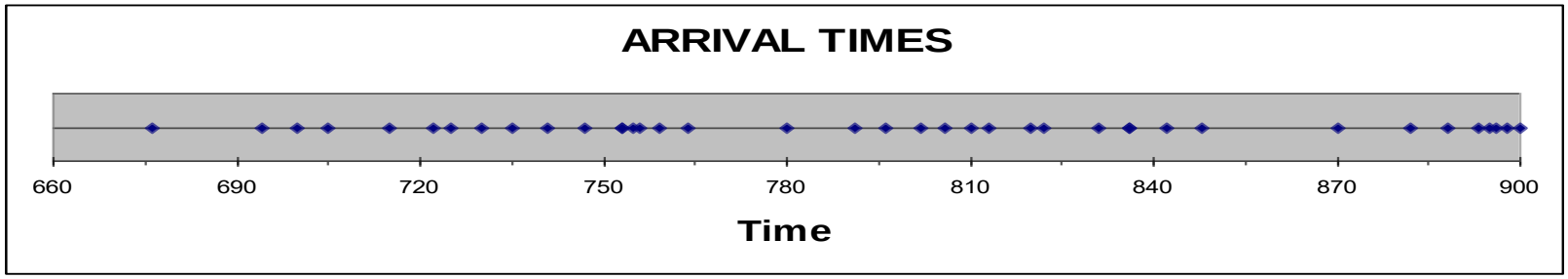
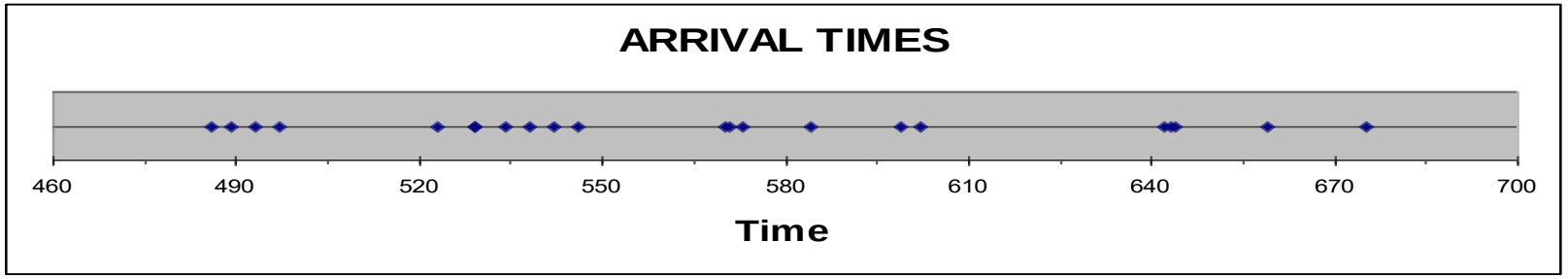
Demand on Key Servers - Arrivals





Arrival data from a California hospital. Mondays, 2pm-6pm.

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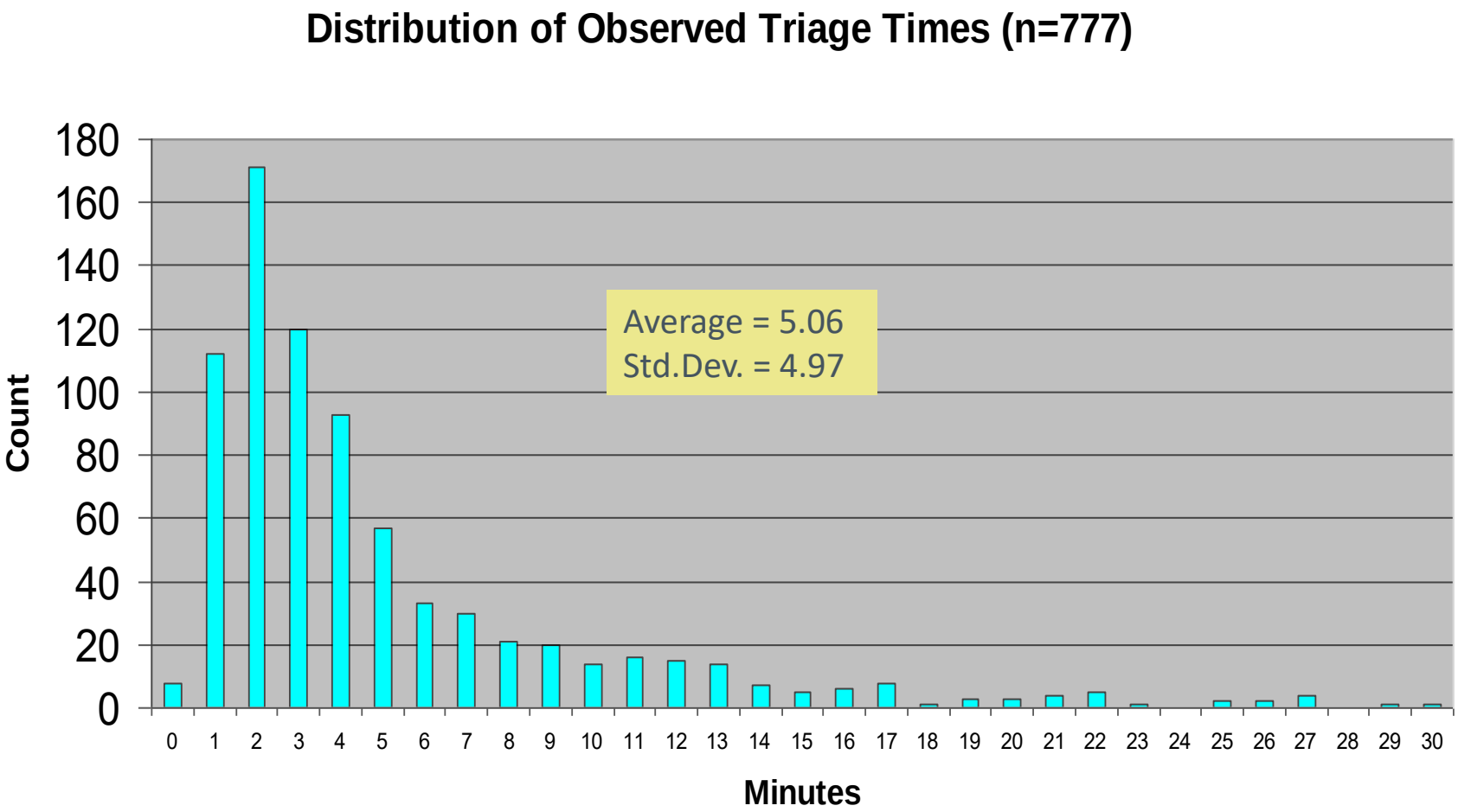
Demand on Key Servers - Service



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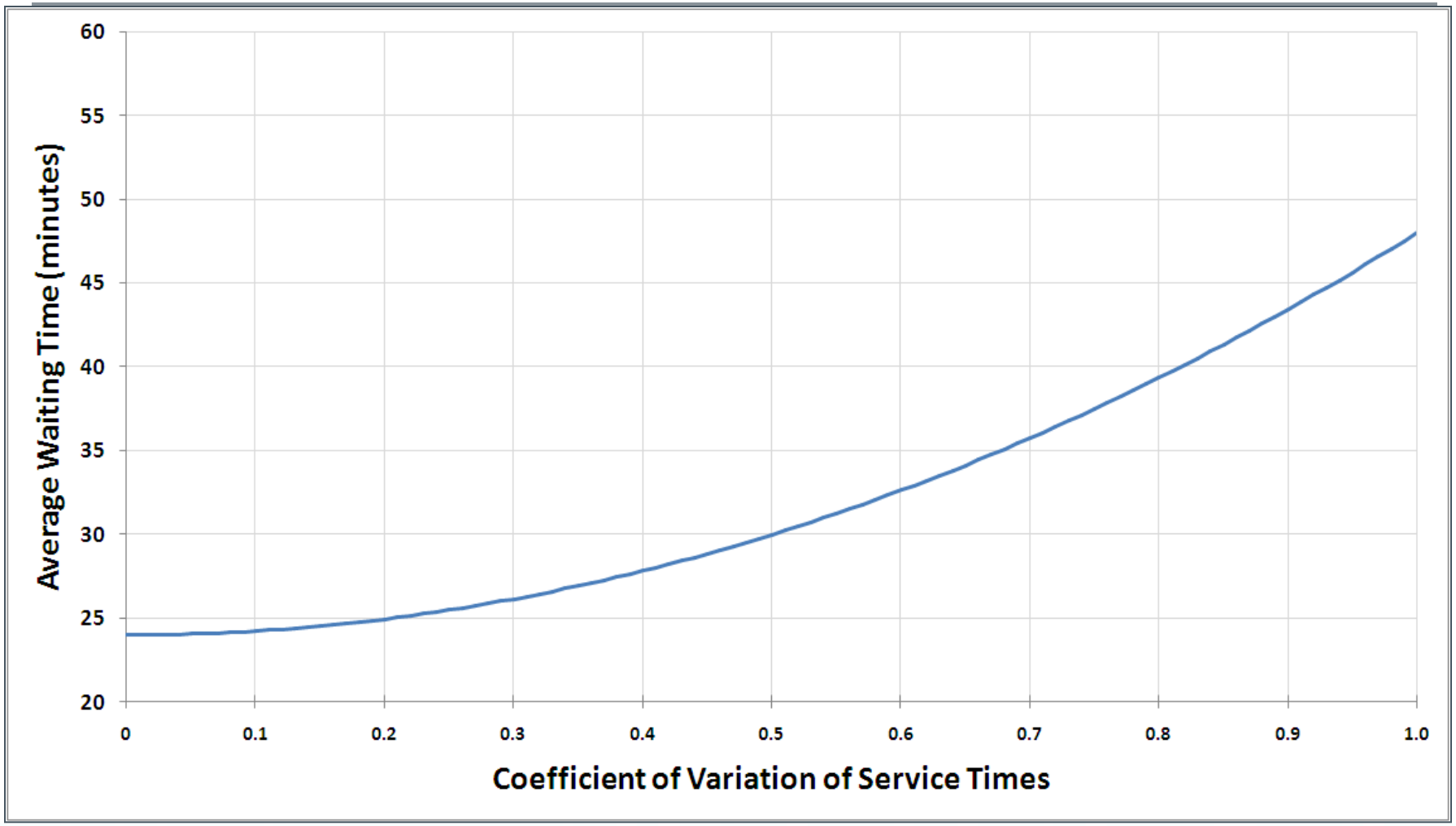
As Server *Variation* Increases…



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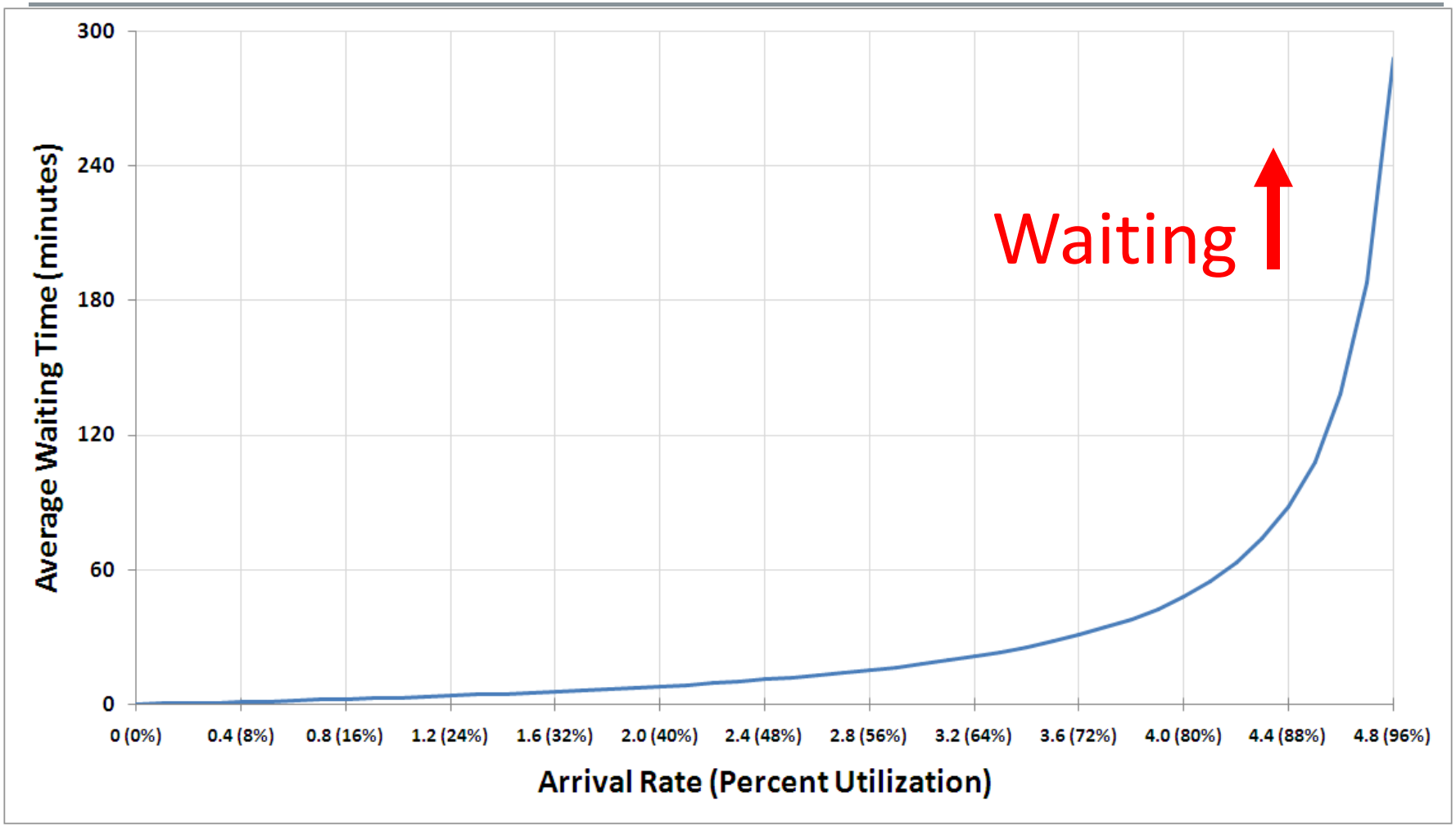
As *Utilization* Increases…



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Theory of Constraints – FT Example

Physician

3pts/hr

Nurse

30 min/pt

=

1) How many patients can my clinic see per hour?

2) How can you improve this system?
3) if you can't add resources….

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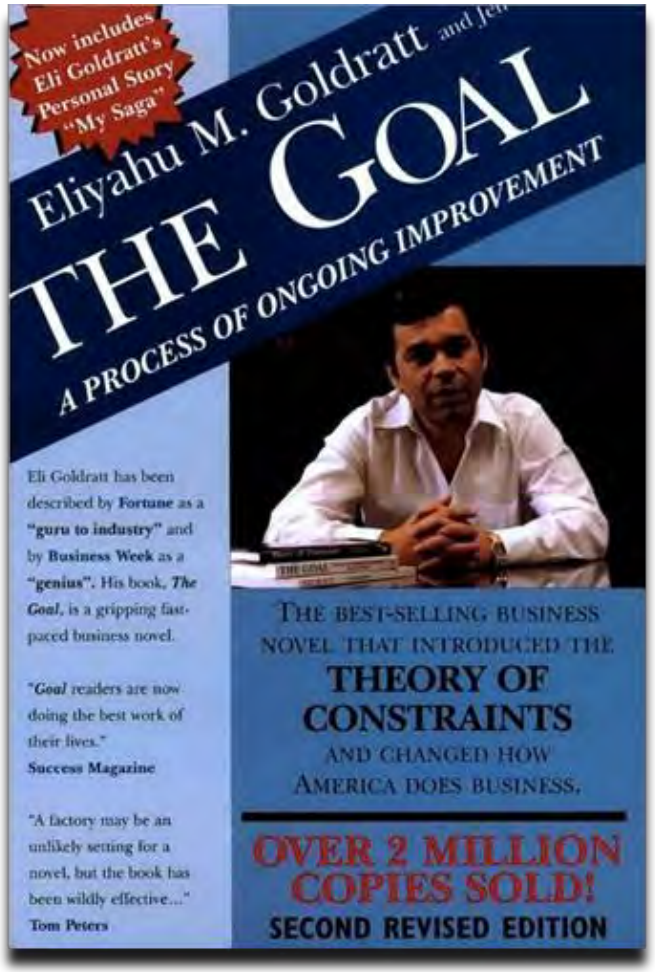
TOC: The Theory of Constraints

- ***Bottleneck***- A resource that has the capacity equal to or less than the demand placed upon it

- ***Non-bottleneck***- A resource that has a capacity that is greater than the demand placed upon it



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Case Study: 75,000-visit Peds ED

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You’re called into the CEO’s Office!

Our ED really stinks!

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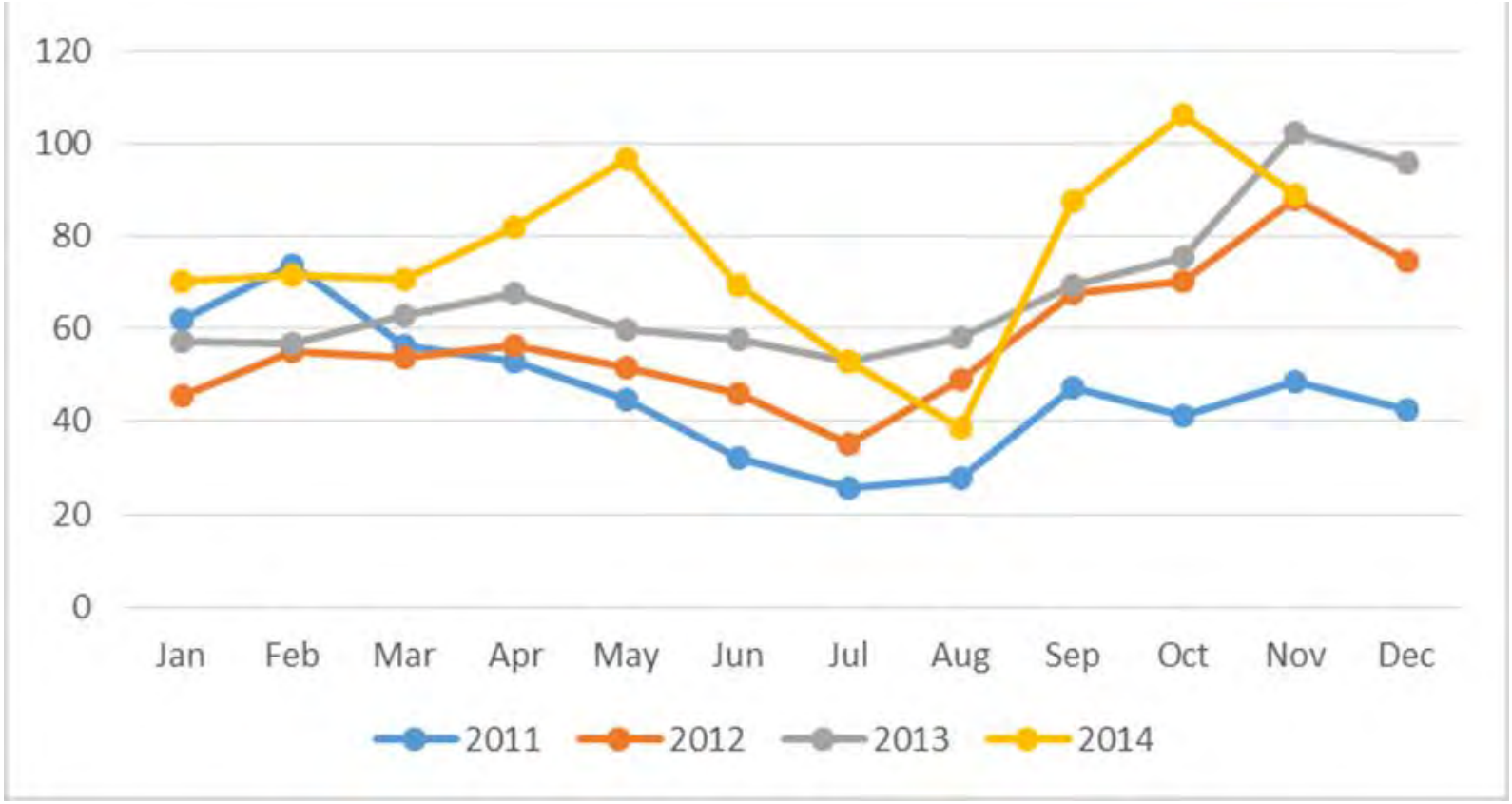
Peds ED Door to Doc by Month



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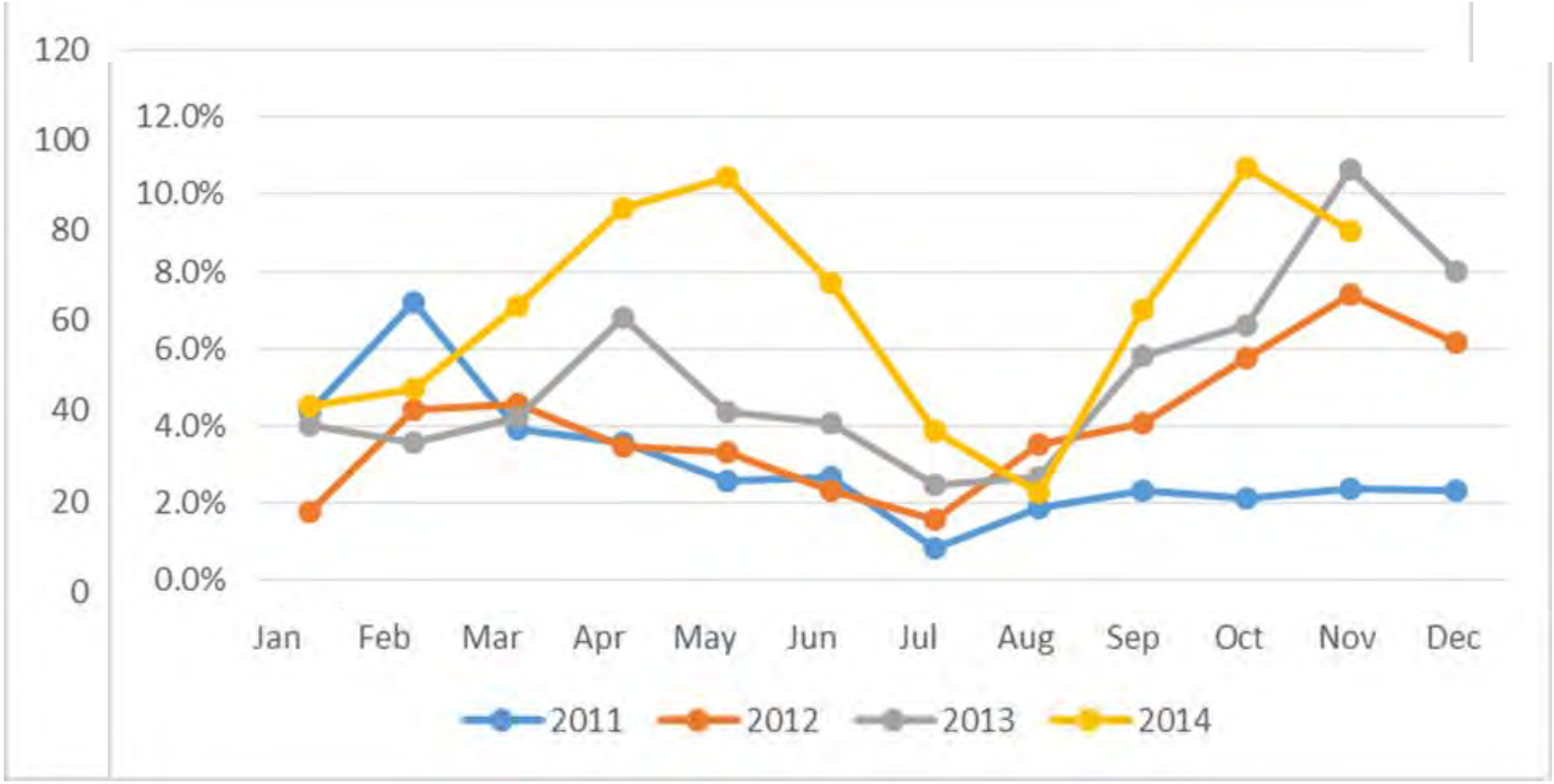
Peds ED LWOBS by Month



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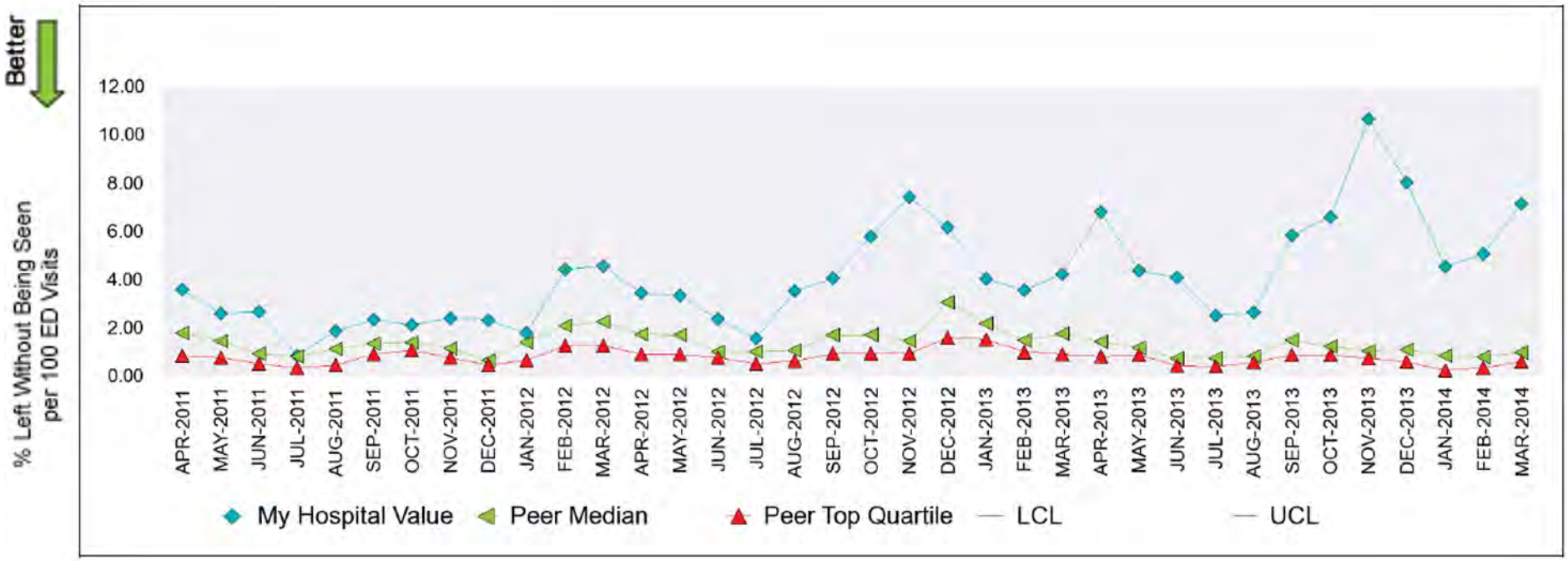
Peds ED LWOBS vs. Peers



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You're called into the CEO's Office!

Our ED really stinks!

YOU better fix this NOW!

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What are you going to do?

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What Information Do You Need?

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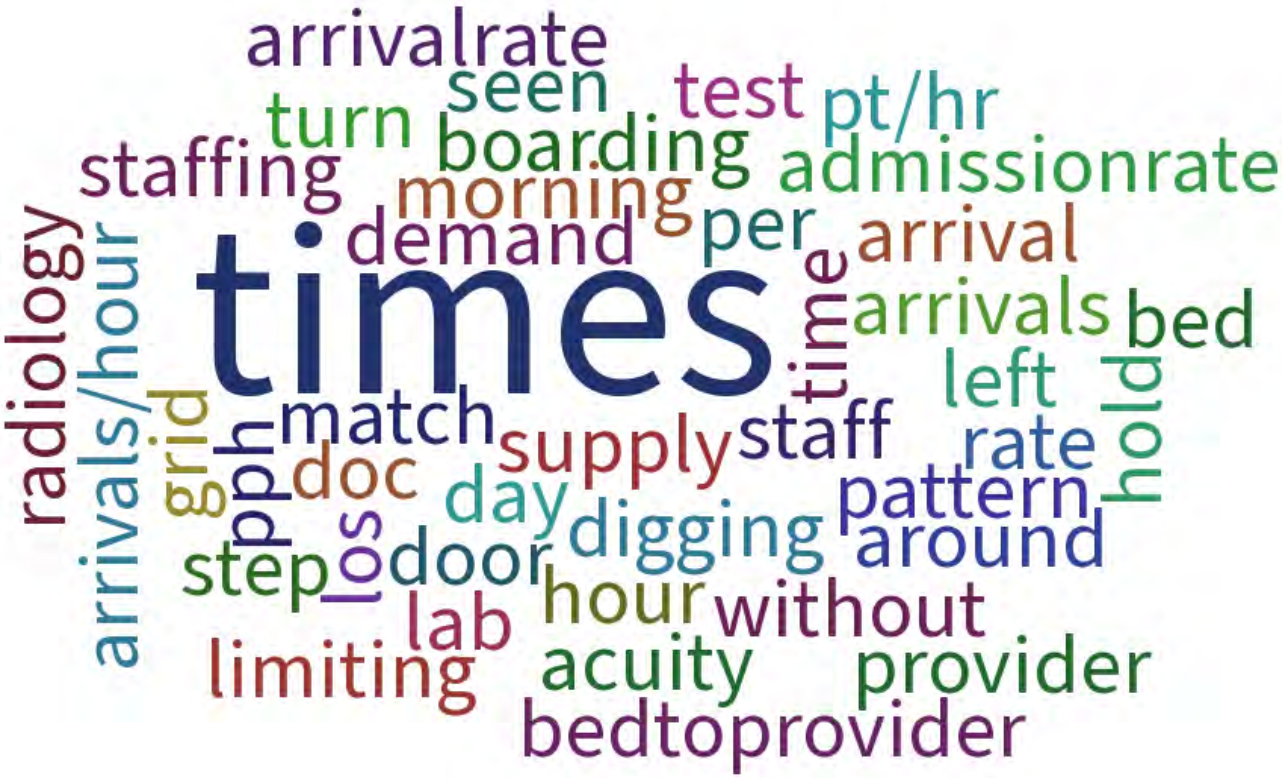
What data do you need from your analyst (1 word only)?



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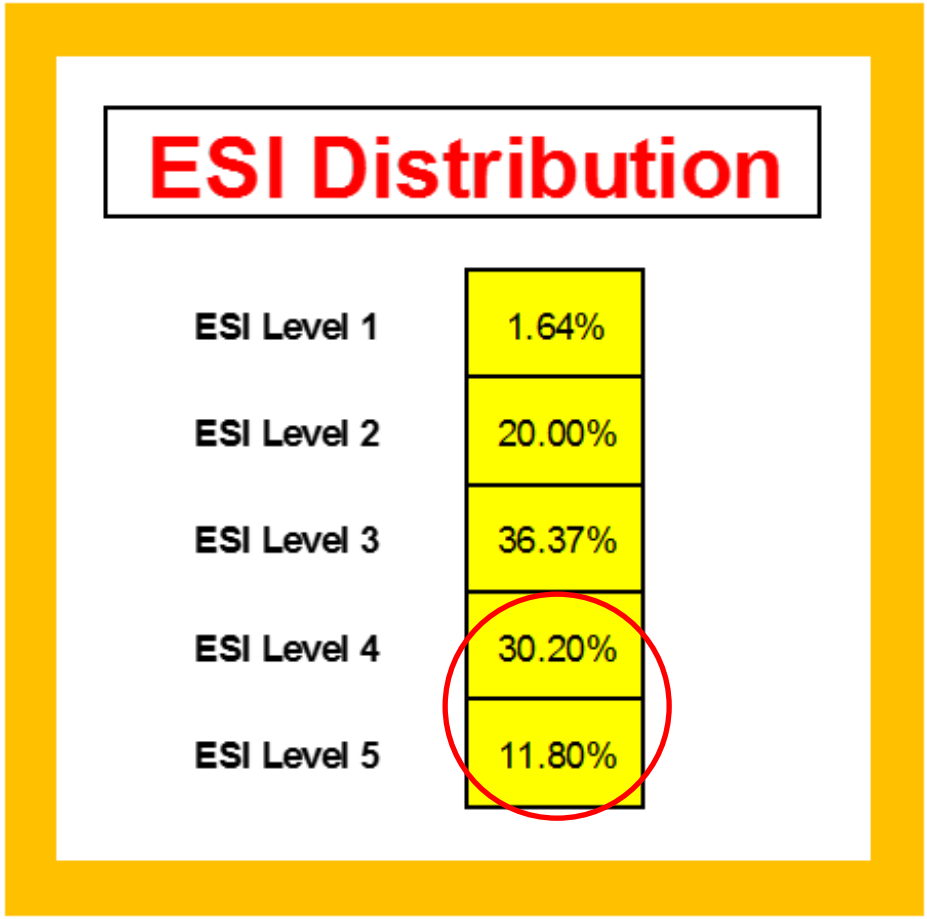
PEDs ED Acuity Mix by ESI Level



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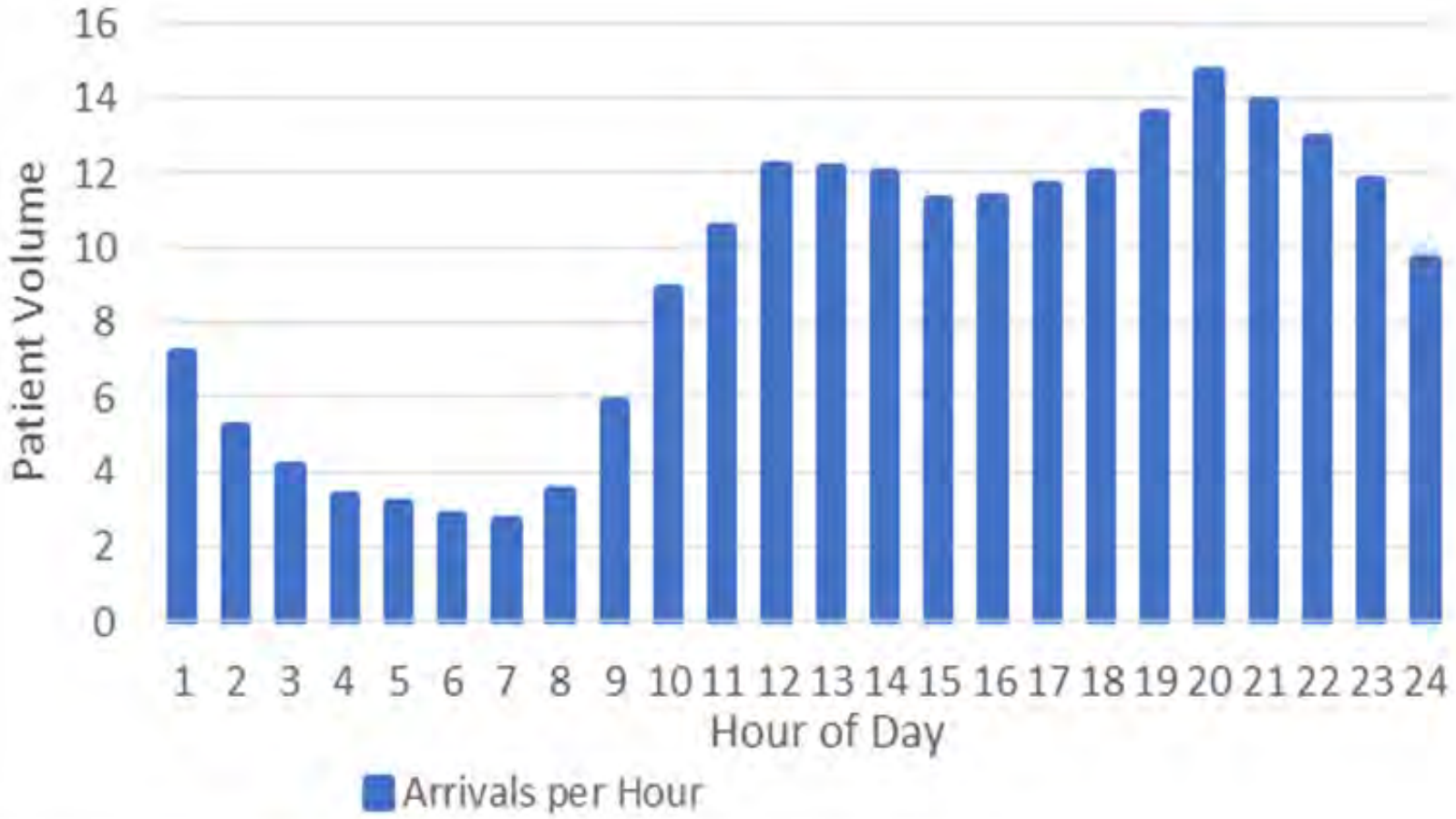
Peds ED Hourly Arrivals



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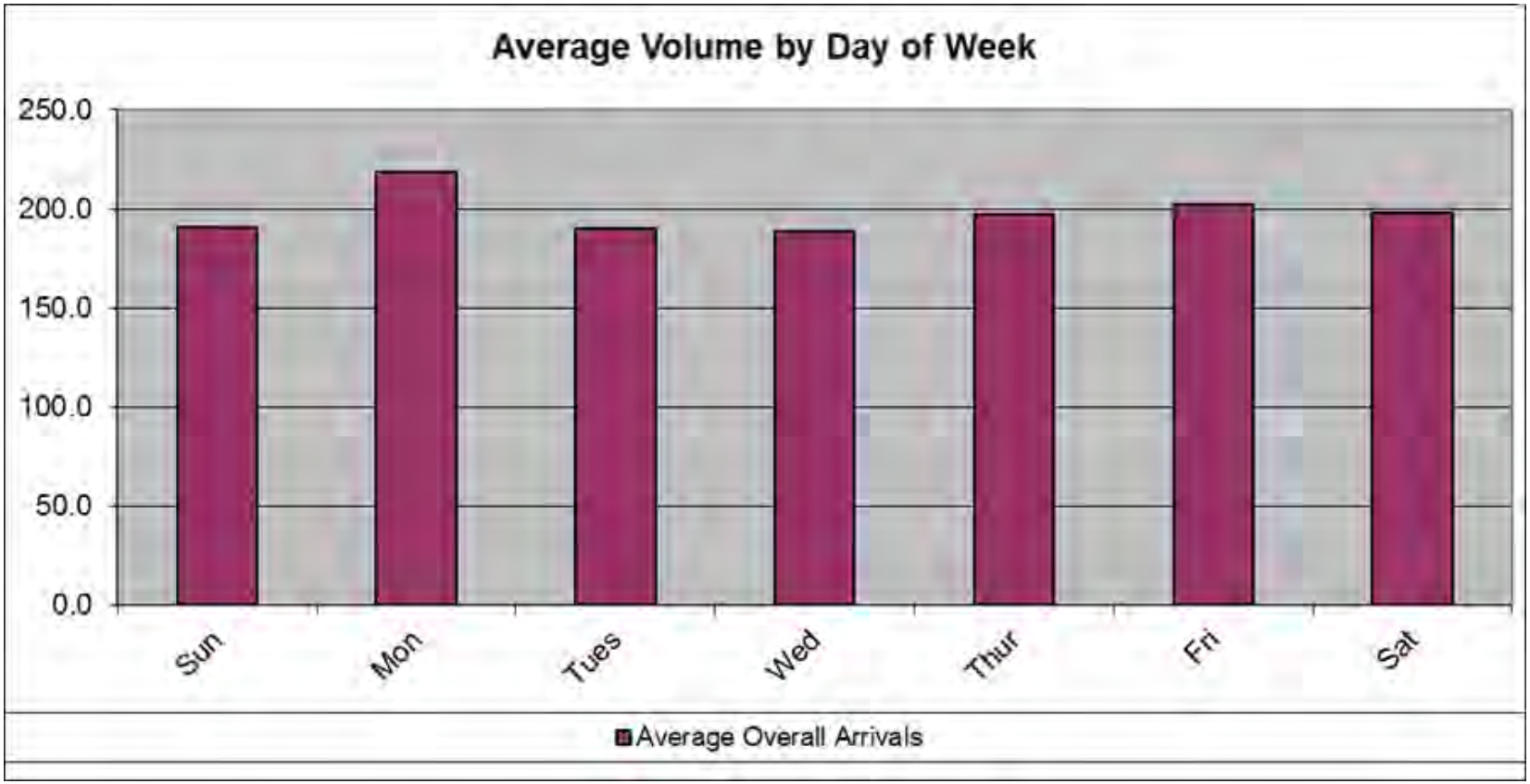
Peds ED Day of Week Arrivals



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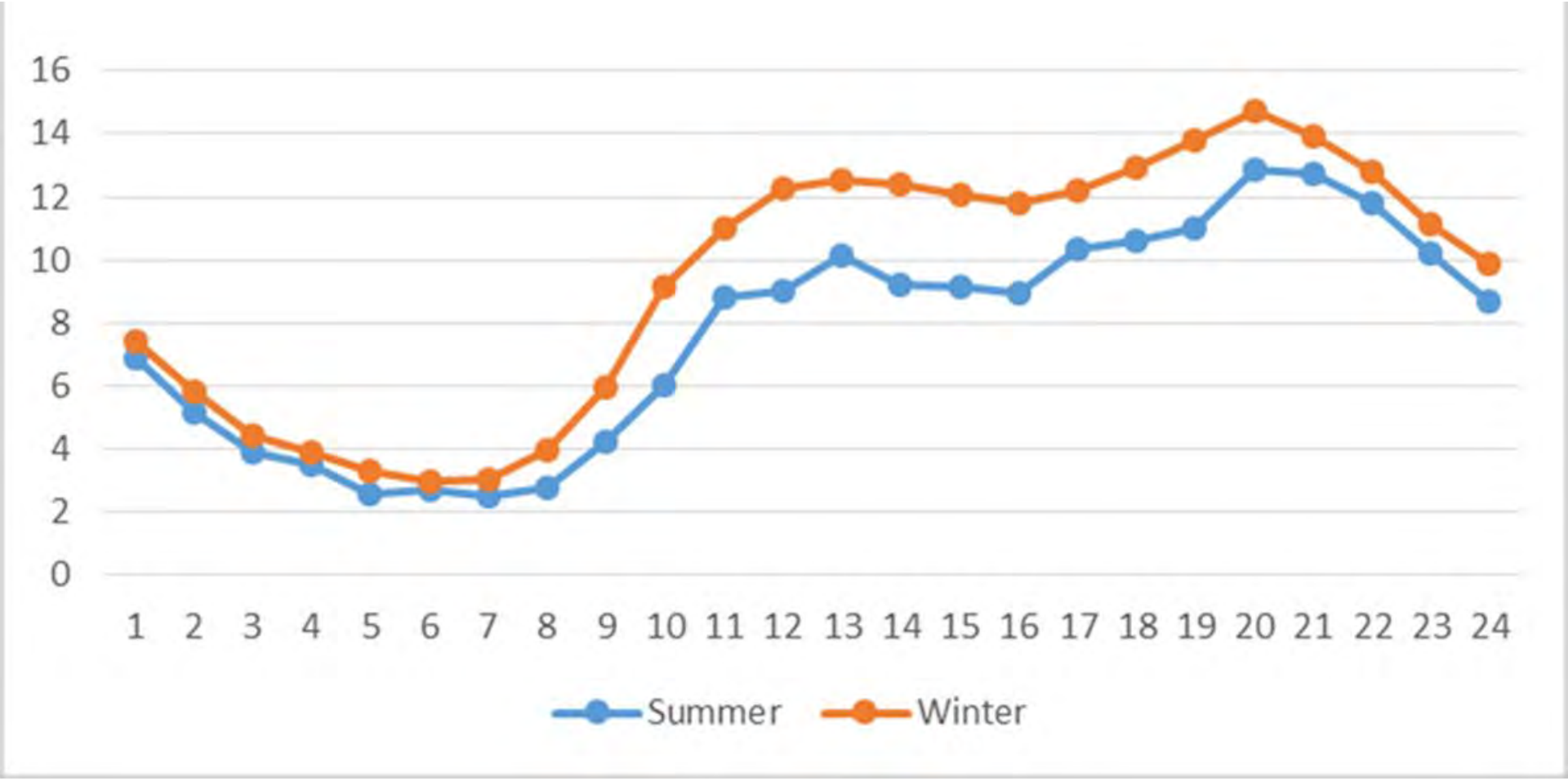
Peds ED Seasonal Hourly Arrivals



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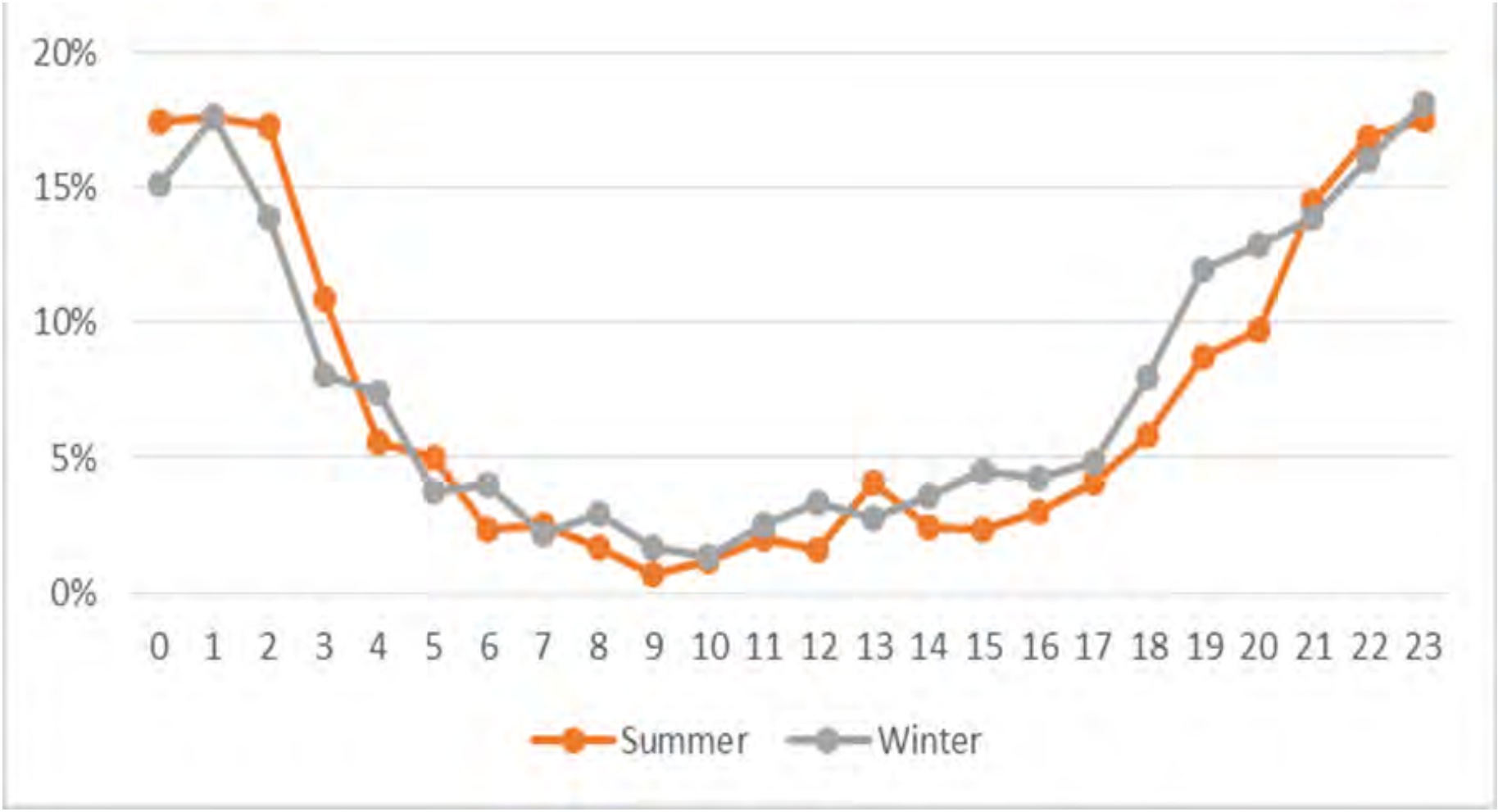
Peds ED Hourly LWOBS



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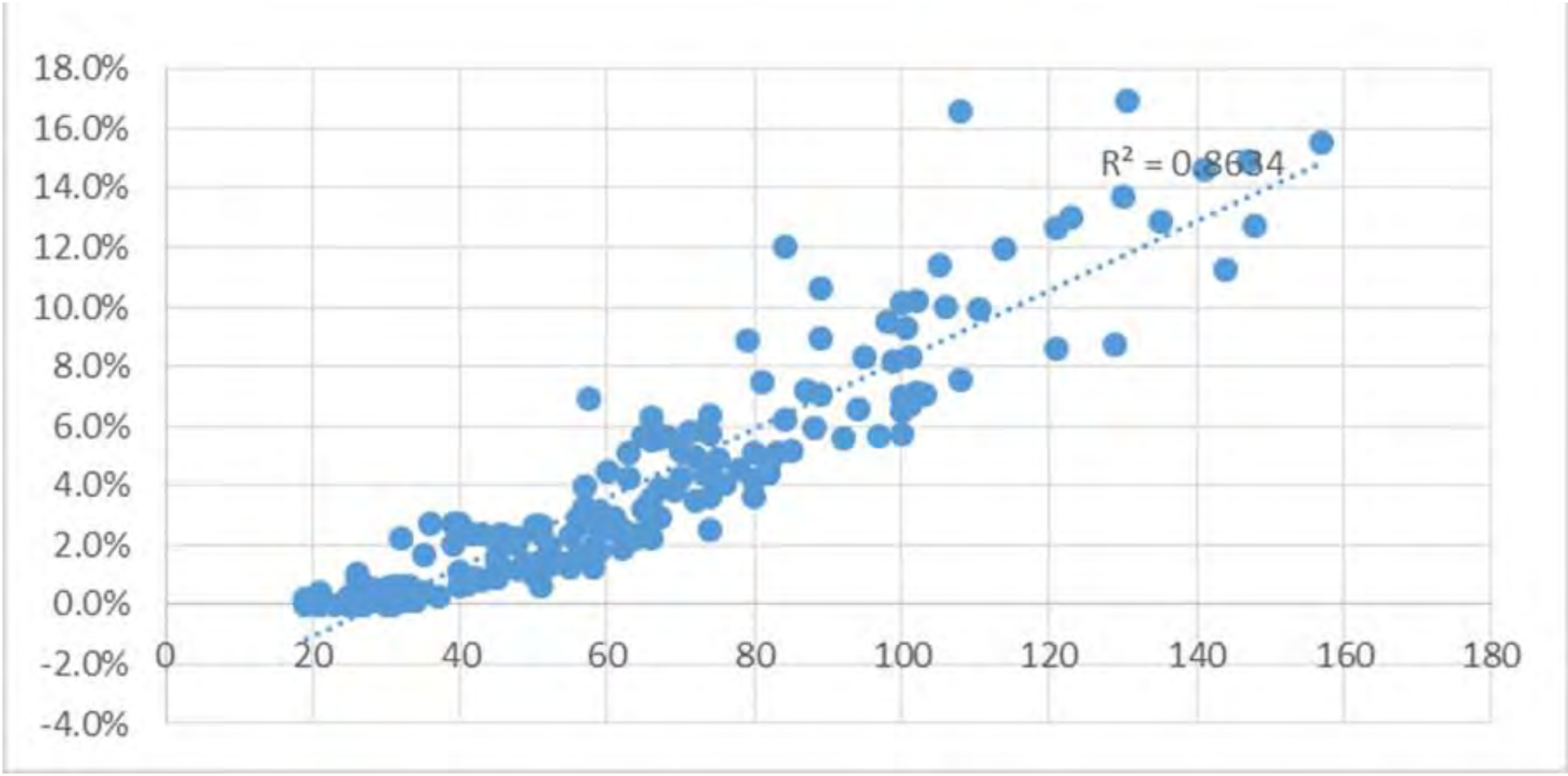
Peds ED LWOBS vs Door to Doc



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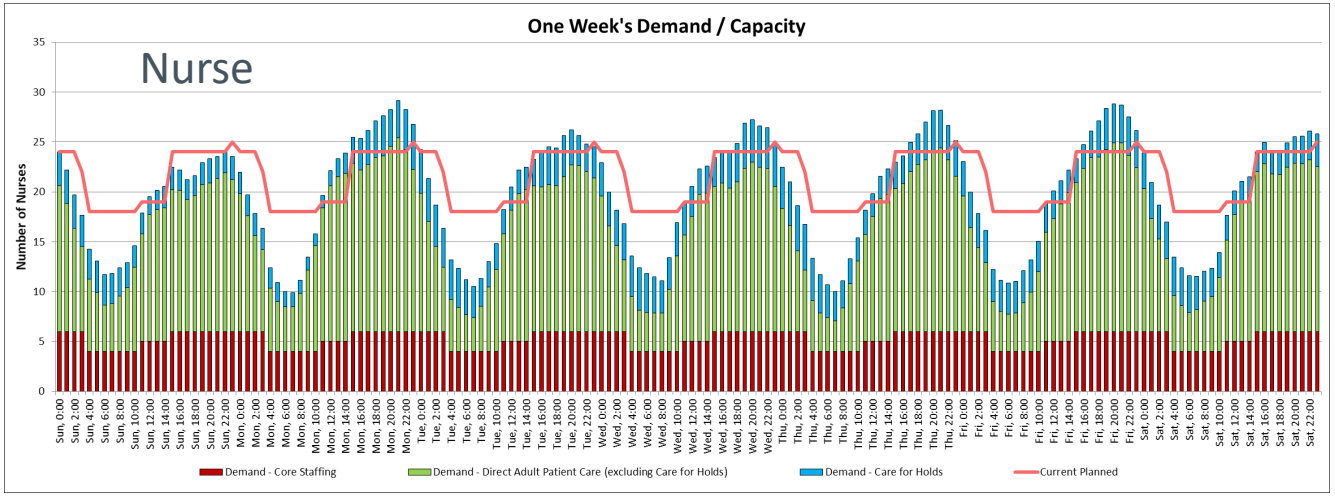
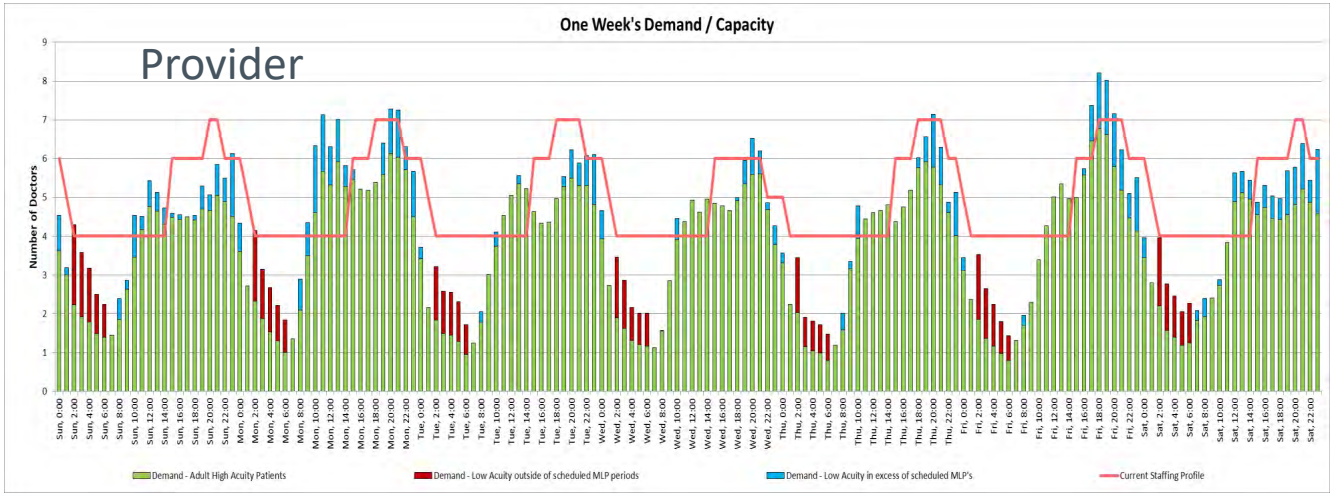
Nurse vs. Provider Staffing





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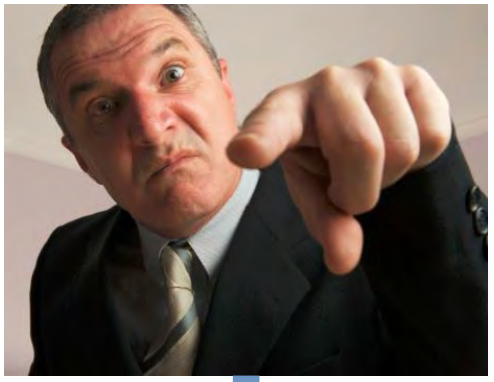
Breakout Session – 7 min

How do you turn this around?



Provide a 5-point, bulleted summary of the following:

1. Problems identified (top 3)
2. Proposed solutions (top 3)
3. Information needed (top 3)

Designate one person to present

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What are the most significant problems in this emergency department?

Top

0	test'

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Basic Approach to Staffing

1. Define the arrival *Demand*
2. Define and align the server *Capacity* (physician, nurse, APC, resident, bed productivity)
3. Execute in the *Context* of your current operational environment

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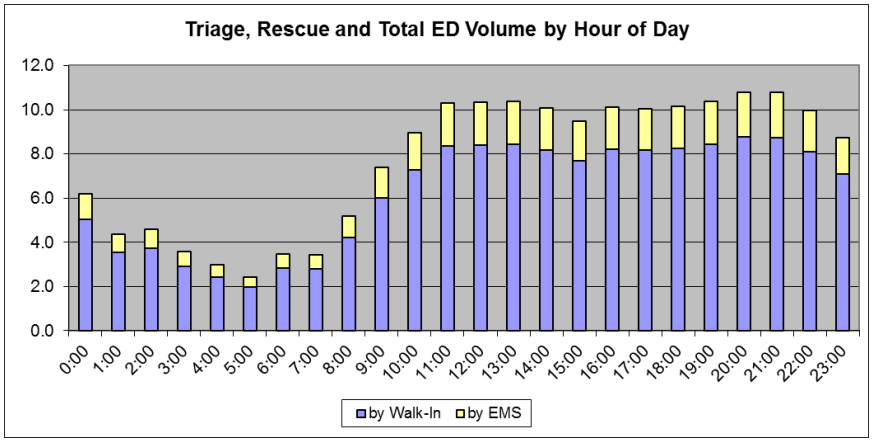
1. Define the Arrival Demand

- Arrival demand defines the demand for healthcare delivery
- Is the primary driver for physician, APC, and resident staffing



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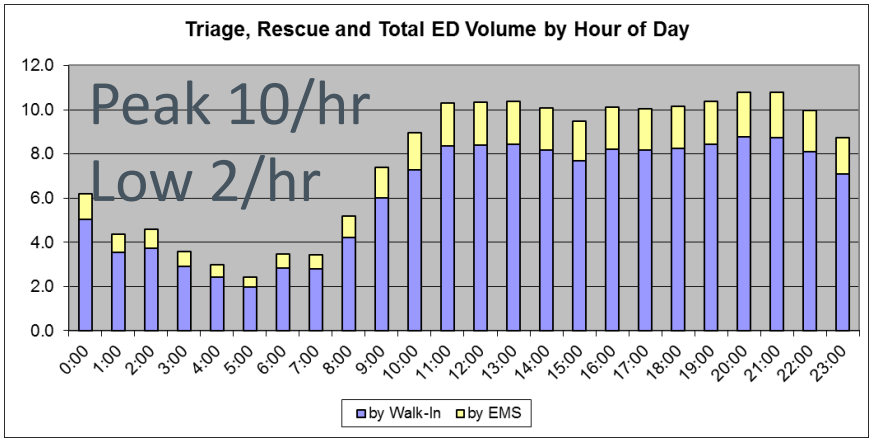
1. Demand – Hour of Day Variation

- Peak usually starts between 8a and 11am
- Usually ends between 9pm and 11pm
- Typically between 4:1 and 6:1 peak vs overnight arrivals
- Pediatrics and low acuity – higher evenings



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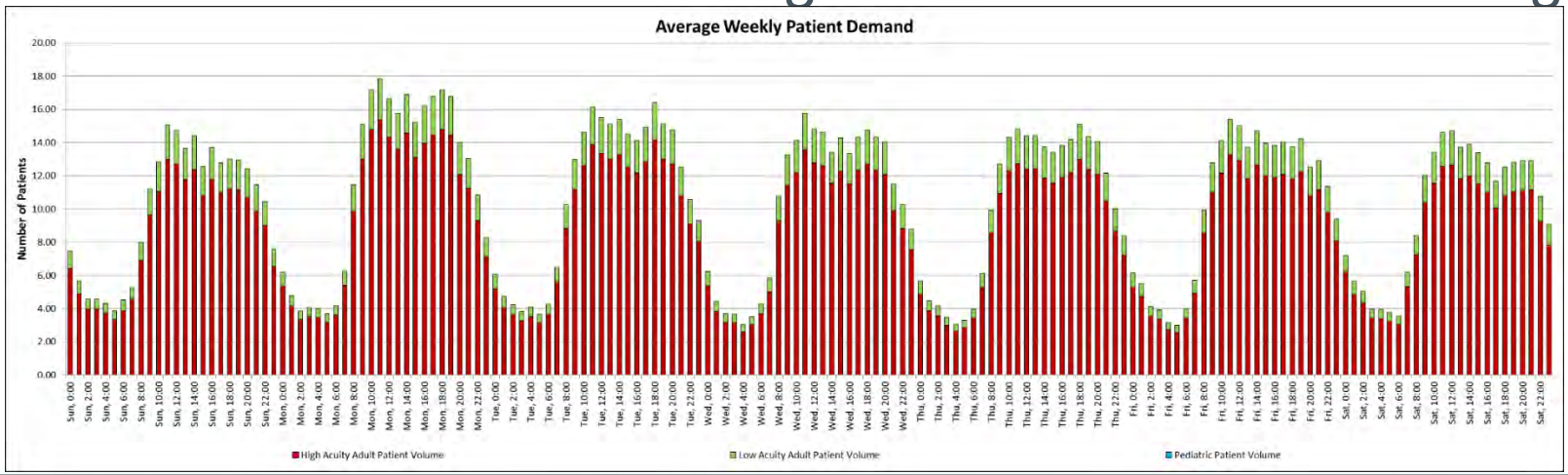
1. Demand – Hour of Week Variation

- Volume varies significantly by day of week in most institutions
- Weekend volume is usually lower than weekday volume
- Mondays are usually the *busiest* and also have the *highest acuity*
- Pediatrics will have much higher weekends and evenings



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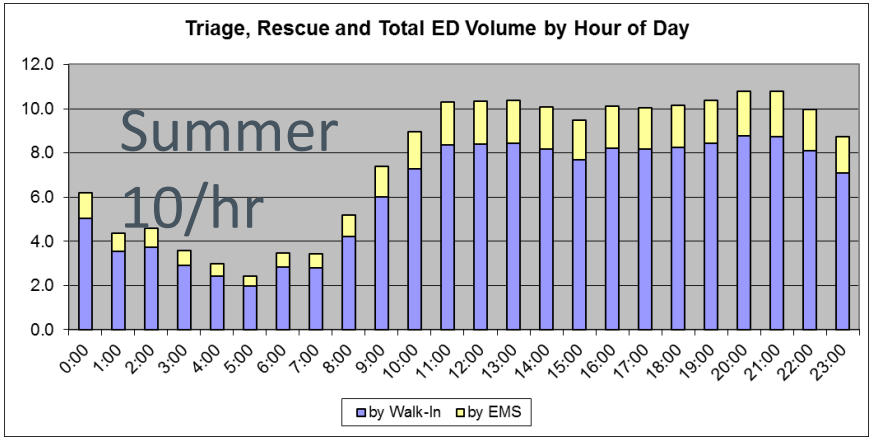
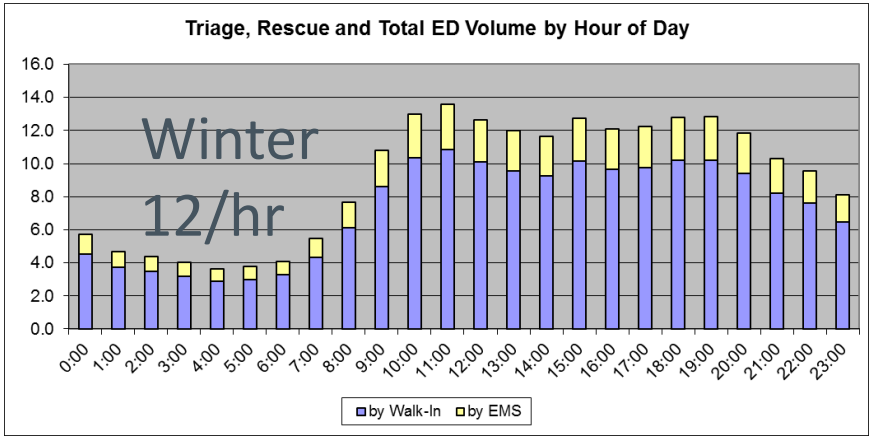
1. Demand - Seasonal Variation

- Seasonal Variation can be problematic if not considered
- Ultimately affects the size of your ED and the operational approach
- Peds follows this profile
- Need specific strategies to staff appropriately – part time staffing, preferential vacations, snowbird scheduling





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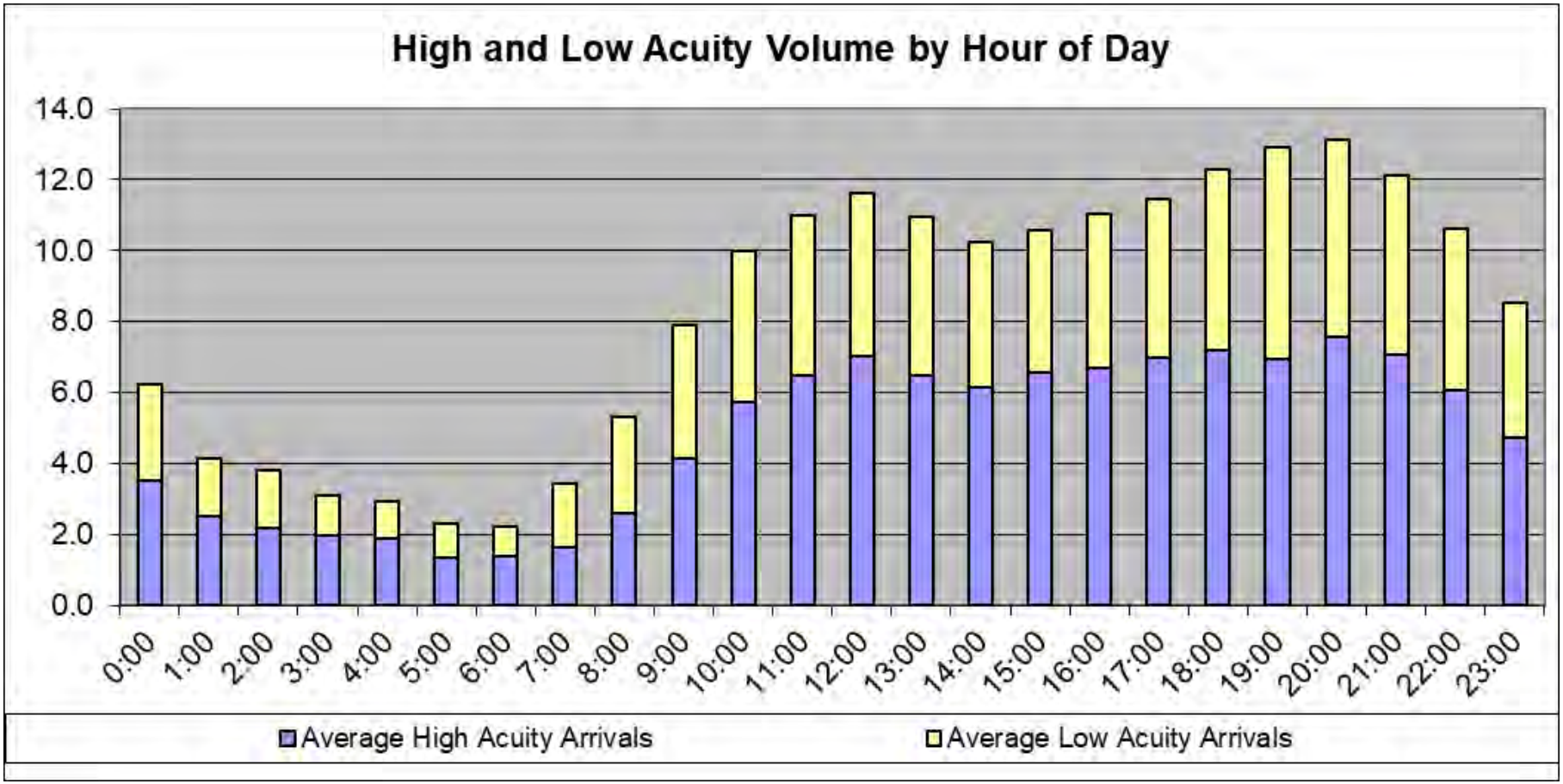
1. Demand - Acuity



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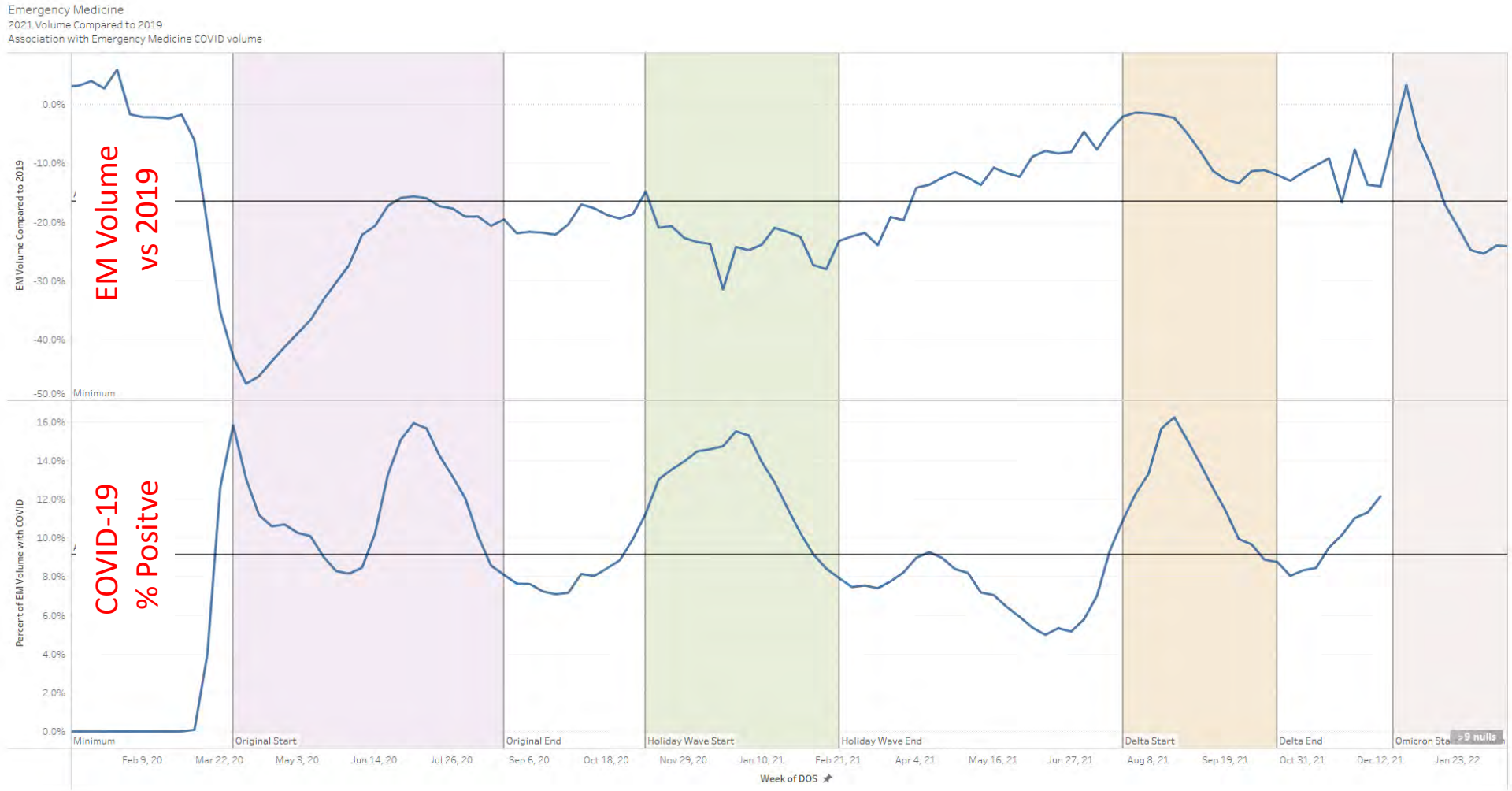
1. Demand – Special Demand COVID-19



The 2020 holiday wave aligns most closely with the current volume experience; both in timing around the holiday season and the depth of the volume suppression. This has led to its use as the historical modelling point for the analysis.

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2. Define Server Capacity

1. Assess the volume over a week and divide by the total staffing hours

$$\frac{1400 \text{ pts/wk}}{700 \text{ doc hrs/wk}} = 2 \text{ pts/hr}$$

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2. Capacity – Average Service Rate

1. Assess the volume over a week and divide by the total staffing hours

$$\frac{1400 \text{ pts/wk}}{700 \text{ doc hrs/wk}} = 2 \text{ pts/hr}$$

2. *Peak productivity* will usually be higher as lower overnight volumes tend to drive the overall average down

$$\frac{1100 \text{ pts/wk}}{500 \text{ doc hrs/wk}} = 2.2 \text{ pts/hr}$$

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Benchmarks are Scarce

Nursing

- No source for ideal productivity
- Most recommendations are from nurse advocate organizations
- Growing evidence that lower nurse staffing results in increased morbidity, mortality, and cost

Physician

- No source for ideal productivity
- ACEP, SAEM, AAEM all have position statements
- Other studies are largely inaccurate, outdated

Recommended Benchmarking Sources: ACEP; Premier; EDBA; VHA

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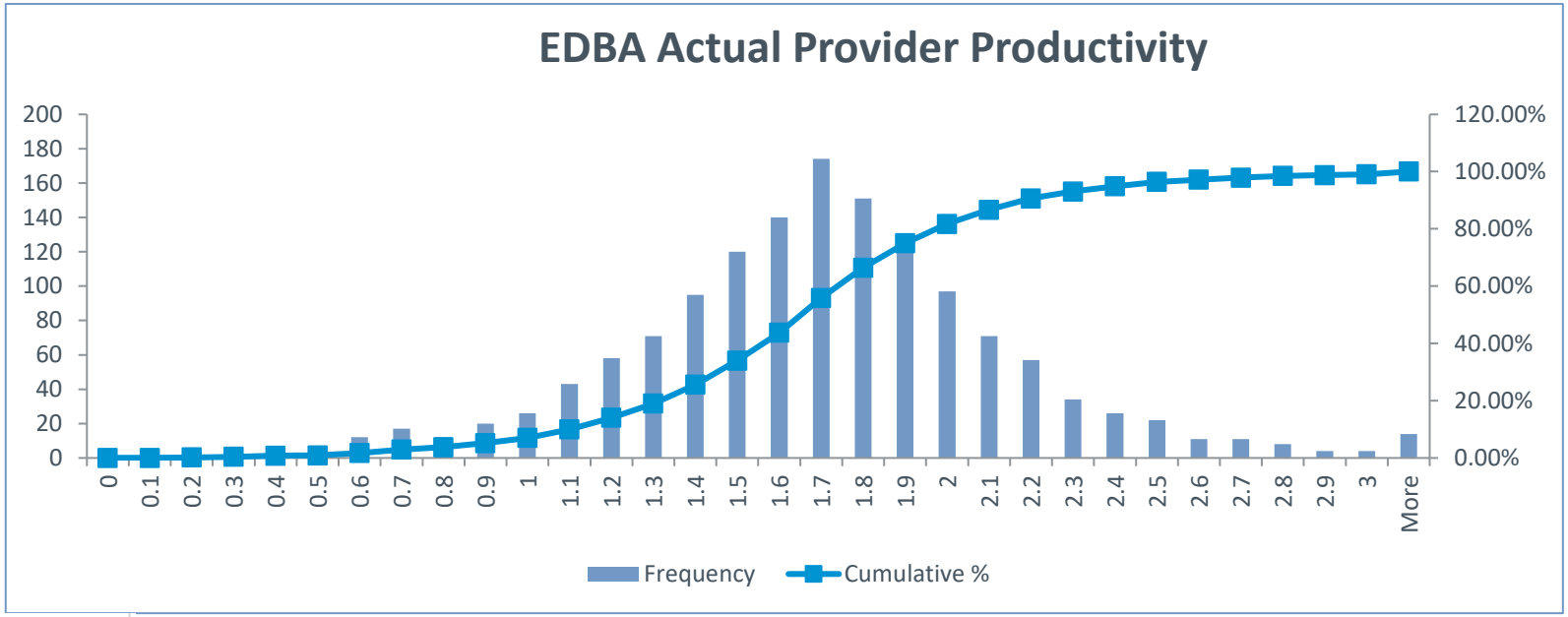
EDBA Actual PPH



EDBA Actual Provider PPH	
Mean	1.67
Median	1.67
Mode	1.34
Standard Deviation	0.46
Range	3.84
Minimum	0.14
Maximum	3.98
Count	1377

Based on 2018 data

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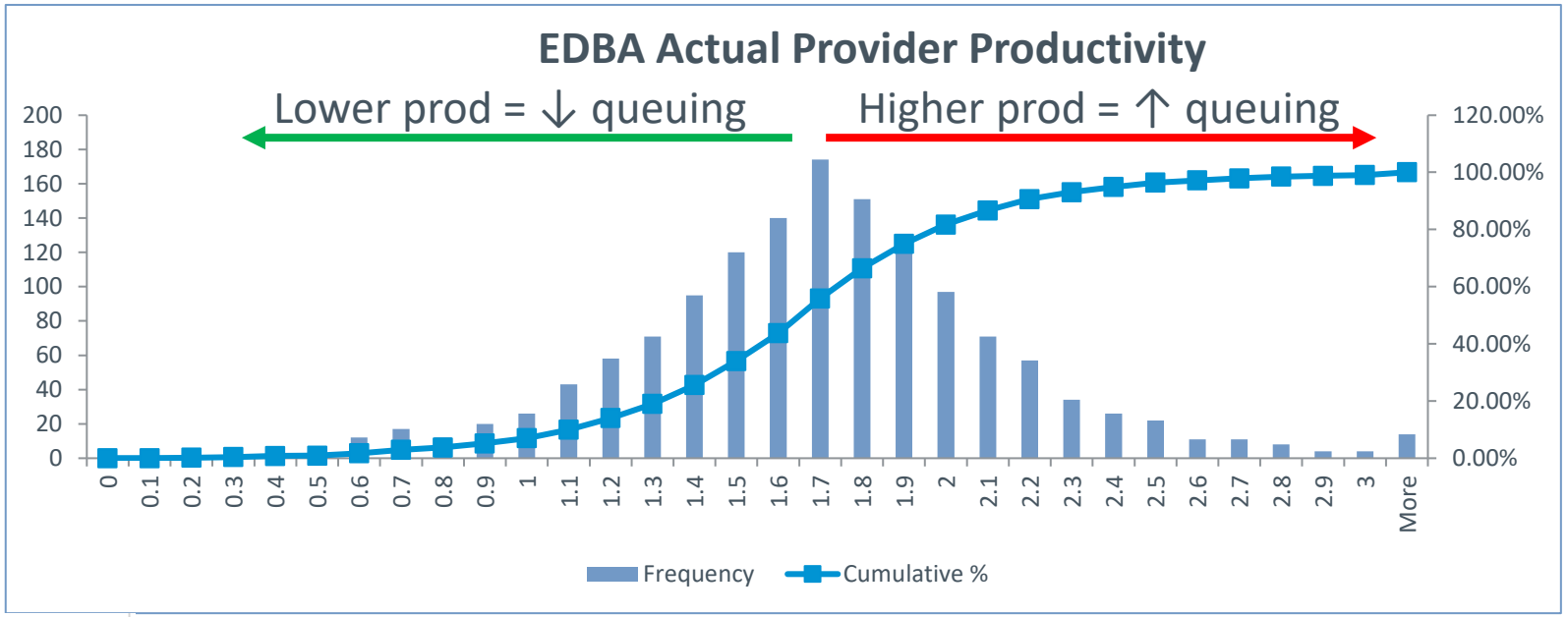
EDBA Actual PPH



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Mean	1.67
Median	1.67
Mode	1.34
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Range	3.84
Minimum	0.14
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Count	1377

Must take system flow into account!

Based on 2018 data

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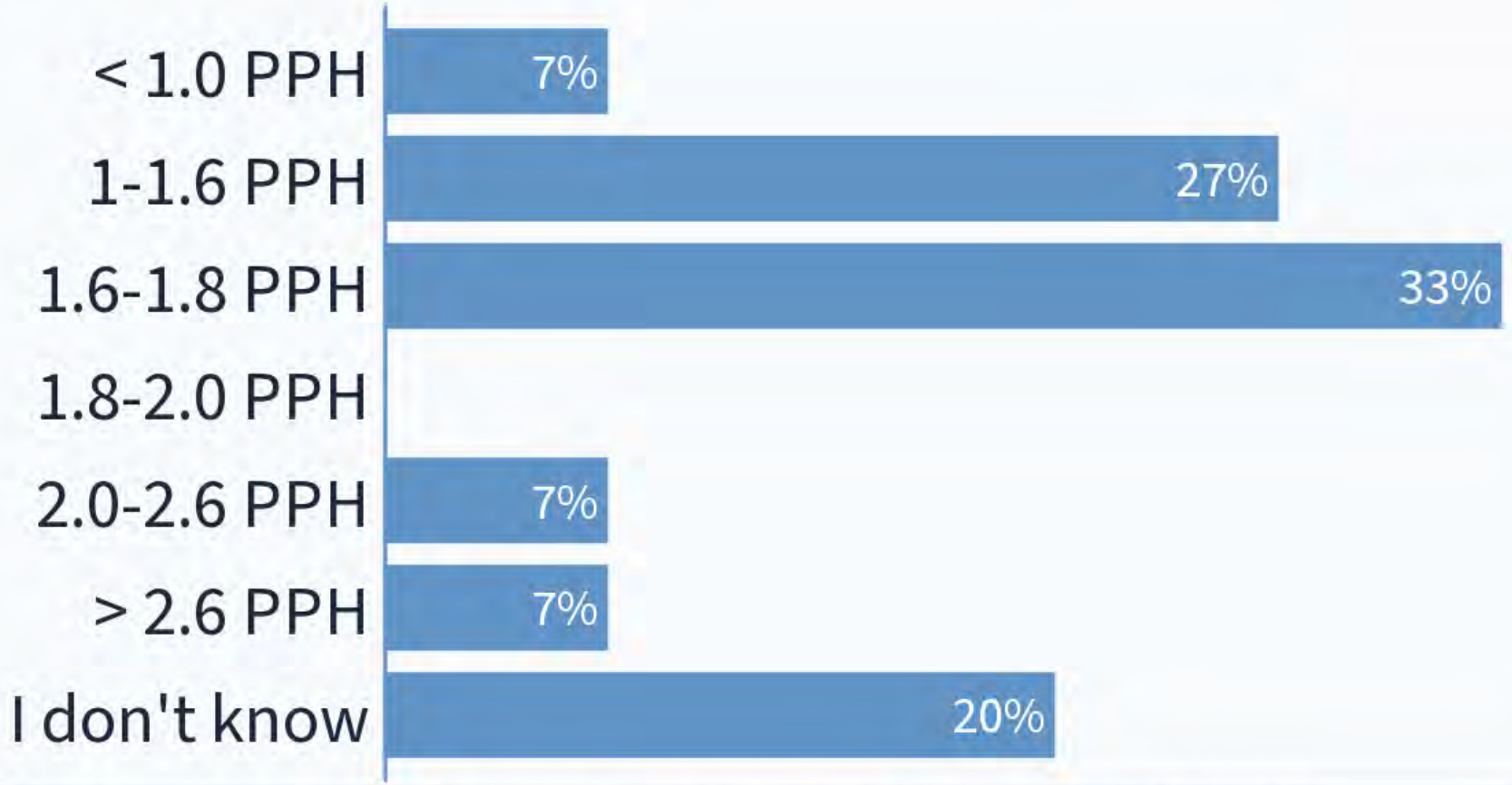
What is Your Current Provider Productivity?



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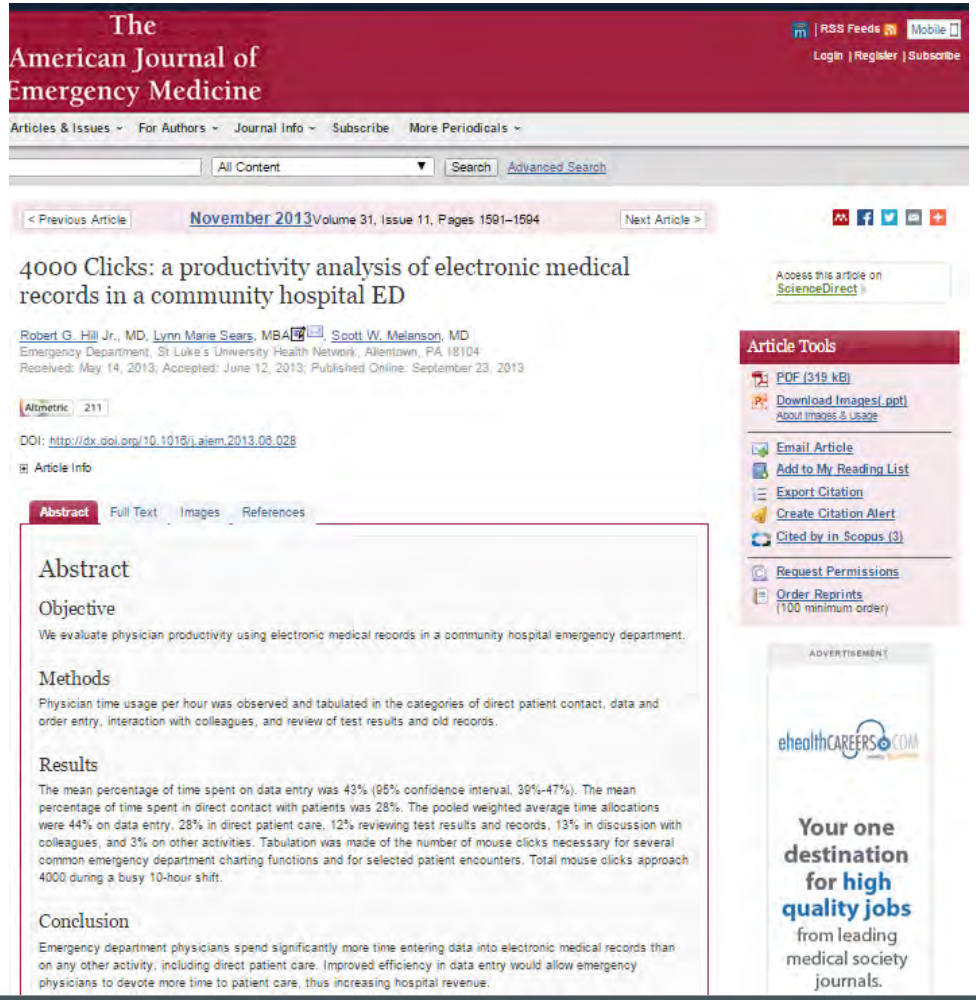

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4000 Clicks: a productivity analysis of electronic medical records in a community hospital ED

Robert G. Hill Jr., MD, Lynn Marie Sears, MBA, Scott W. Melanson, MD

Emergency Department, St Luke's University Health Network, Allentown, PA 18104

Received: May 14, 2013; Accepted: June 12, 2013; Published Online: September 23, 2013

Altmetric 211

DOI: http://dx.doi.org/10.1016/j.ajem.2013.06.028

Article Info

Abstract | Full Text | Images | References

Abstract

Objective

We evaluate physician productivity using electronic medical records in a community hospital emergency department.

Methods

Physician time usage per hour was observed and tabulated in the categories of direct patient contact, data and order entry, interaction with colleagues, and review of test results and old records.

Results

The mean percentage of time spent on data entry was 43% (95% confidence interval, 39%-47%). The mean percentage of time spent in direct contact with patients was 28%. The pooled weighted average time allocations were 44% on data entry, 28% in direct patient care, 12% reviewing test results and records, 13% in discussion with colleagues, and 3% on other activities. Tabulation was made of the number of mouse clicks necessary for several common emergency department charting functions and for selected patient encounters. Total mouse clicks approach 4000 during a busy 10-hour shift.

Conclusion

Emergency department physicians spend significantly more time entering data into electronic medical records than on any other activity, including direct patient care. Improved efficiency in data entry would allow emergency physicians to devote more time to patient care, thus increasing hospital revenue.

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- 43% of time on data entry
- 28% on direct care
- 12% Results review
- 13% Communication
- 3% Other

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Scribes

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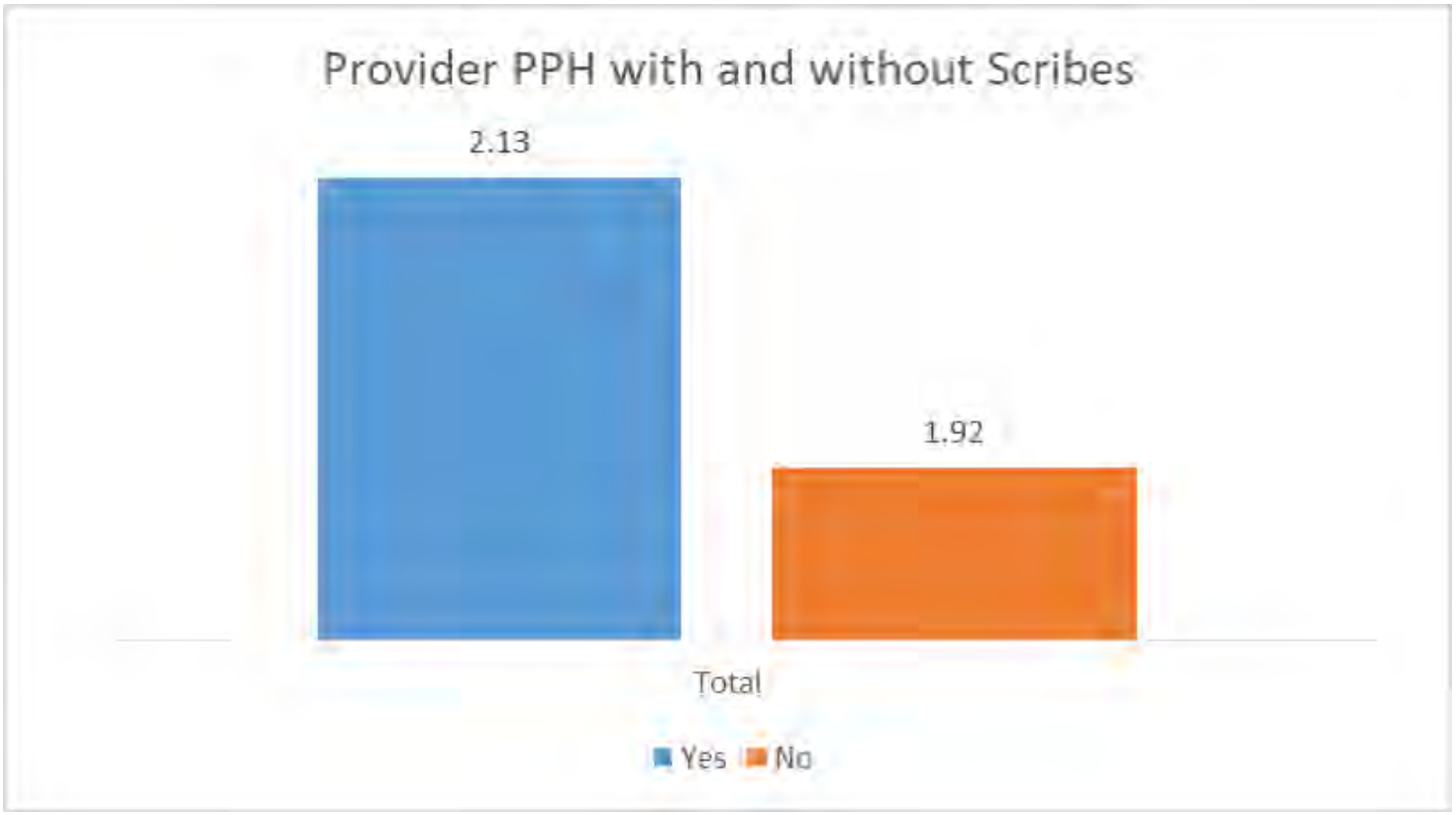
EDBA Impact of Scribes



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Scribes vs Voice Dictation

Nuance Dragon Medical One

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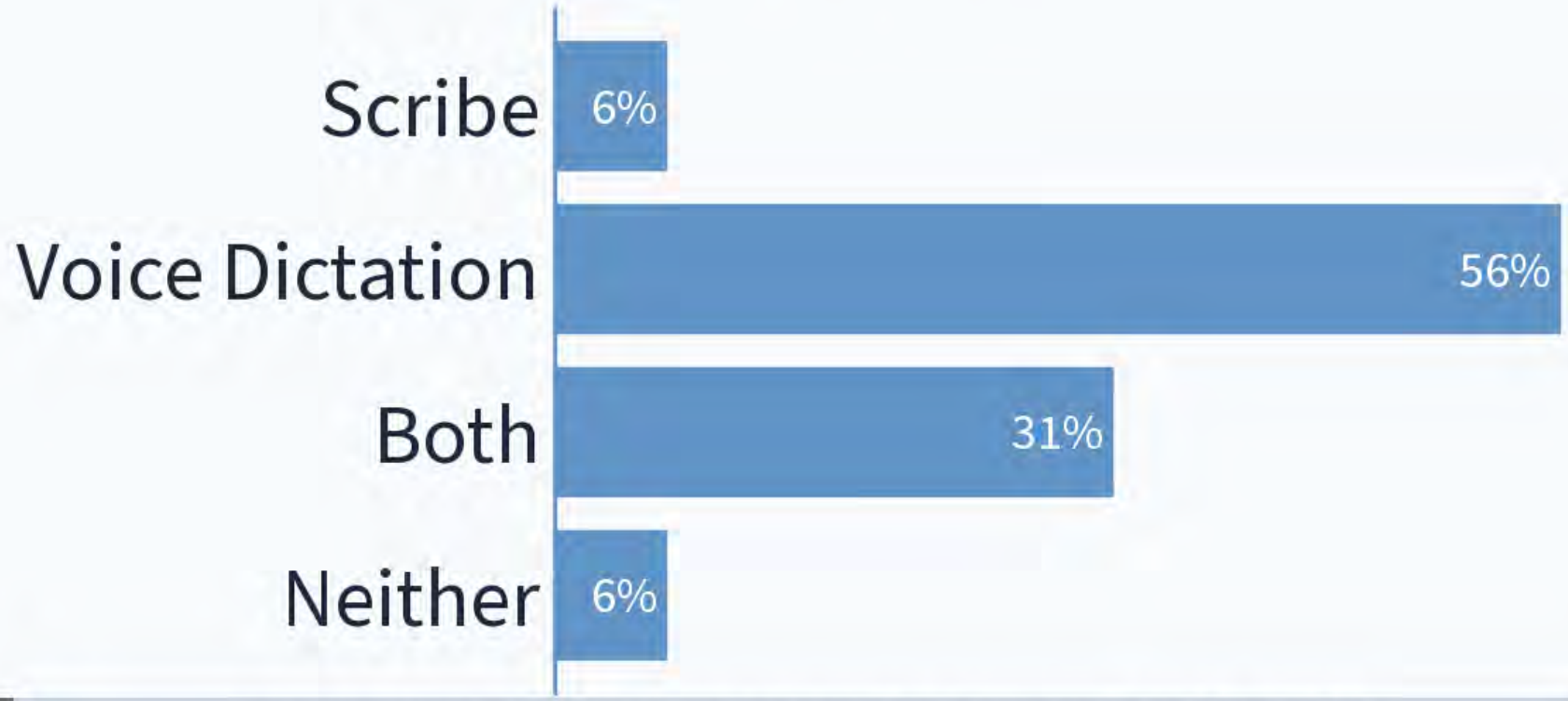
Does Your ED Currently Use Scribes or Voice Dictation?



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Theory of Constraints – FT Example

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3pts/hr

Nurse

30 min/pt

=

1) How many patients can my clinic see per hour?

2) How can you improve this system?
3) if you can't add resources….

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2. Nurse Capacity

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Health

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Nursing Shortage: How It May Affect You

Family Awarded $2.7 Million over Alleged Nursing Neglect at Kansas Hospital

By LAURA MARQUEZ
Jan. 21, 2006

abc WORLD NEWS with Charles Gibson

12 comments

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Shirley Keck, a 61-year-old mother of five, was having trouble breathing one Sunday afternoon, so her daughter, Becky Hartman, rushed her to the emergency room at Wesley Hospital in Wichita, Kan.

Doctors there thought Keck had pneumonia and admitted her. But for the next seven hours, Hartman sat by her mother's bedside watching her condition deteriorate, and seeing her struggle for each breath. She said she repeatedly tried to get help from the nurses.

"I begged for help," she said. "We had plenty of time to get help, and we got none."

Keck did not have pneumonia. She was actually having a heart attack that was causing liquid

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Worked Hours per Patient Visit (whppv)

- Nursing worked hours per patient visit:
- WHPPV is just the inverse of the calculation we use for provider pts/hr

Pts/hr

$$\frac{1400 \text{ pts/wk}}{700 \text{ doc hrs/wk}} = 2 \text{ pts/hr}$$

inverse

Whppv

$$\frac{1000 \text{ RN hrs/wk}}{600 \text{ pts/wk}} = 1.67 \text{ whppv}$$

- Total worked hours per patient visit is calculated similarly, but includes all other staff as well as nurse admin FTEs.

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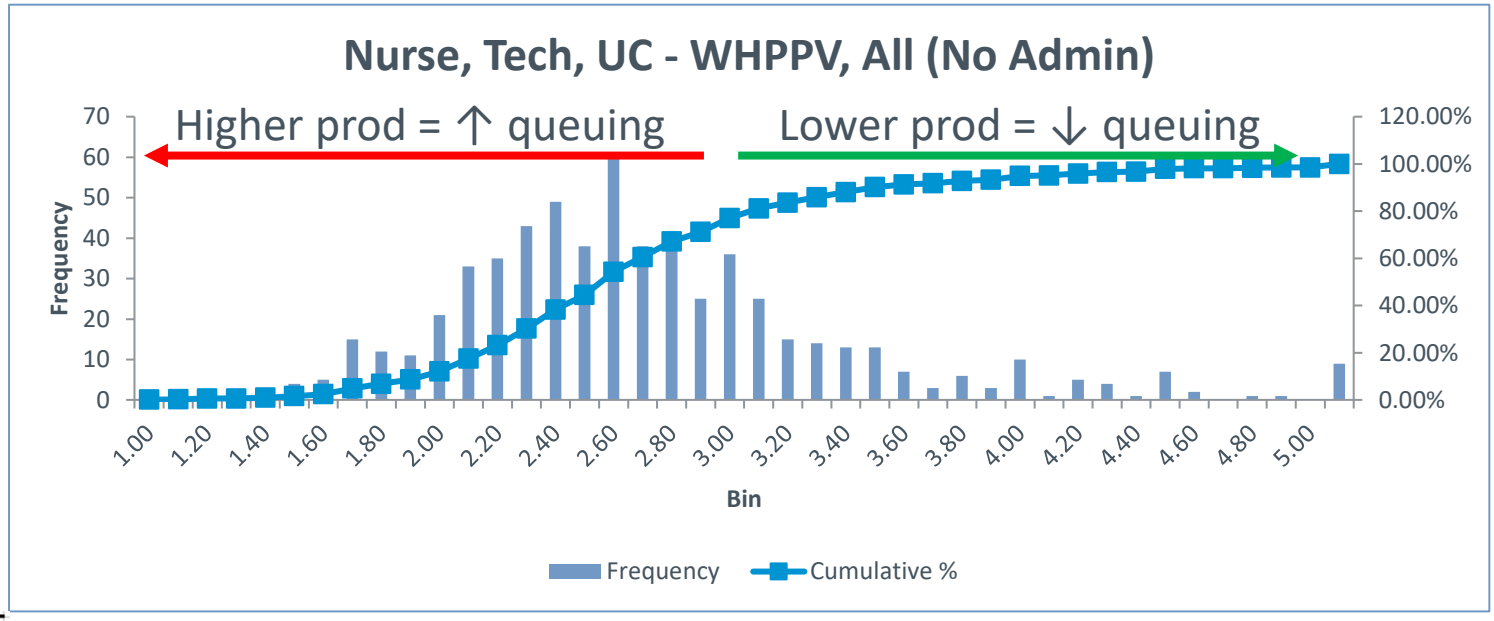
EDBA WHPPV – All Sites



WHPPV, All (No Admin)	
Mean	2.68
Median	2.56
Mode	2.80
Standard Deviation	0.80
Range	7.70
Minimum	0.67
Maximum	8.37
Count	610

*This data set does not include admin FTE

Based on 2018 data

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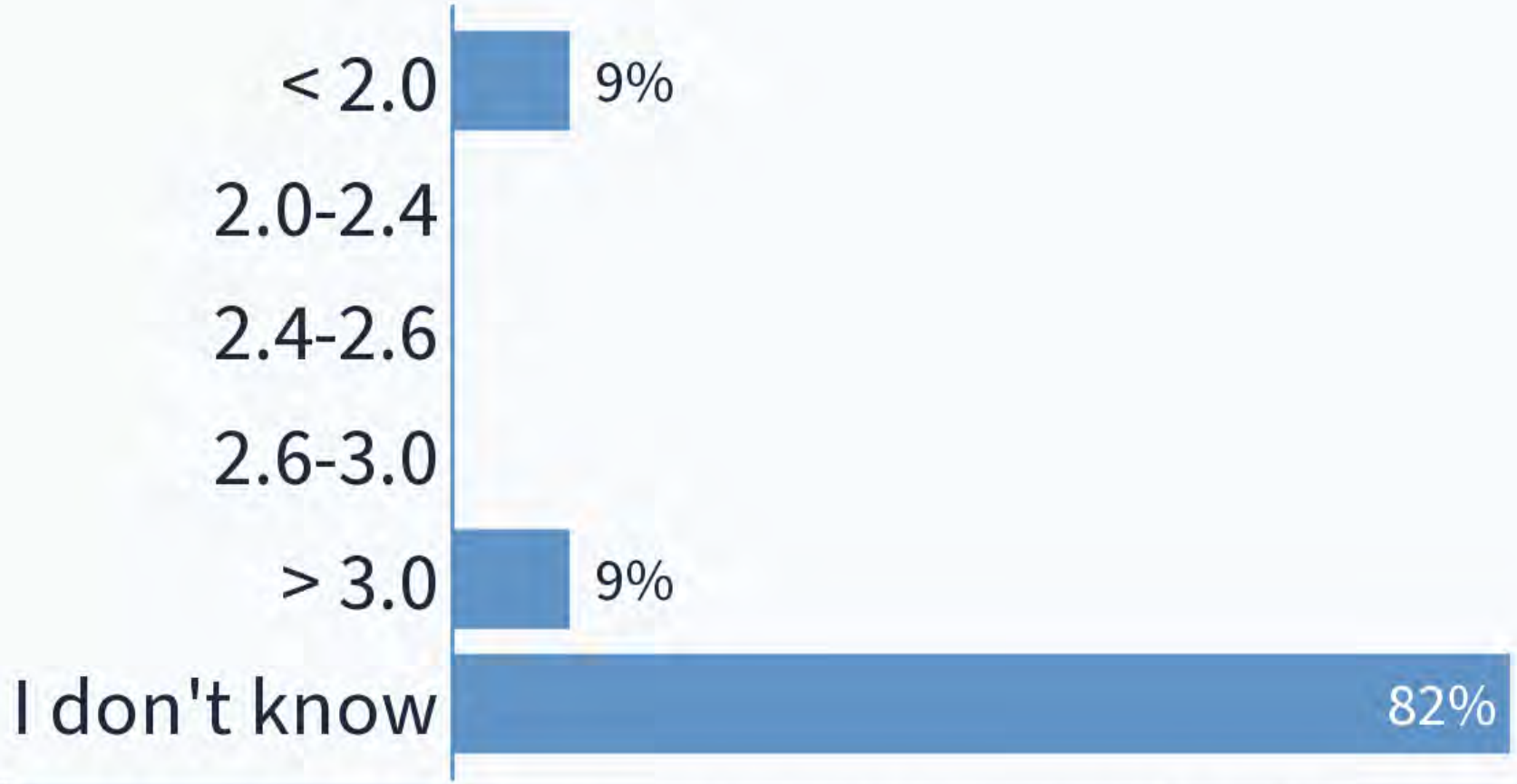
When poll is active, respond at **pollev.com/josephcrane528**

Text **JOSEPHCRANE528** to **22333** once to join

What is Your Current Nurse WHPPV?



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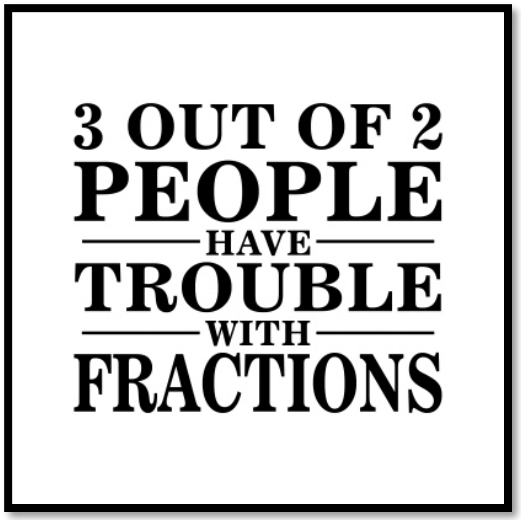
2. Capacity – Nurse Staffing Ratios

1. Many nurse staffing paradigms are driven off of bed ratios (4 beds per nurse)
2. Nurse staffing will depend on occupancy



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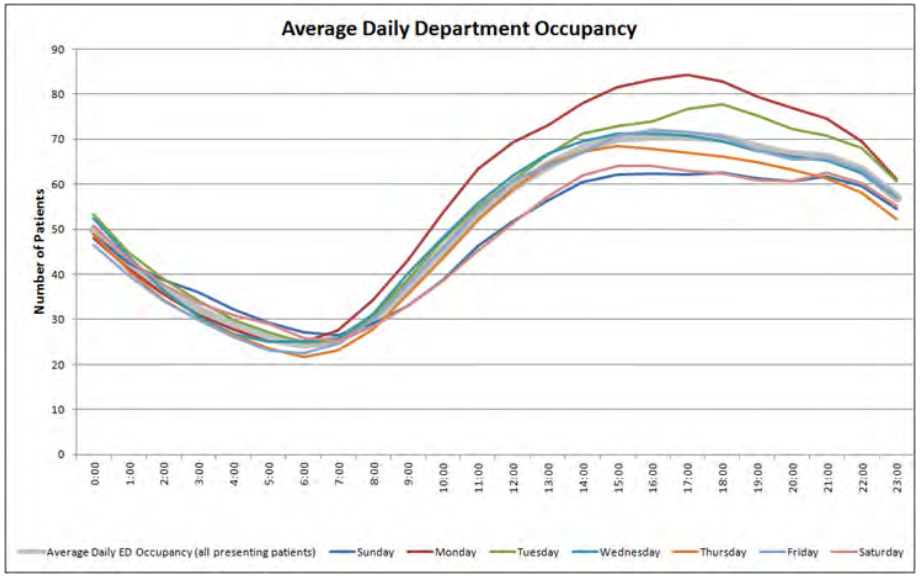

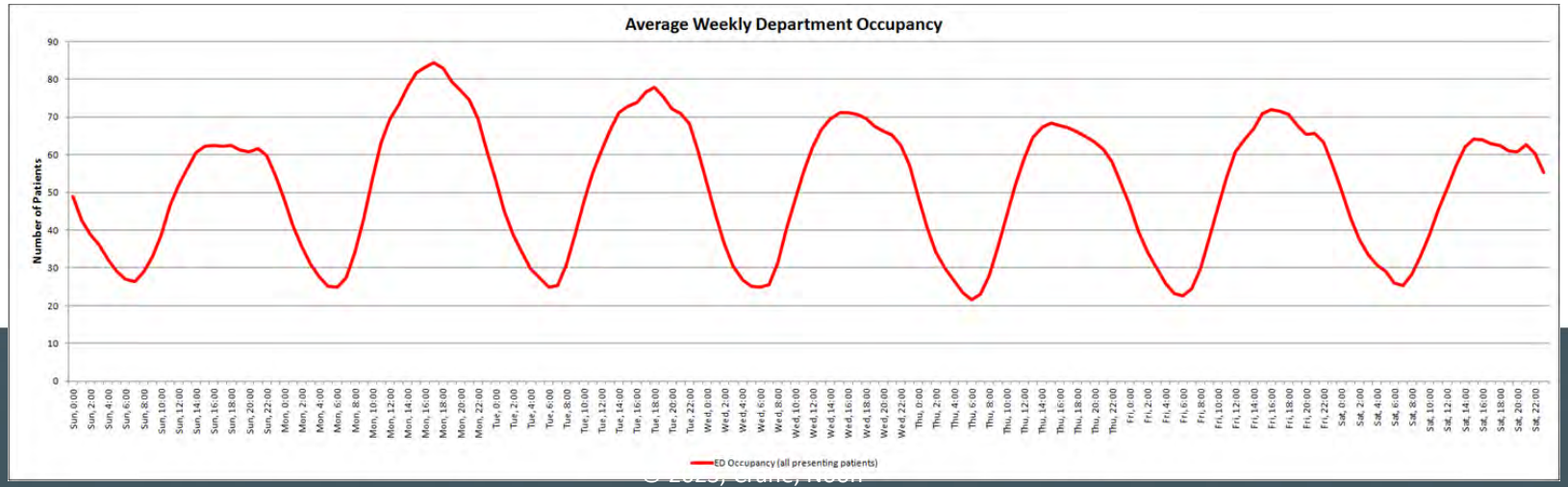

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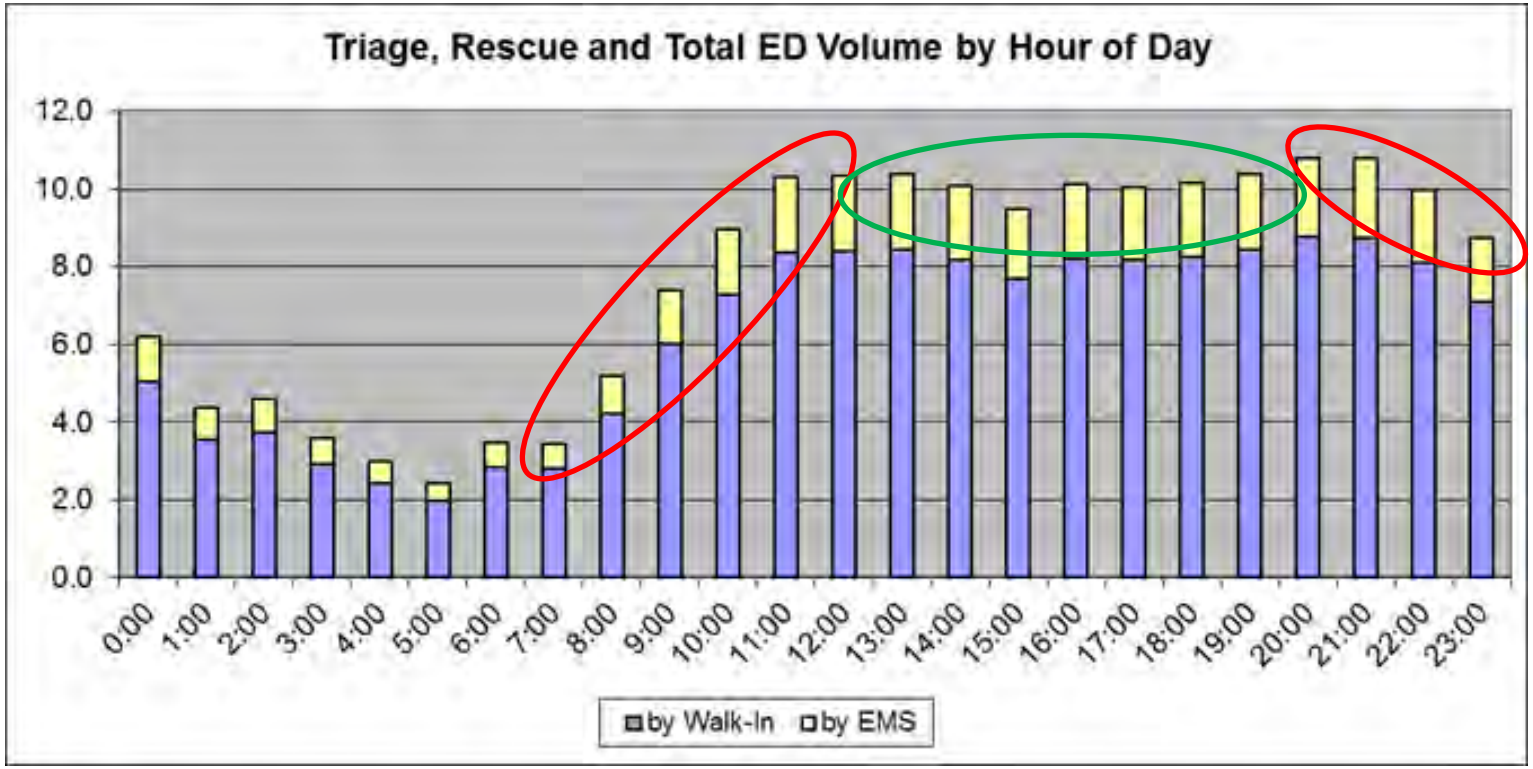
Dynamic Capacity Alignment



Steady state staffing is straightforward

Ramp up and ramp down is more difficult

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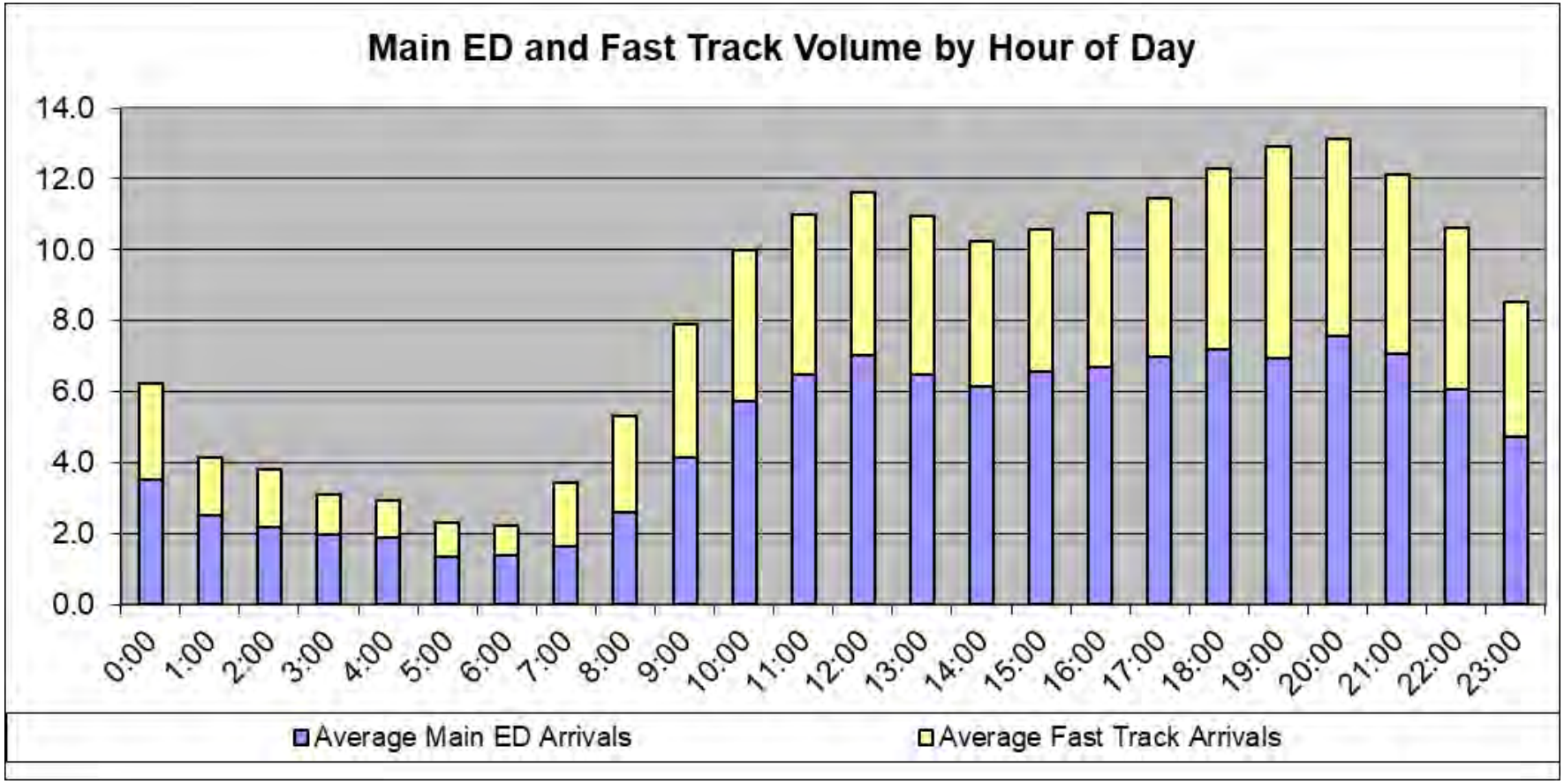
Arrivals – 72k Visits



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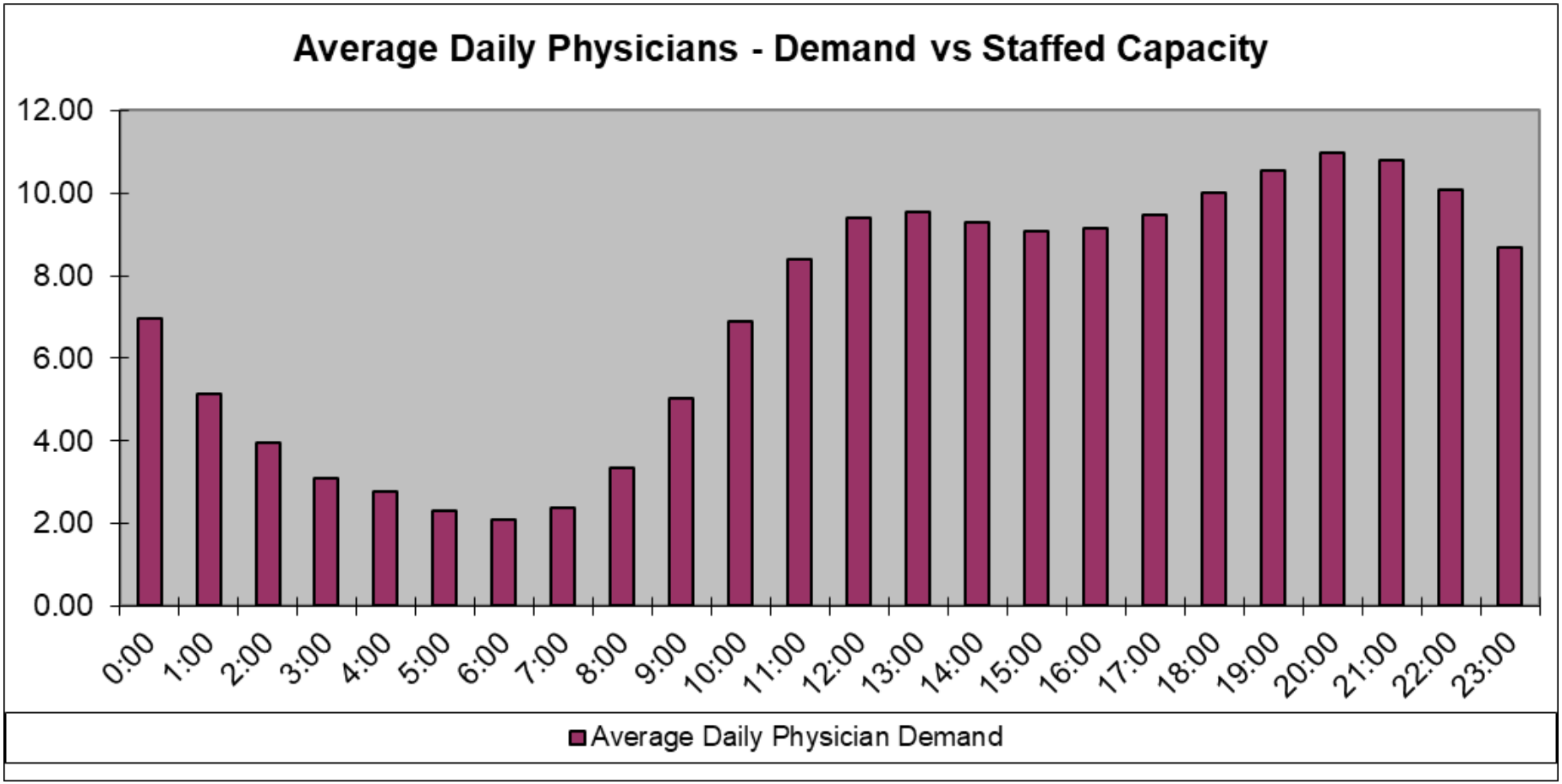
Provider Demand – 72k Visits



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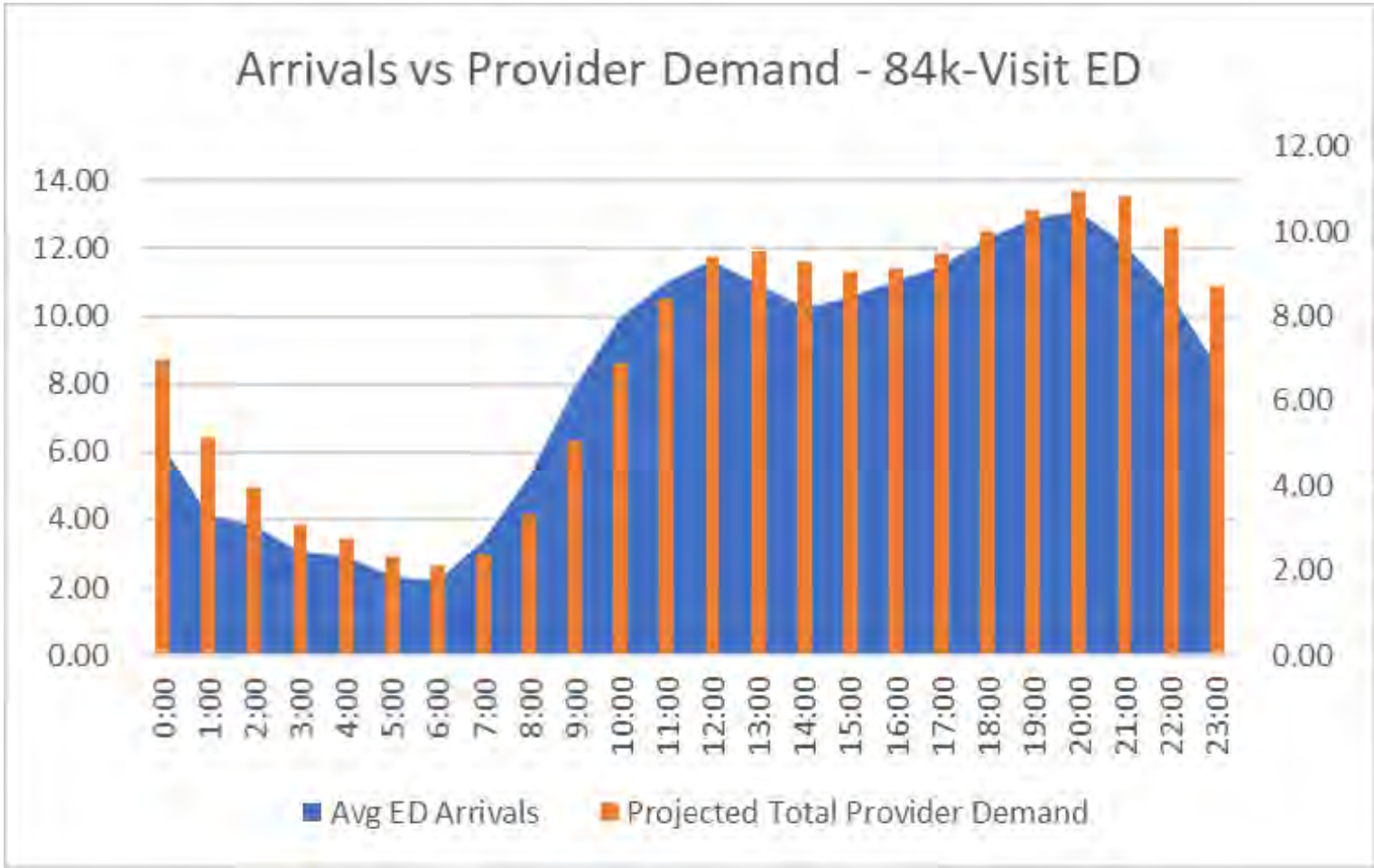
Overlay Arrivals and Provider Demand



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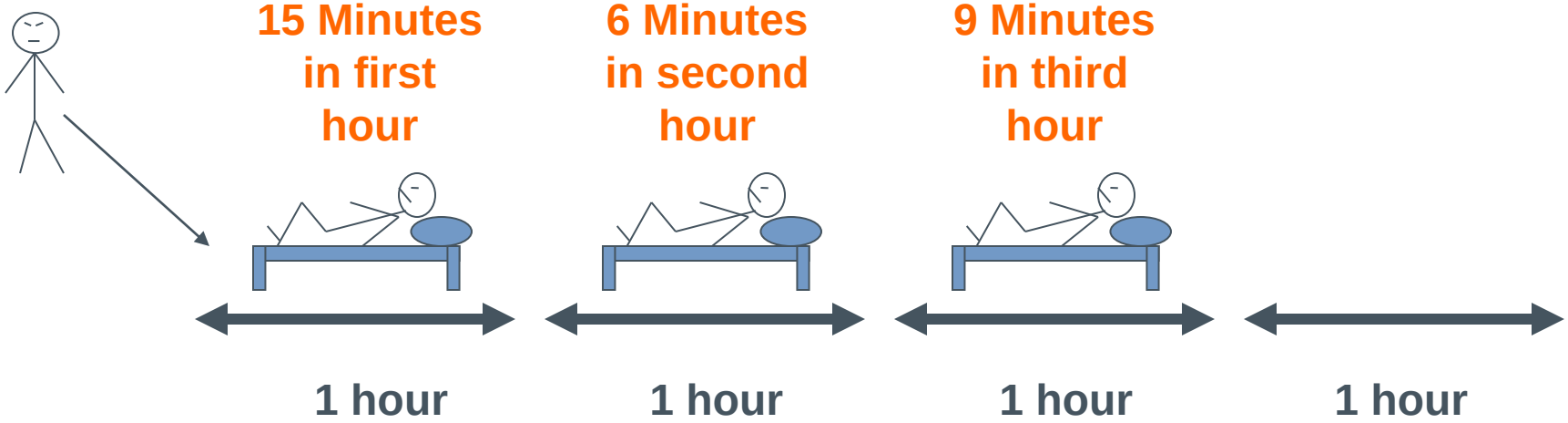
MD Demand – 2 pts/hr

MD spends 30 minutes per patient, but when?

50% in first 33% **20% in second 33%** **30% in third 33%**

15 Minutes in first hour **6 Minutes in second hour** **9 Minutes in third hour**



3-hour Length Of Stay

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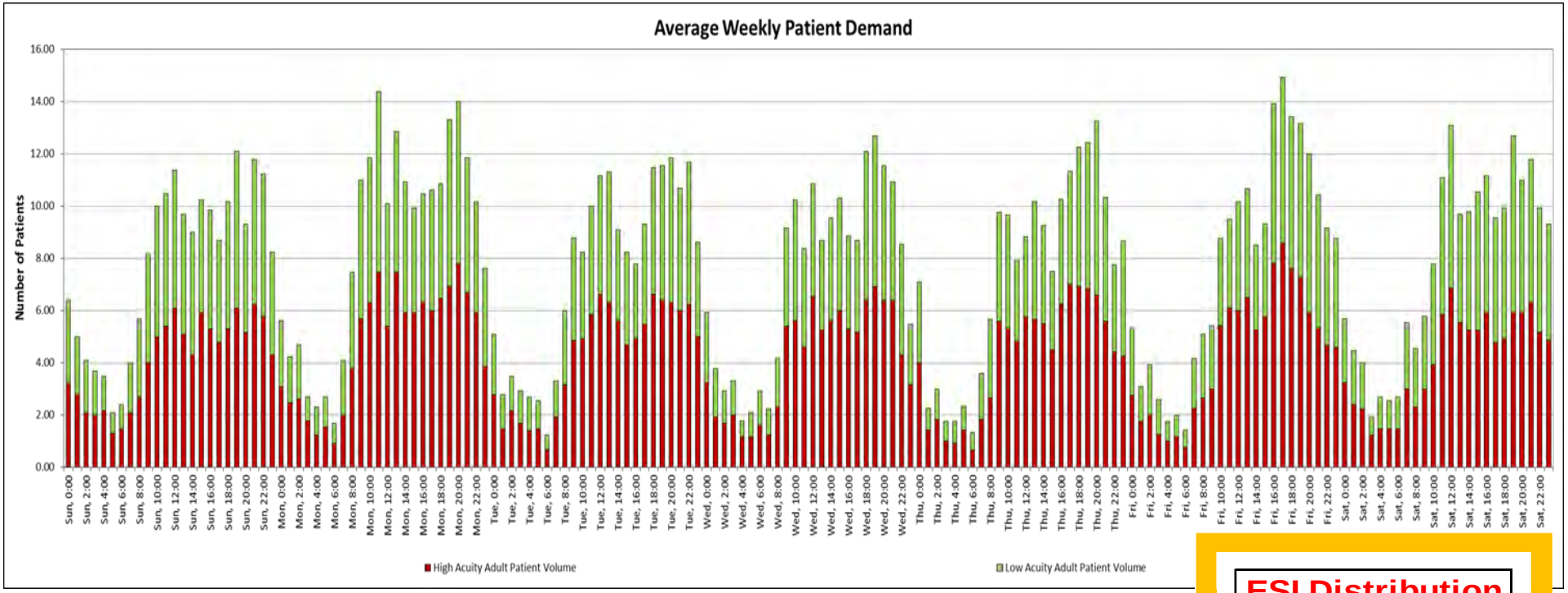
Optimizing the Alignment



ESI Distribution

ESI Level 1	1.64%
ESI Level 2	20.00%
ESI Level 3	36.37%
ESI Level 4	30.20%
ESI Level 5	11.80%

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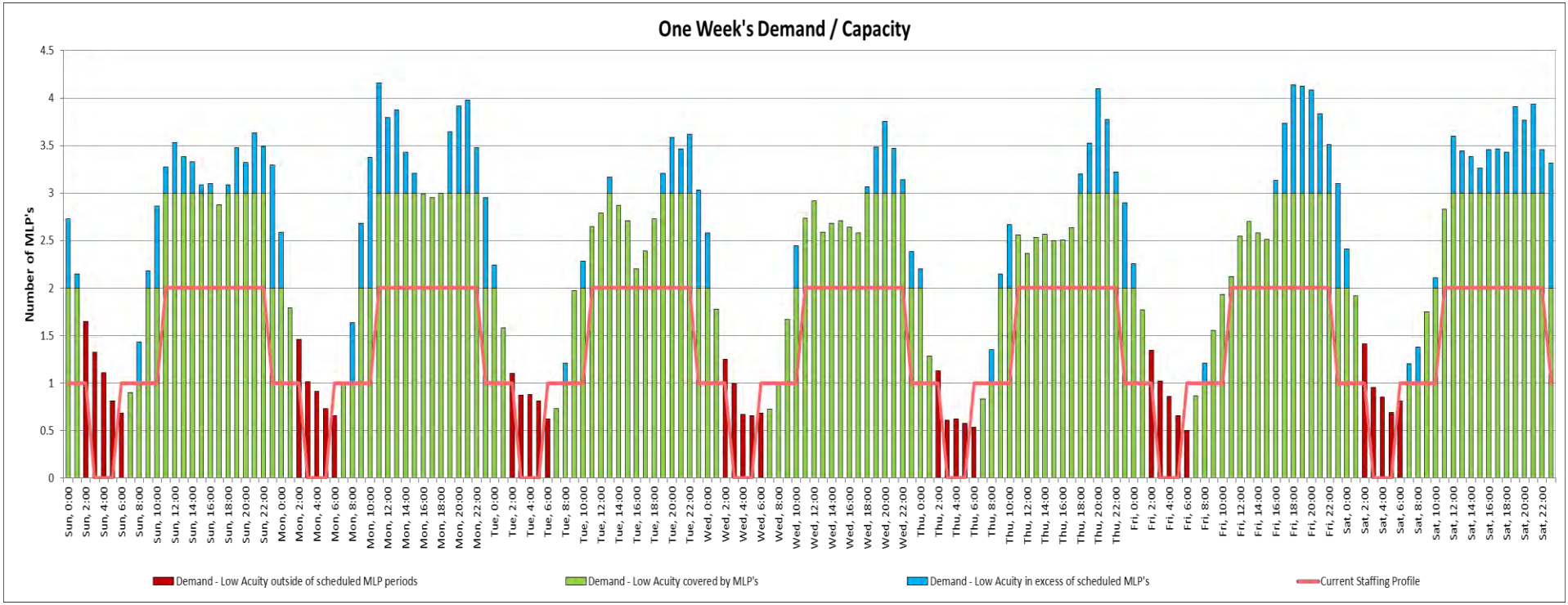
APC



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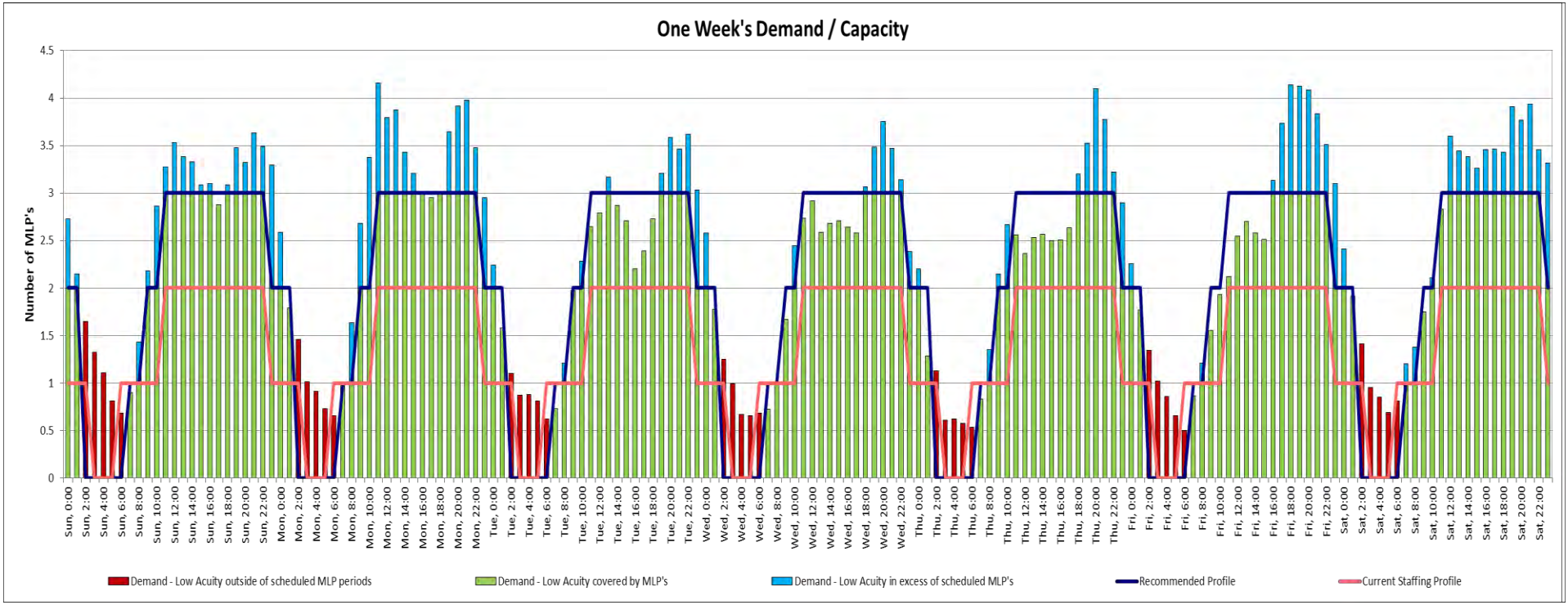
APC



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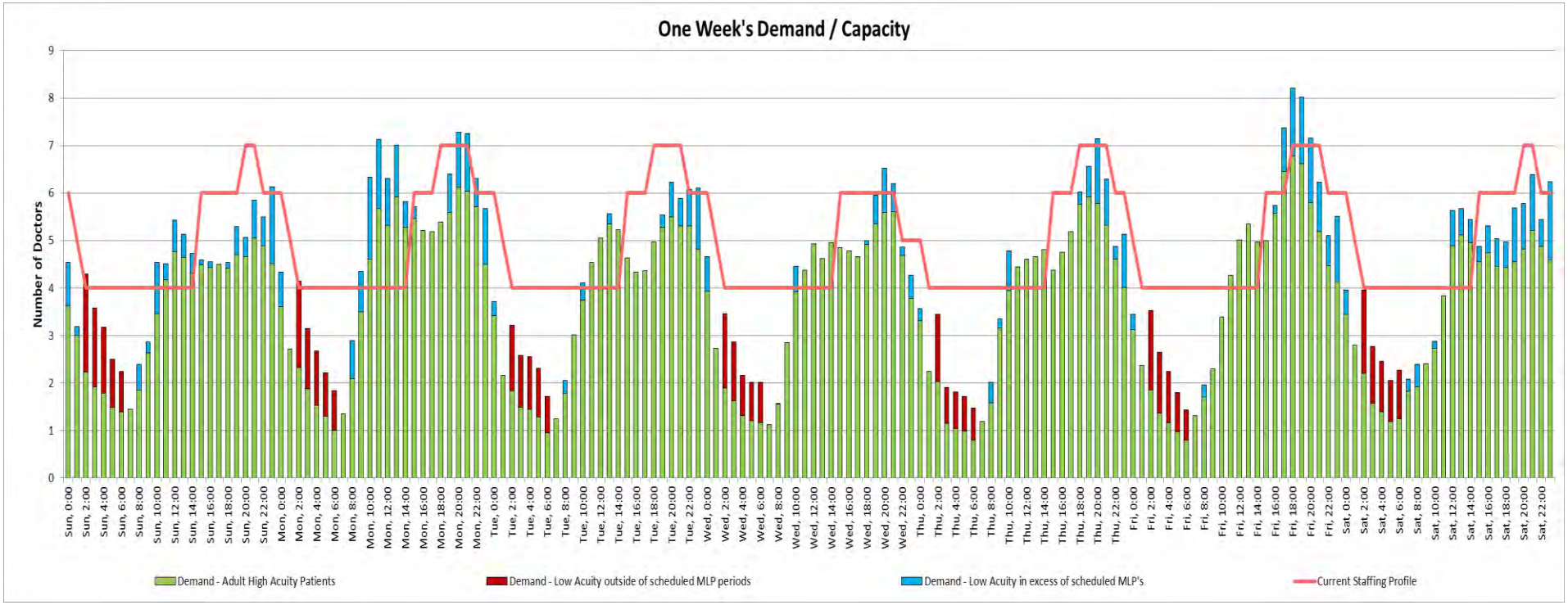
Physician



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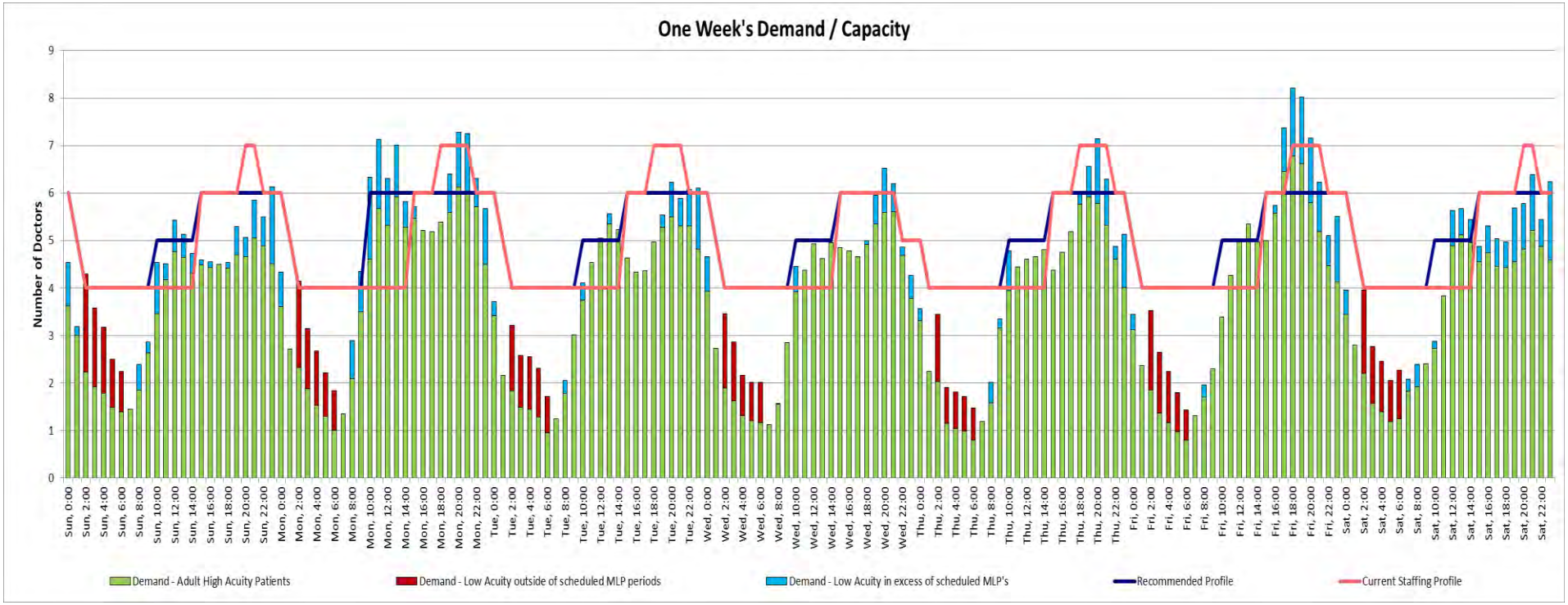
Physician



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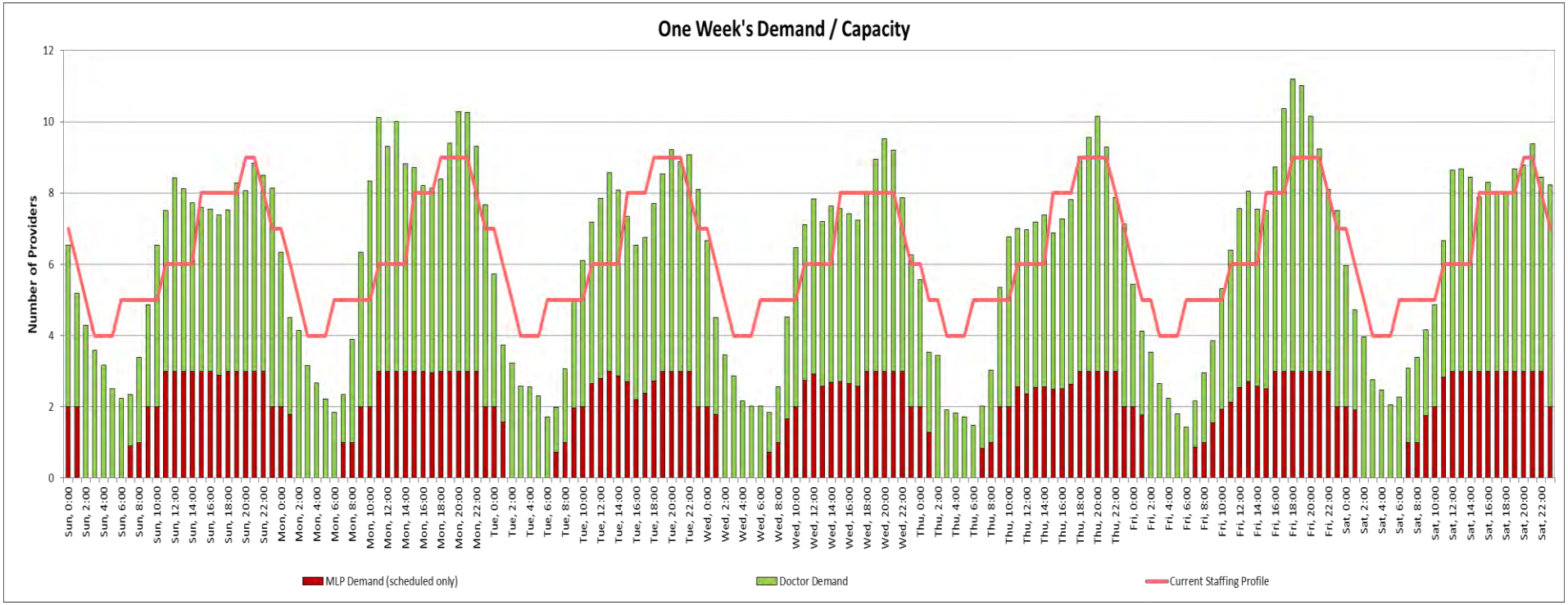
Provider



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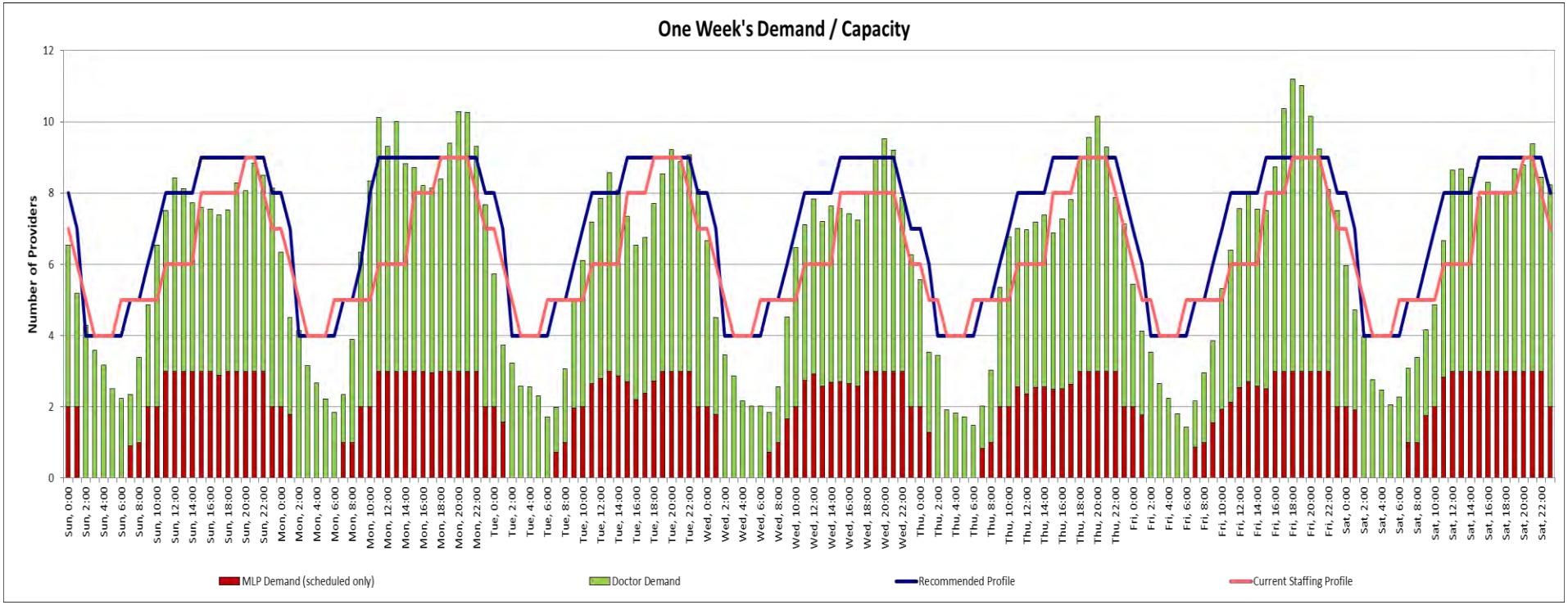
Provider



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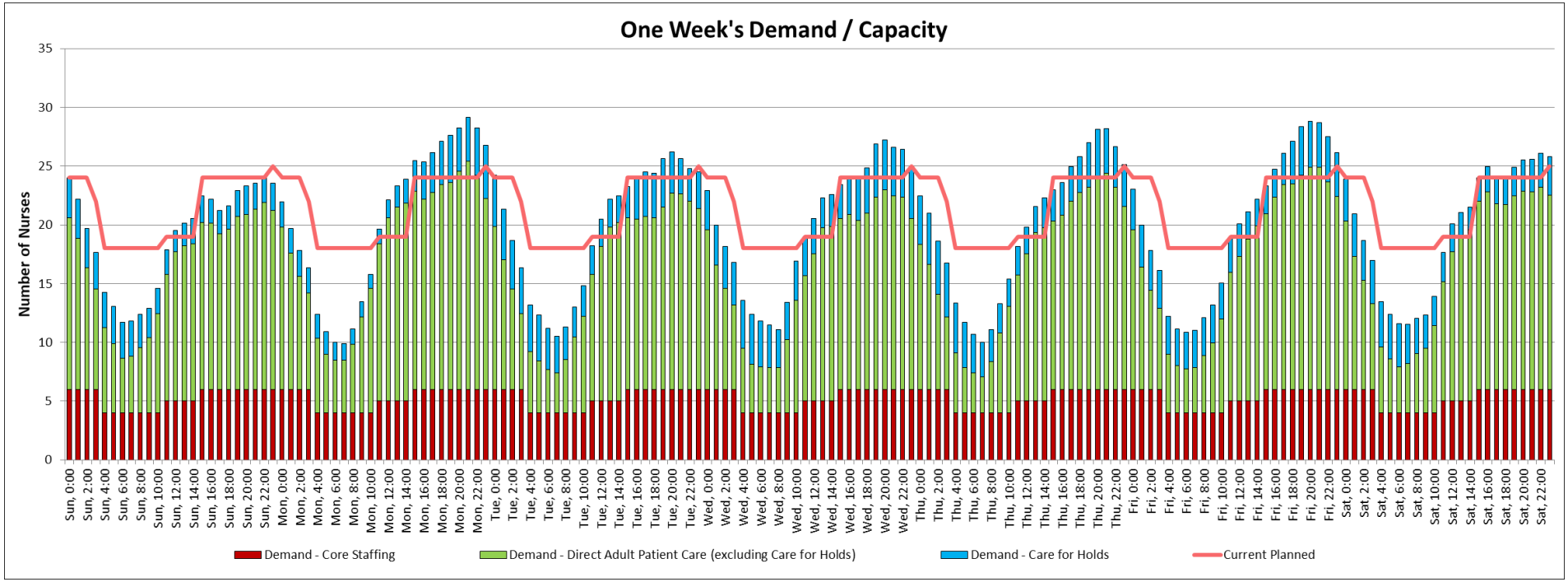
Current Nurse Staffing - Planned



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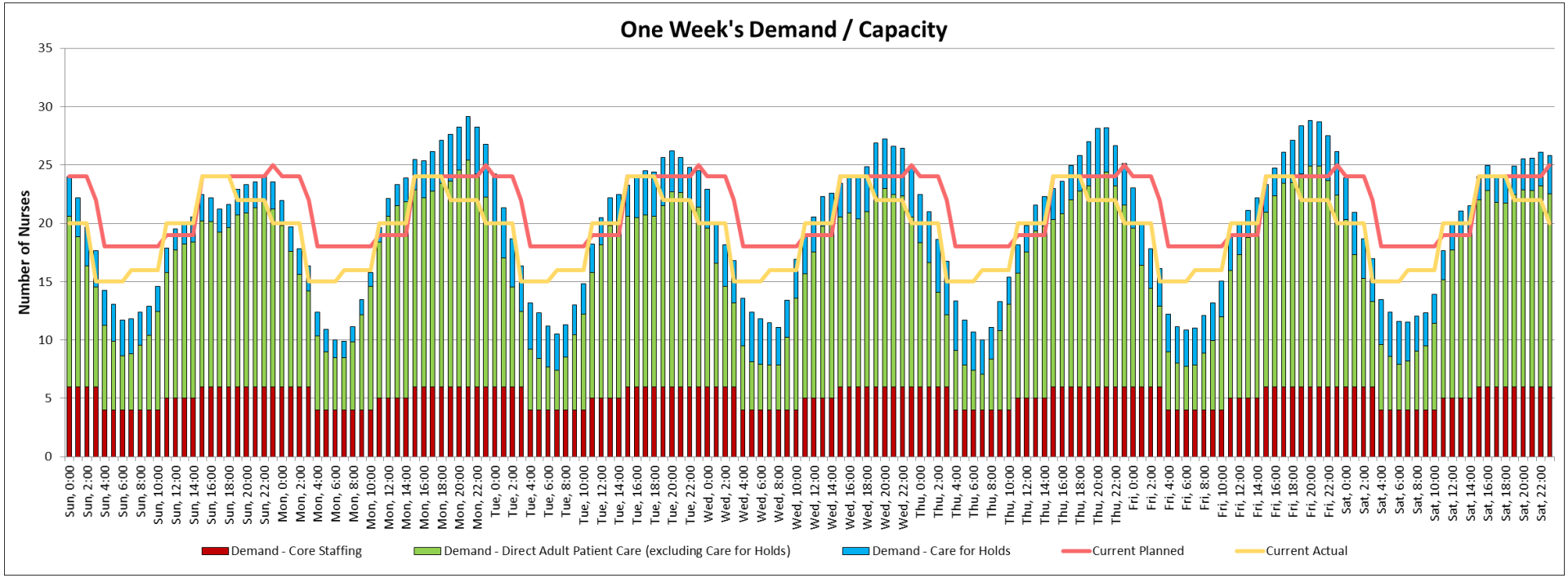
Current Nurse Staffing - Actual



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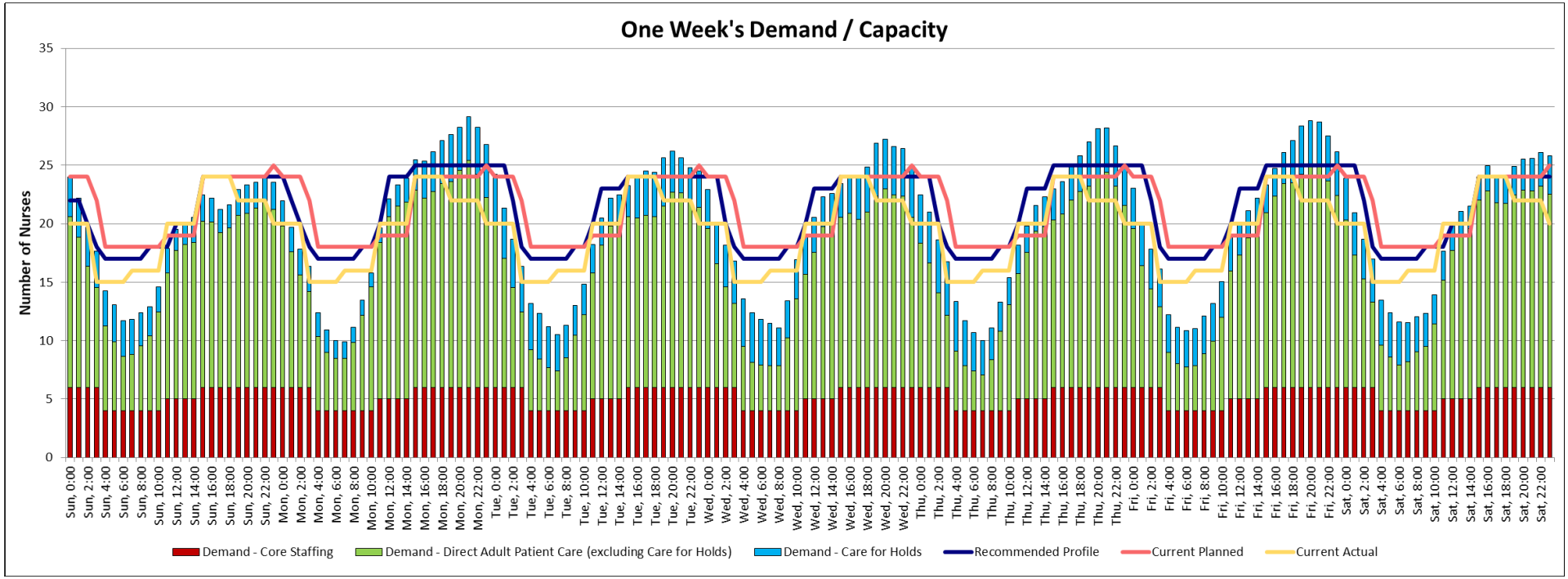
Future Nurse Staffing



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Basic Approach to Staffing

1. Define the arrival *Demand*
2. Define and align the server *Capacity* (physician, nurse, APC, resident, bed productivity)
3. Execute in the *Context* of your current operational environment

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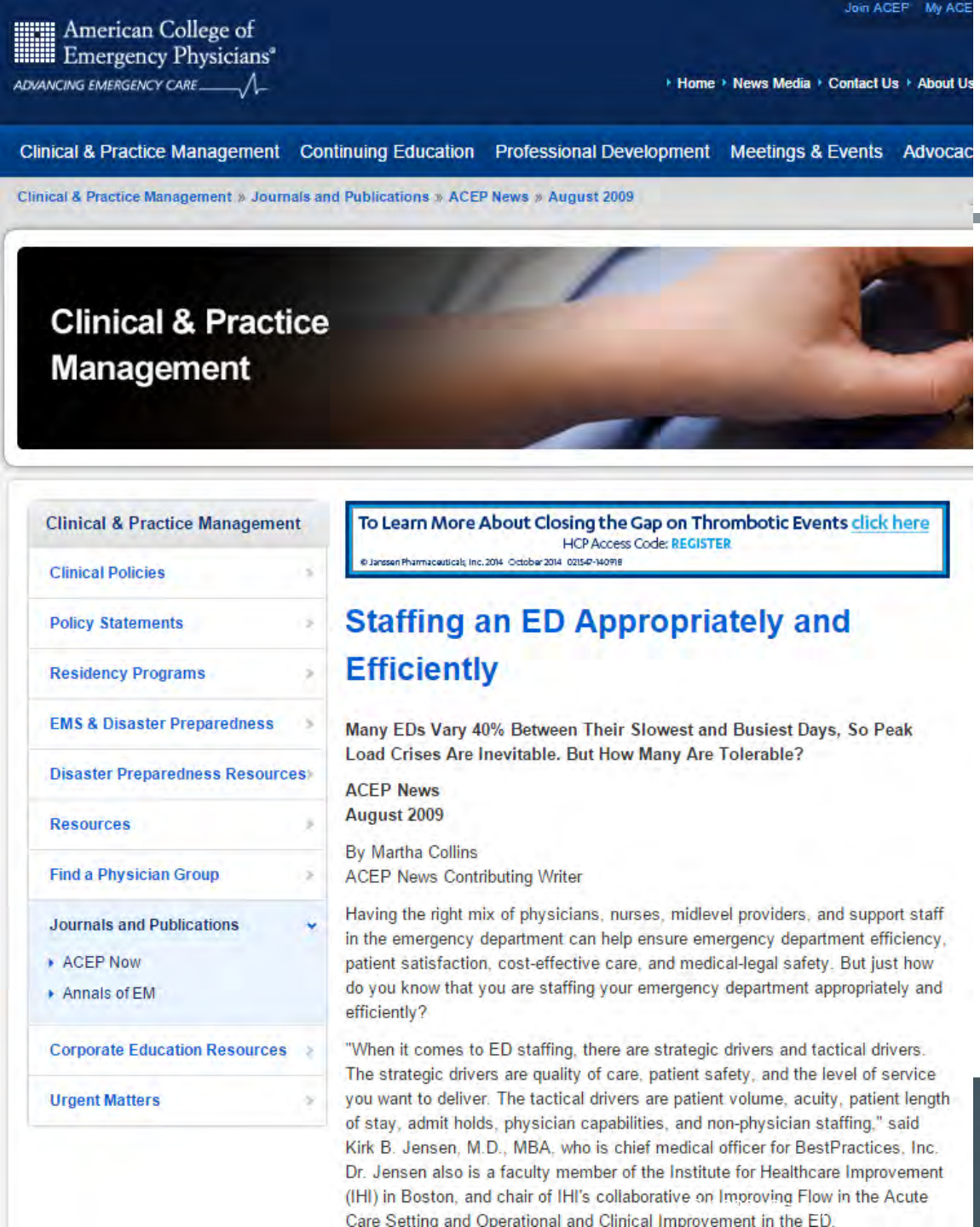

- Geography,
- Process,
- and People

This ED is a lot harder to staff….

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Than this ED….

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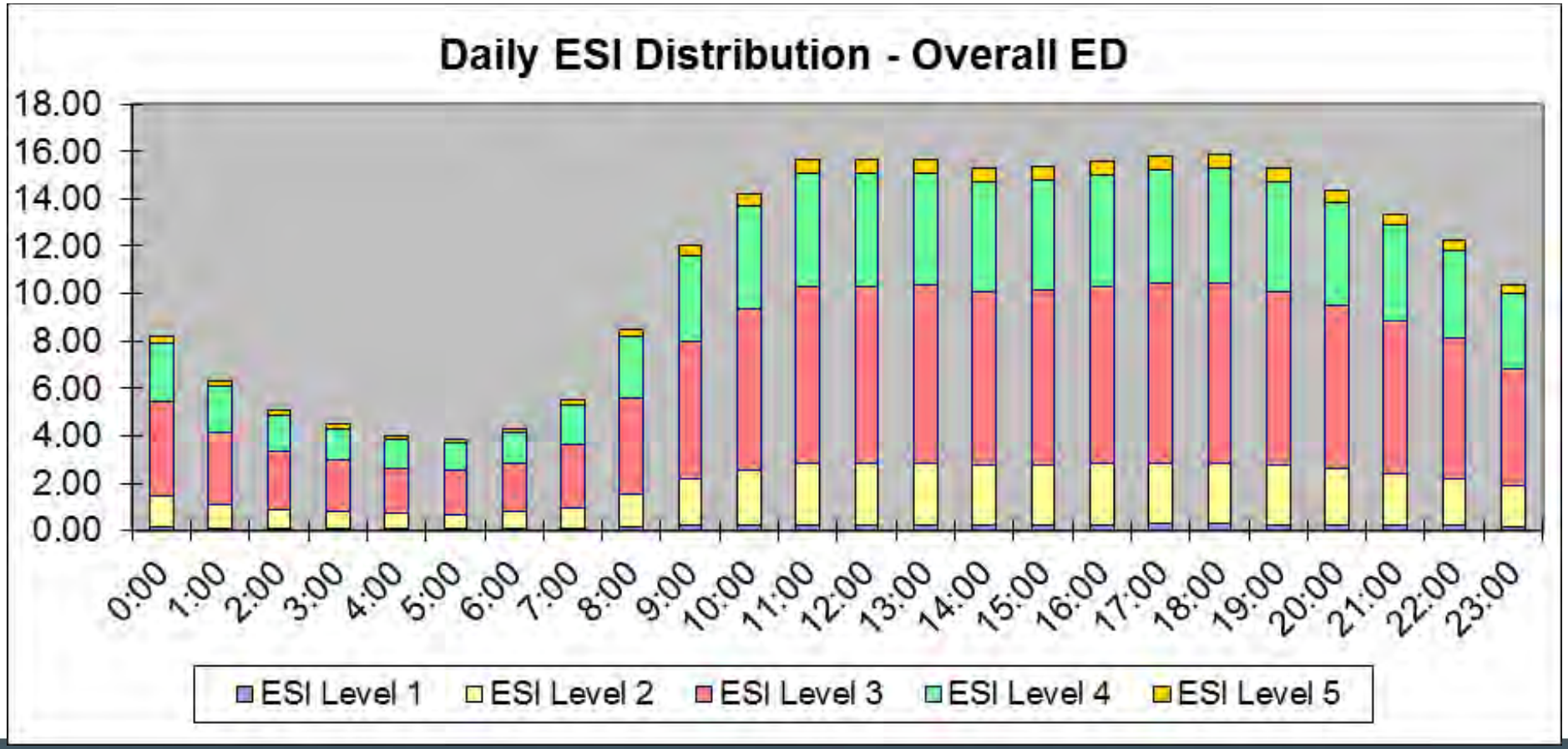
Arrival Acuity by HOD



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There are Really Only 3 Types of ED Patients…

Easy

Complicated

Sick

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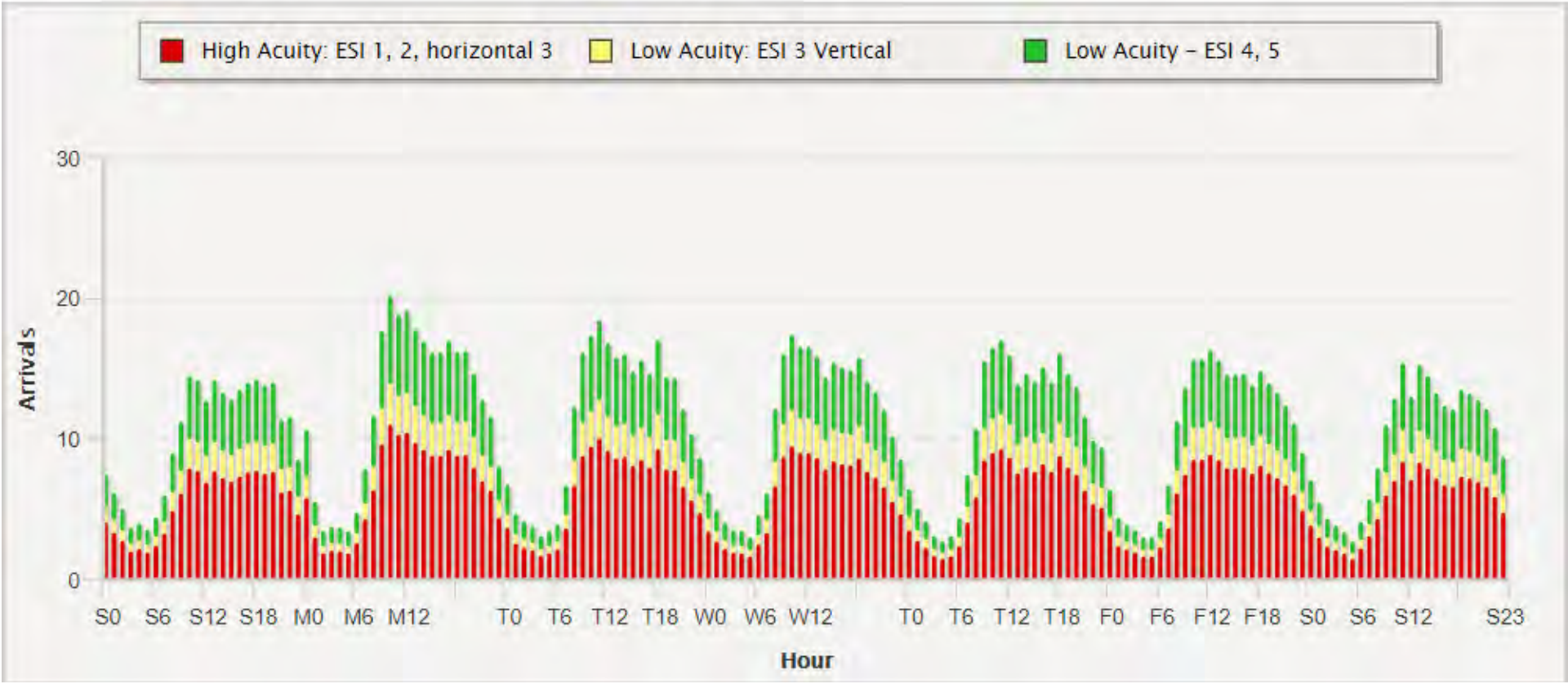
Optimizing Streams

Arrivals: Horizontal versus Vertical, 3 layers



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Walk-in Arrivals

Assessment

Ambulance Arrivals

Easy

8 pts/hr

“Vertical”

Super Track

Complicated

3 pts/hr

“Vertical”

Intake/RME

Sick

8 pts/hr

“Horizontal”

Main ED

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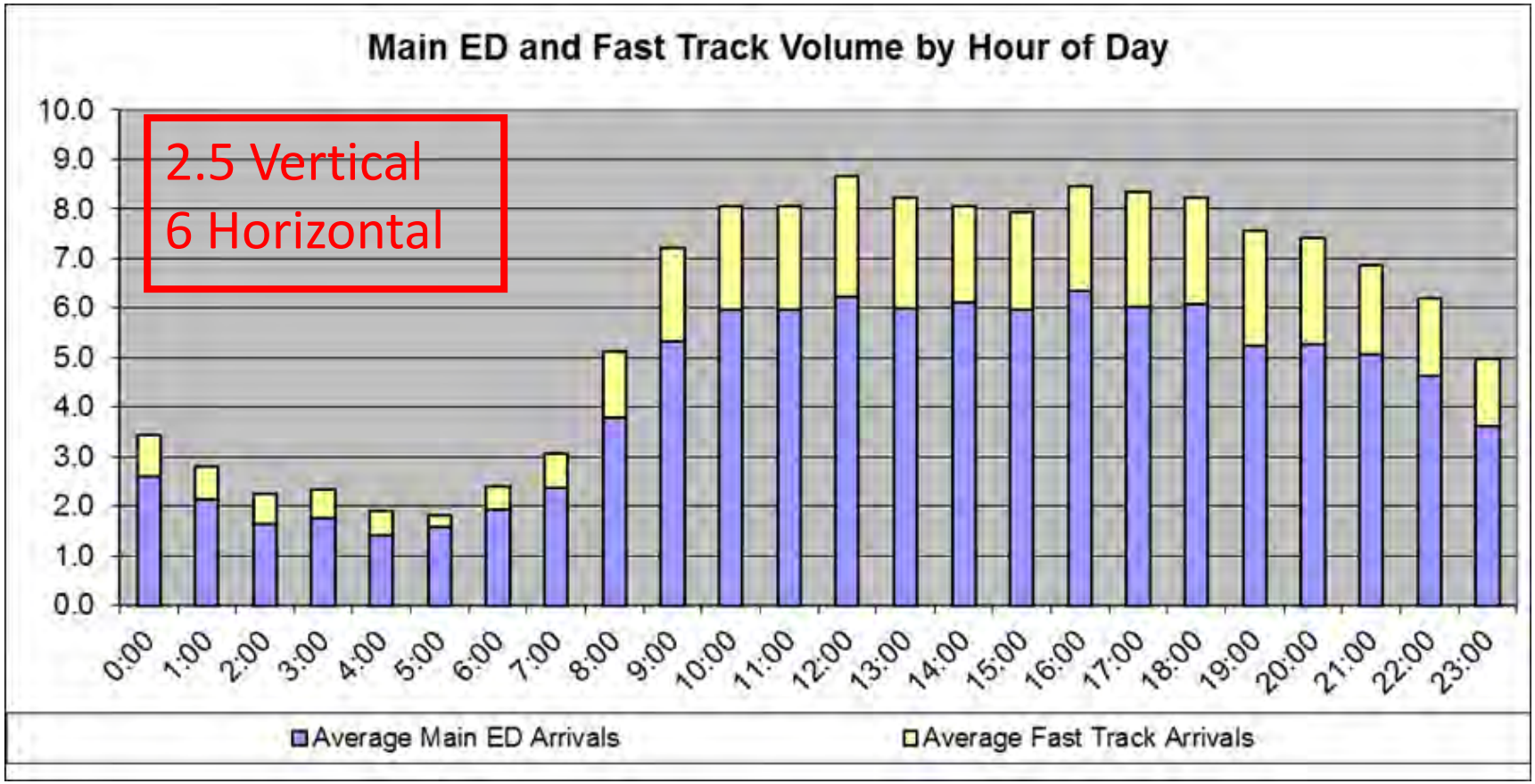
Low Acuity Arrivals = ESI 4,5



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Walk-in Arrivals

Ambulance Arrivals

Assessment

Easy

Complicated

Sick

2.5 pts/hr
"Vertical"
Super Track

6 pts/hr
"Horizontal"
Main ED

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SPECIAL OPs

DR. WELCH is a practicing emergency physician with Utah Emergency Physicians and a research fellow at the Intermountain Institute for Health Care Delivery Research. She has written numerous articles and three books on ED quality, safety, and efficiency. She is a consultant with Quality Matters Consulting and her expertise is in ED operations.

The SuperTrack Is SUPER!

Patient segmentation can improve efficiency, patient care, and other key ED metrics

by SHARI WELCH, MD, FACEP

Other newer examples of patient segmentation include:

- Geriatric ED
- Chest pain center
- Pediatric ED
- Critical decision unit
- Observation unit
- SuperTrack

For emergency departments seeing medium to high volumes of patients, the concept of patient segmentation is becoming popular as a flow strategy.[1] Patient segmentation means grouping patients requiring similar levels of care and having similar anticipated lengths of stay (LOS) into a geographic area with dedicated staff and resources. The earliest example of patient segmentation is Fast Track, which now has a very compelling body of literature behind it.[2-6] Other newer examples of patient segmentation include:

- Geriatric ED
- Chest pain center
- Pediatric ED
- Critical decision unit
- Observation unit
- SuperTrack

SuperTrack was pioneered by Jody Crane, MD, in the Mary Washington Hospital Emergency Department in Fredericksburg, Virginia, as part of a complete patient-flow makeover.[7] The Mary Washington ED was seeing more than 100,000 visits when it opened its new doors in 2006 and was plagued with front-end waits and delays. As part of a complete overhaul of its ED patient flow, Crane and his colleagues

acuity patients (Emergency Severity Index Level 5). It dedicated six rooms as SuperTrack from 8 a.m. to 6 p.m., where identified patients would be seen by a patient care team con-

Once patients were found to meet the SuperTrack criteria, they were quickly placed in a room, and a patient care tech (PCT) would expedite this process and alert the pro-

plies, and staff dedicated to the care of very low-acuity patients. Parkland UCED improved all of its performance metrics, improved the overall flow of the department, and

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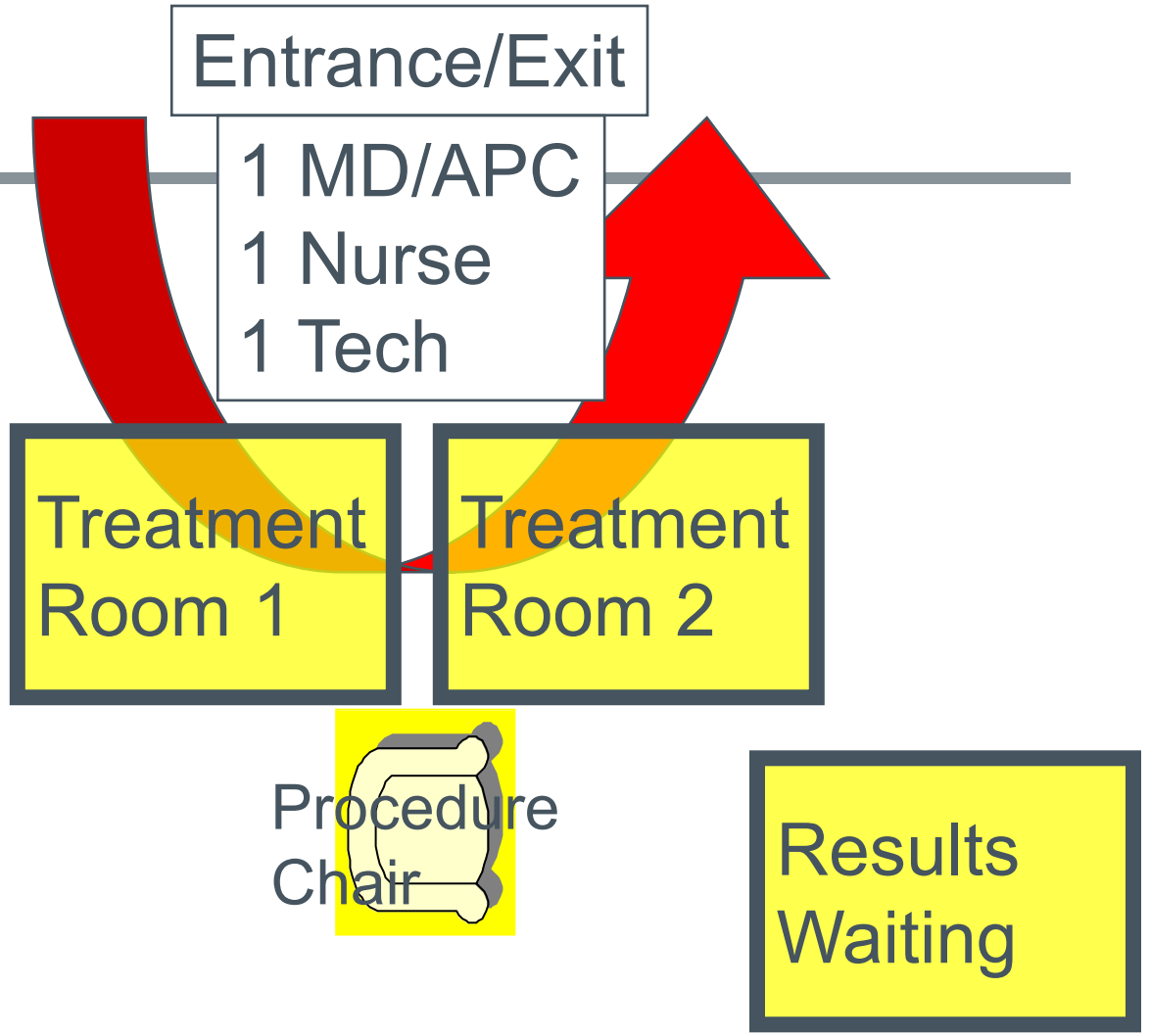
“Super Track”

- Fast Track located *in or near triage* for the purpose of promptly treating patients who require very low resource utilization



2 x Doc

4.5 x Nurse

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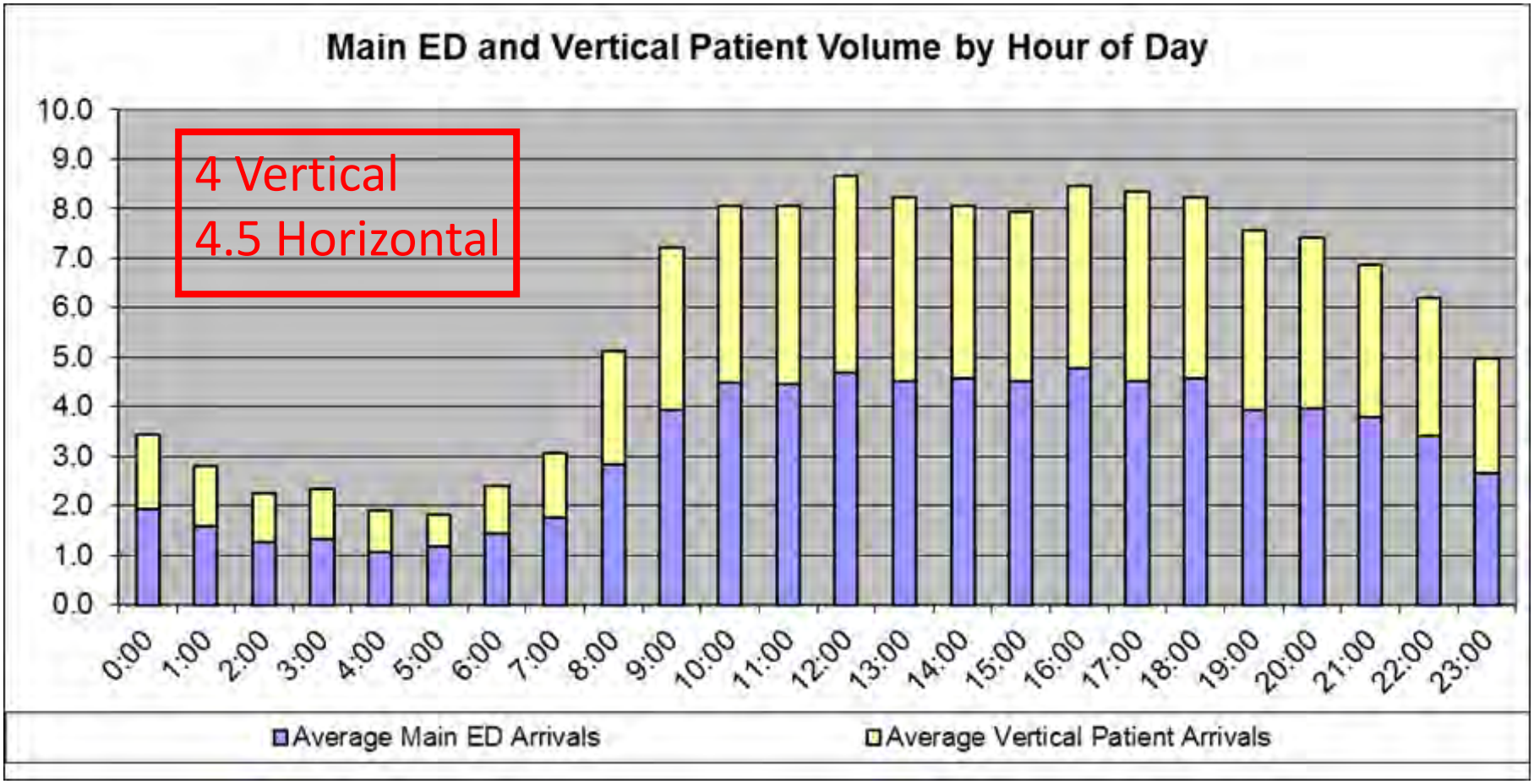
Intake Arrivals – ESI 4, 5, 33% ESI 3



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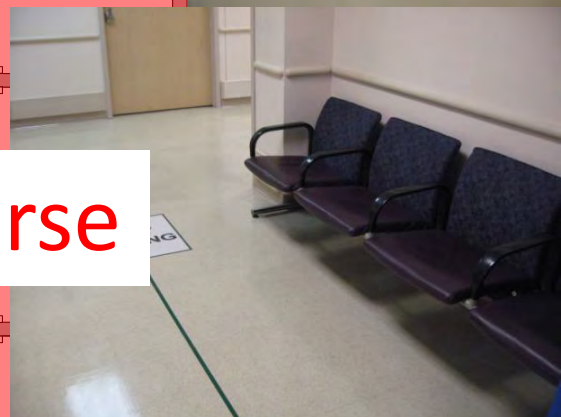
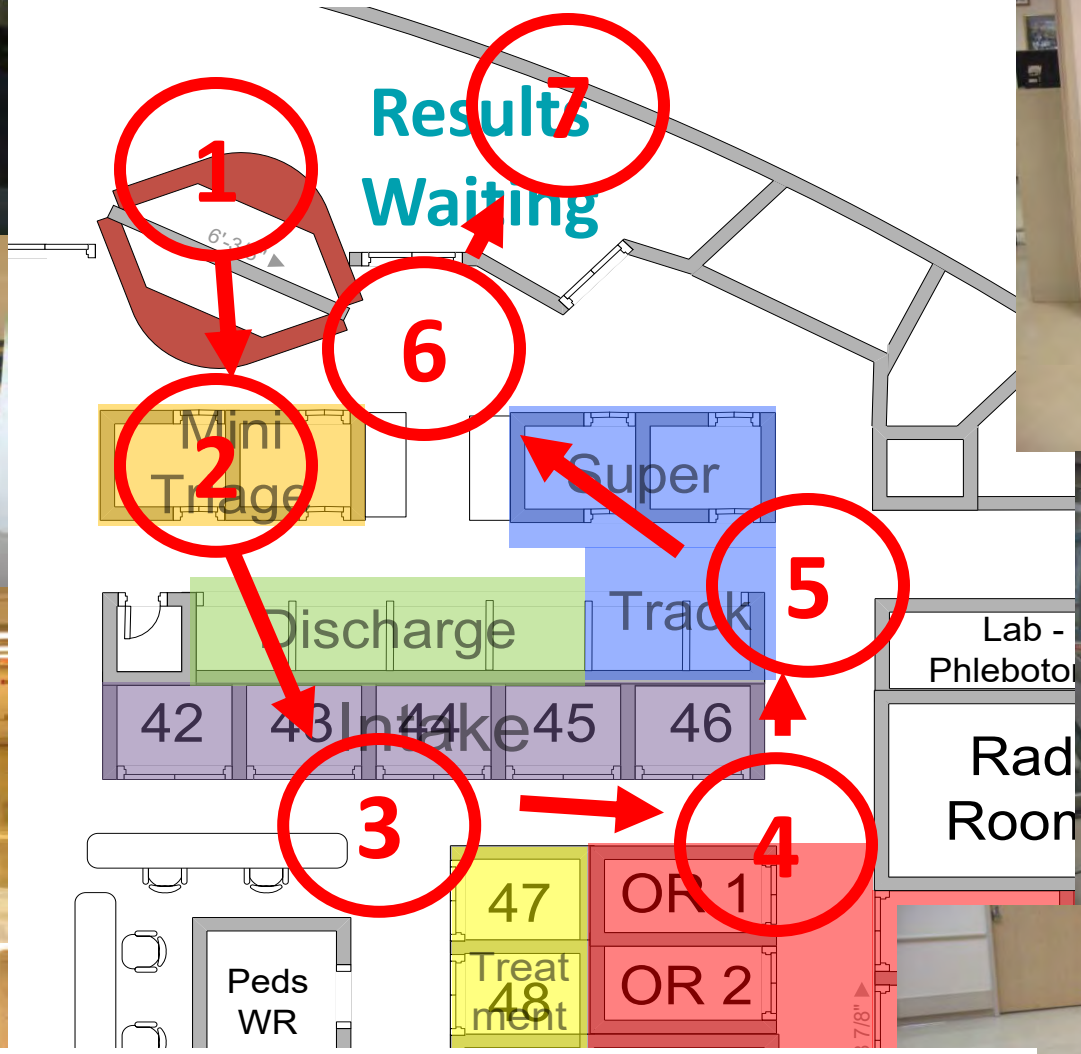
Intake Systems





1.25 x Doc 3.5 x Nurse

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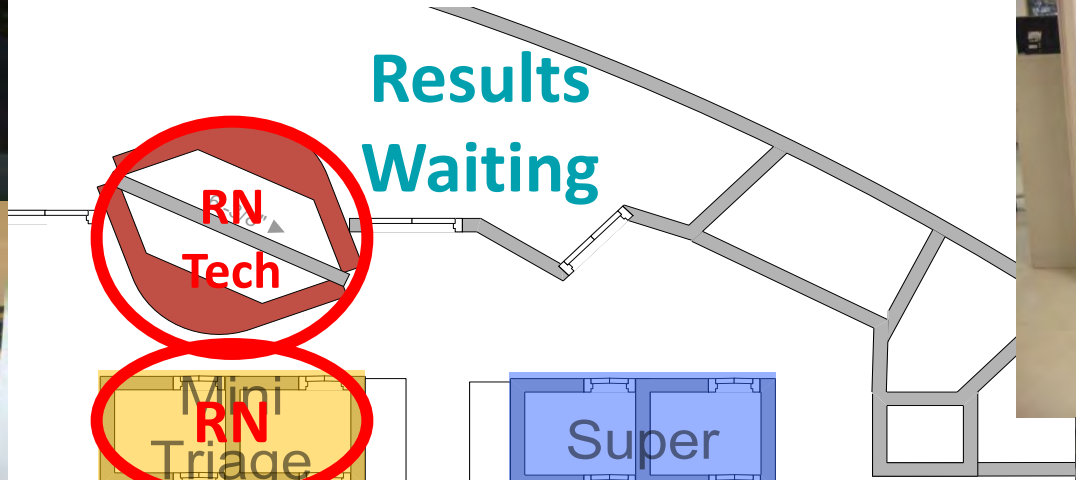
Know Your Staff Needs



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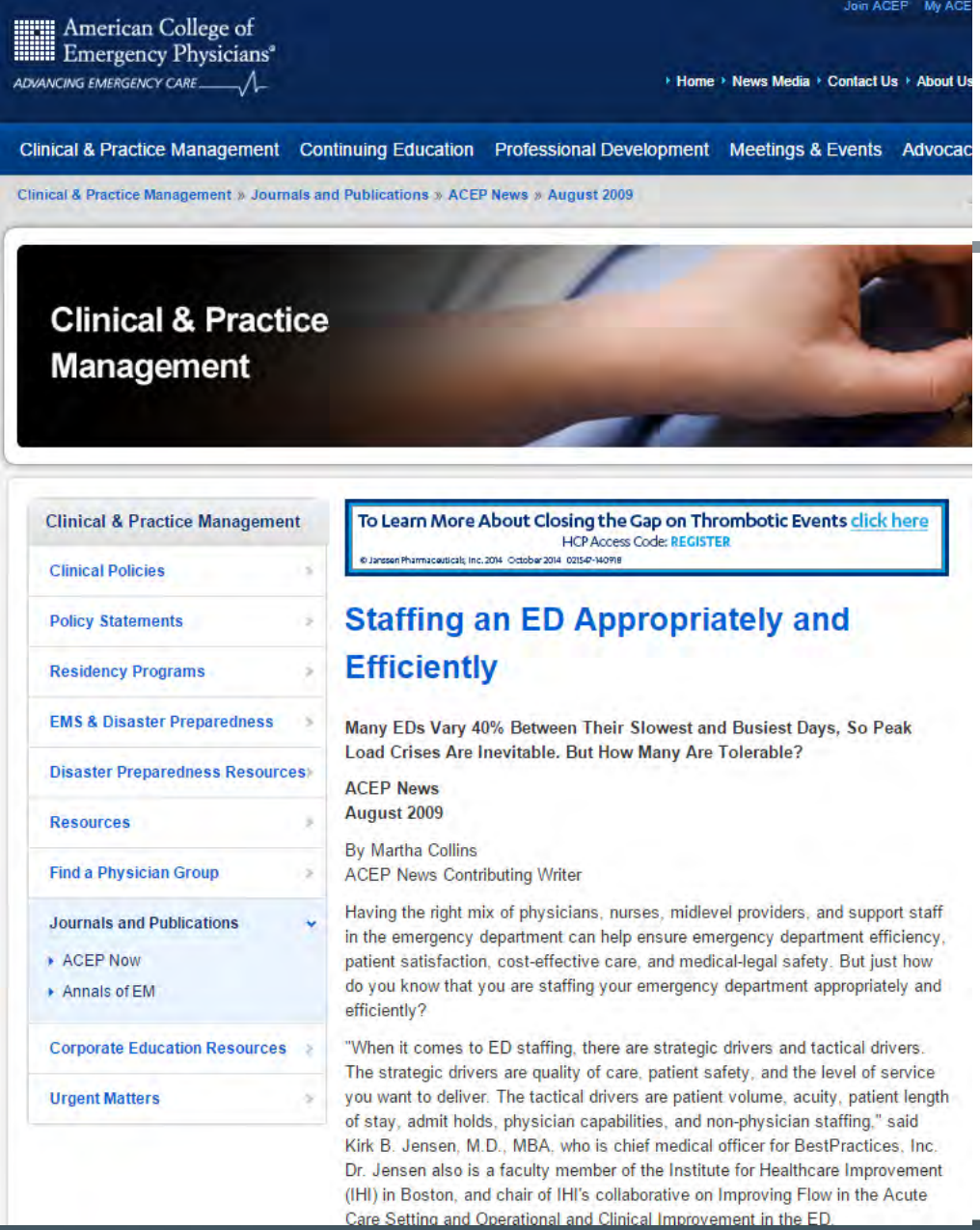

- Symptoms:
  - Elevated patient throughput times
  - High left-without-being-seen rate
  - Low patient satisfaction
  - Clinician behavior in a stressful environment
  - Low clinician satisfaction and retention
- The four key drivers of patient satisfaction:
  - Length of stay
  - Quality of the interactions with providers
  - Quality of the explanations
  - Pain management

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Outline

- Academic Principles
- Case Study – 75,000-visit ED
- Approach to Staffing Optimization
  - Define Demand
  - Define Capacity
  - Contextualize
- Conclusions

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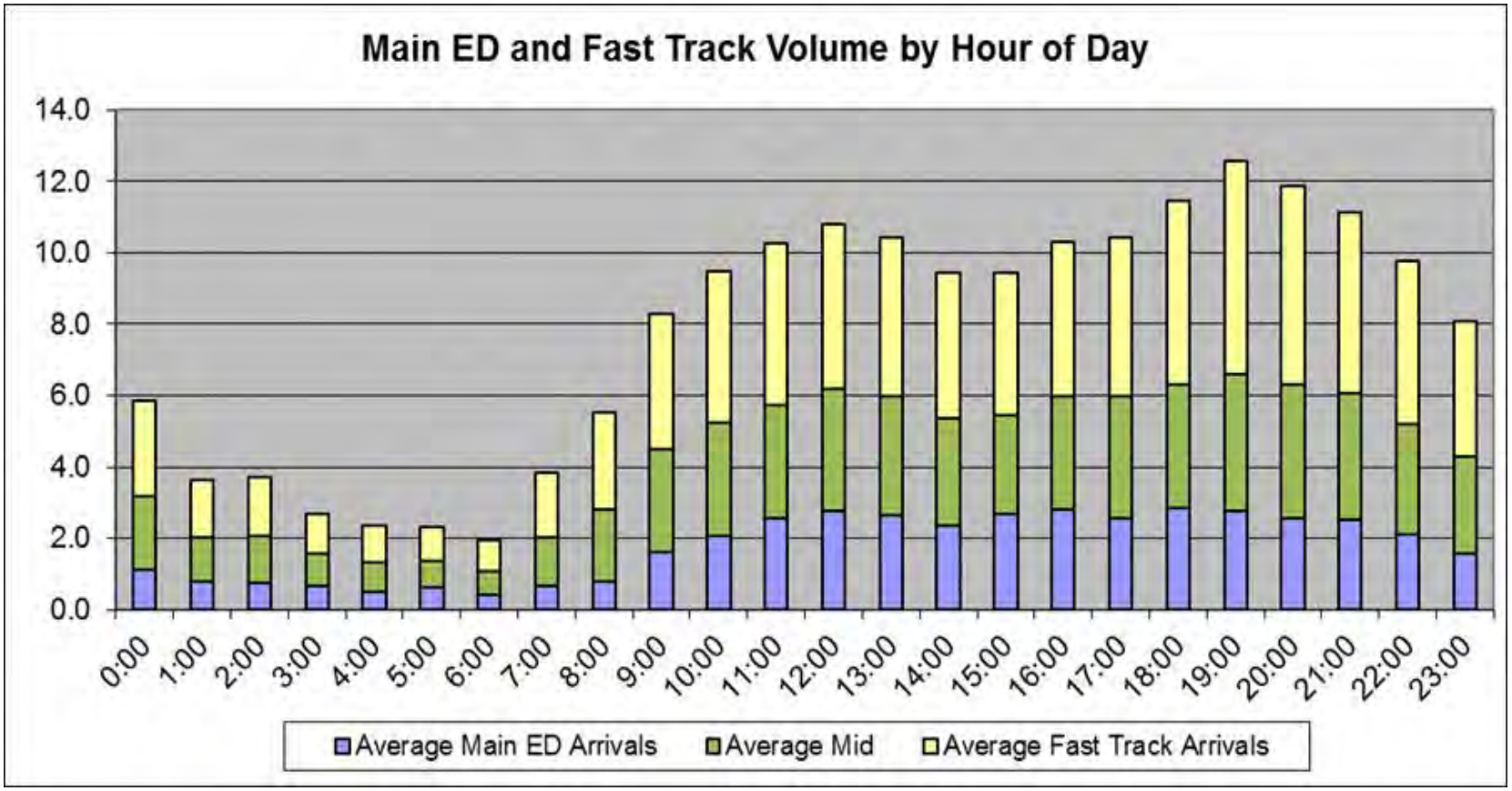
Case Study - Future Directions



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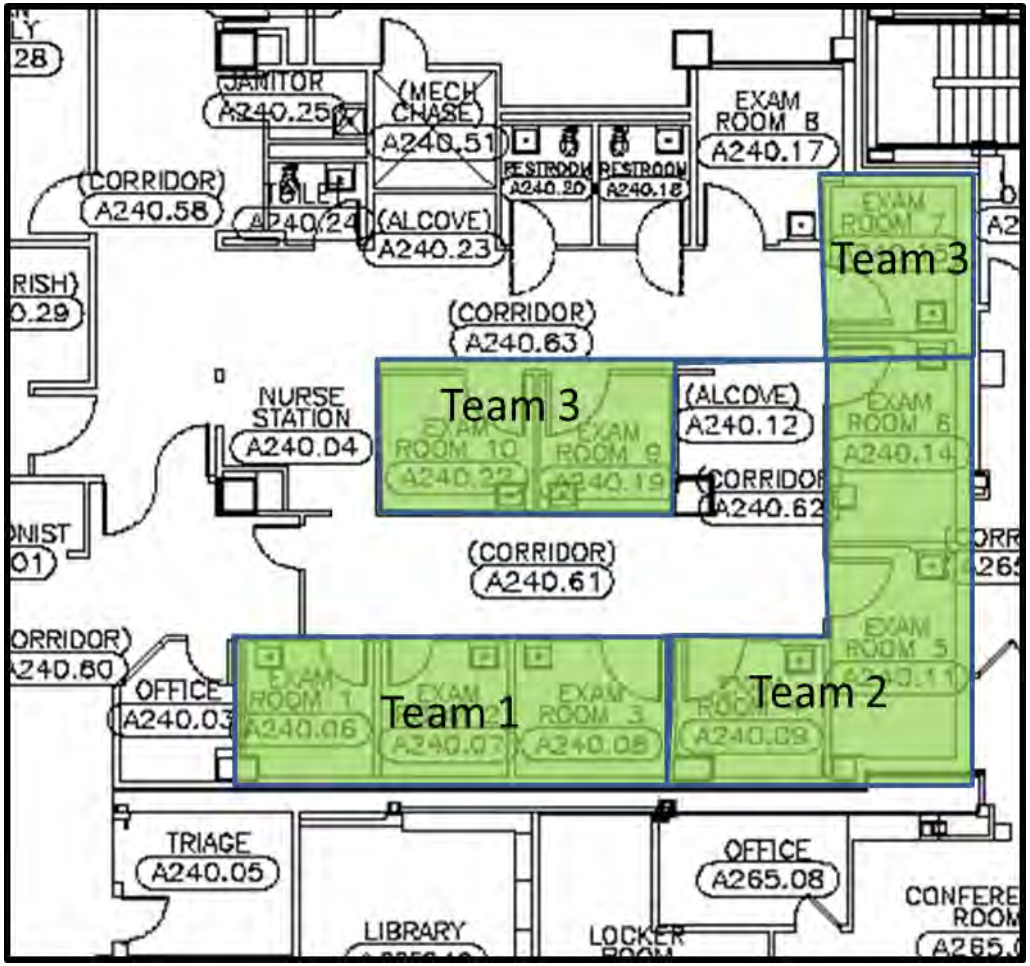
Low Acuity Option 2



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Overall Provider

Current Staffing Profile

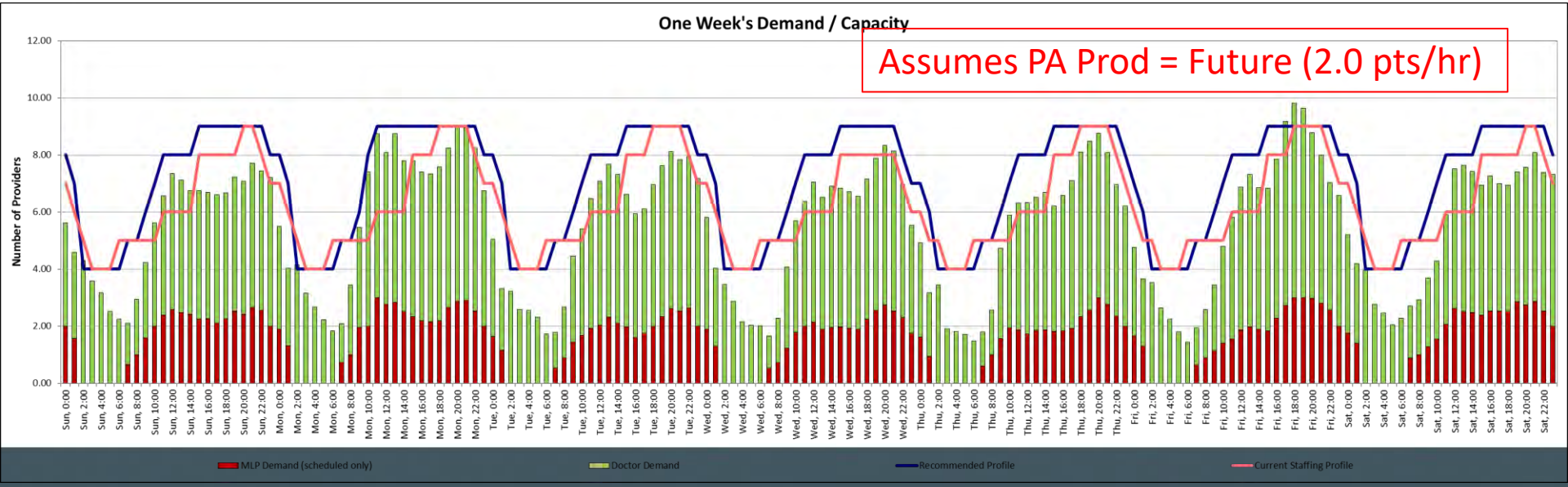
Sun	Mon	Tues	Wed	Thur	Fri	Sat
7.0	7.0	7.0	7.0	6.0	6.0	7.0
6.0	6.0	6.0	6.0	5.0	5.0	6.0
5.0	5.0	5.0	5.0	5.0	5.0	5.0
4.0	4.0	4.0	4.0	4.0	4.0	4.0
4.0	4.0	4.0	4.0	4.0	4.0	4.0
4.0	4.0	4.0	4.0	4.0	4.0	4.0
5.0	5.0	5.0	5.0	5.0	5.0	5.0
5.0	5.0	5.0	5.0	5.0	5.0	5.0
5.0	5.0	5.0	5.0	5.0	5.0	5.0
5.0	5.0	5.0	5.0	5.0	5.0	5.0
5.0	5.0	5.0	5.0	5.0	5.0	5.0
6.0	6.0	6.0	6.0	6.0	6.0	6.0
6.0	6.0	6.0	6.0	6.0	6.0	6.0
6.0	6.0	6.0	6.0	6.0	6.0	6.0
6.0	6.0	6.0	6.0	6.0	6.0	6.0
8.0	8.0	8.0	8.0	8.0	8.0	8.0
8.0	8.0	8.0	8.0	8.0	8.0	8.0
8.0	8.0	8.0	8.0	8.0	8.0	8.0
8.0	9.0	9.0	8.0	9.0	9.0	8.0
8.0	9.0	9.0	8.0	9.0	9.0	8.0
9.0	9.0	9.0	8.0	9.0	9.0	9.0
9.0	9.0	9.0	8.0	9.0	9.0	9.0
8.0	8.0	8.0	7.0	8.0	8.0	8.0
7.0	7.0	7.0	6.0	7.0	7.0	7.0
152.0	154.0	154.0	148.0	152.0	152.0	152.0
1,064.0						

Recommended Profile

Sun	Mon	Tues	Wed	Thur	Fri	Sat
8.0	8.0	8.0	8.0	7.0	7.0	8.0
7.0	7.0	7.0	7.0	6.0	6.0	7.0
4.0	4.0	4.0	4.0	4.0	4.0	4.0
4.0	4.0	4.0	4.0	4.0	4.0	4.0
4.0	4.0	4.0	4.0	4.0	4.0	4.0
4.0	4.0	4.0	4.0	4.0	4.0	4.0
4.0	4.0	4.0	4.0	4.0	4.0	4.0
5.0	5.0	5.0	5.0	5.0	5.0	5.0
5.0	5.0	5.0	5.0	5.0	5.0	5.0
6.0	6.0	6.0	6.0	6.0	6.0	6.0
7.0	8.0	7.0	7.0	7.0	7.0	7.0
8.0	9.0	8.0	8.0	8.0	8.0	8.0
8.0	9.0	8.0	8.0	8.0	8.0	8.0
8.0	9.0	8.0	8.0	8.0	8.0	8.0
8.0	9.0	8.0	8.0	8.0	8.0	8.0
9.0	9.0	9.0	9.0	9.0	9.0	9.0
9.0	9.0	9.0	9.0	9.0	9.0	9.0
9.0	9.0	9.0	9.0	9.0	9.0	9.0
9.0	9.0	9.0	9.0	9.0	9.0	9.0
9.0	9.0	9.0	9.0	9.0	9.0	9.0
9.0	9.0	9.0	8.0	9.0	9.0	9.0
8.0	8.0	8.0	7.0	8.0	8.0	8.0
170.0	175.0	170.0	168.0	168.0	168.0	170.0
1,189.0						

Change from Current

Sun	Mon	Tues	Wed	Thur	Fri	Sat
1.0	1.0	1.0	1.0	1.0	1.0	1.0
1.0	1.0	1.0	1.0	1.0	1.0	1.0
-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0
-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.0	1.0	1.0	1.0	1.0	1.0	1.0
2.0	3.0	2.0	2.0	2.0	2.0	2.0
2.0	3.0	2.0	2.0	2.0	2.0	2.0
2.0	3.0	2.0	2.0	2.0	2.0	2.0
2.0	3.0	2.0	2.0	2.0	2.0	2.0
2.0	3.0	2.0	2.0	2.0	2.0	2.0
1.0	1.0	1.0	1.0	1.0	1.0	1.0
1.0	1.0	1.0	1.0	1.0	1.0	1.0
1.0	1.0	1.0	1.0	1.0	1.0	1.0
1.0	0.0	0.0	1.0	0.0	0.0	1.0
1.0	0.0	0.0	1.0	0.0	0.0	1.0
0.0	0.0	0.0	1.0	0.0	0.0	0.0
0.0	0.0	0.0	1.0	0.0	0.0	0.0
1.0	1.0	1.0	1.0	1.0	1.0	1.0
1.0	1.0	1.0	1.0	1.0	1.0	1.0
18.0	21.0	16.0	20.0	16.0	16.0	18.0
125.0						



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Overall Nursing

Current Staffing Profile

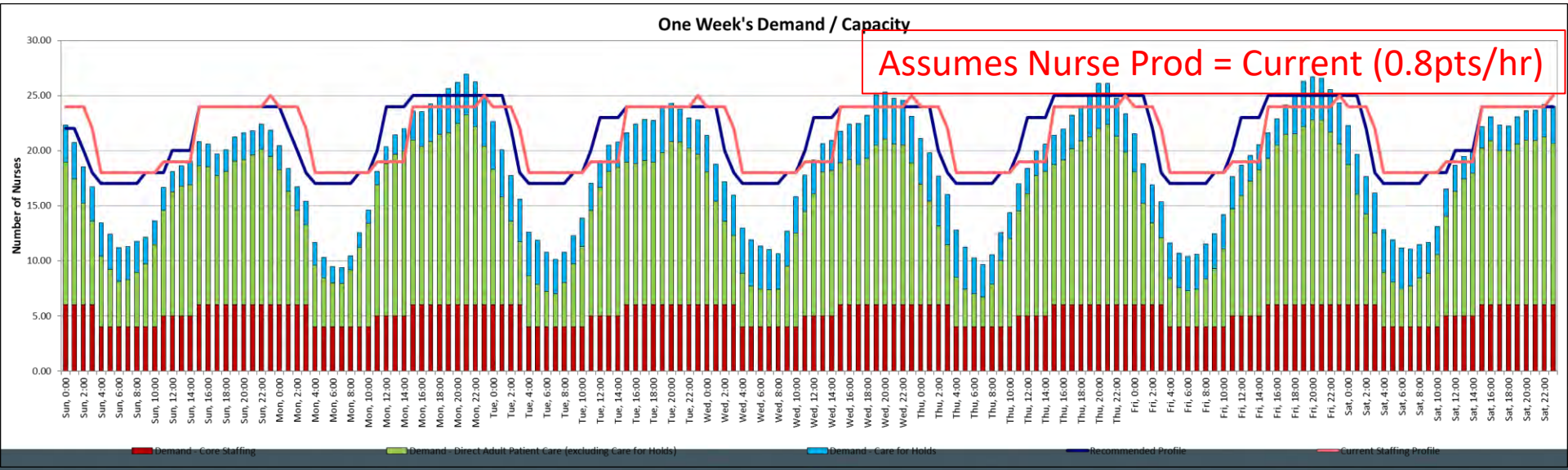
Sun	Mon	Tues	Wed	Thur	Fri	Sat
24.0	24.0	24.0	24.0	24.0	24.0	24.0
24.0	24.0	24.0	24.0	24.0	24.0	24.0
24.0	24.0	24.0	24.0	24.0	24.0	24.0
22.0	22.0	22.0	22.0	22.0	22.0	22.0
18.0	18.0	18.0	18.0	18.0	18.0	18.0
18.0	18.0	18.0	18.0	18.0	18.0	18.0
18.0	18.0	18.0	18.0	18.0	18.0	18.0
18.0	18.0	18.0	18.0	18.0	18.0	18.0
18.0	18.0	18.0	18.0	18.0	18.0	18.0
18.0	18.0	18.0	18.0	18.0	18.0	18.0
19.0	19.0	19.0	19.0	19.0	19.0	19.0
19.0	19.0	19.0	19.0	19.0	19.0	19.0
19.0	19.0	19.0	19.0	19.0	19.0	19.0
19.0	19.0	19.0	19.0	19.0	19.0	19.0
24.0	24.0	24.0	24.0	24.0	24.0	24.0
24.0	24.0	24.0	24.0	24.0	24.0	24.0
24.0	24.0	24.0	24.0	24.0	24.0	24.0
24.0	24.0	24.0	24.0	24.0	24.0	24.0
24.0	24.0	24.0	24.0	24.0	24.0	24.0
24.0	24.0	24.0	24.0	24.0	24.0	24.0
24.0	24.0	24.0	24.0	24.0	24.0	24.0
24.0	24.0	24.0	24.0	24.0	24.0	24.0
25.0	25.0	25.0	25.0	25.0	25.0	25.0
513.0	513.0	513.0	513.0	513.0	513.0	513.0
3,591.0						

Recommended Profile

Sun	Mon	Tues	Wed	Thur	Fri	Sat
22.0	24.0	25.0	24.0	24.0	25.0	25.0
22.0	22.0	25.0	24.0	24.0	25.0	25.0
20.0	20.0	22.0	20.0	20.0	22.0	22.0
18.0	18.0	18.0	18.0	18.0	18.0	18.0
17.0	17.0	17.0	17.0	17.0	17.0	17.0
17.0	17.0	17.0	17.0	17.0	17.0	17.0
17.0	17.0	17.0	17.0	17.0	17.0	17.0
17.0	17.0	17.0	17.0	17.0	17.0	17.0
17.0	17.0	17.0	17.0	17.0	17.0	17.0
18.0	18.0	18.0	18.0	18.0	18.0	18.0
18.0	18.0	18.0	18.0	18.0	18.0	18.0
18.0	20.0	20.0	20.0	20.0	20.0	18.0
20.0	24.0	23.0	23.0	23.0	23.0	20.0
20.0	24.0	23.0	23.0	23.0	23.0	20.0
20.0	24.0	23.0	23.0	23.0	23.0	20.0
24.0	25.0	24.0	24.0	25.0	25.0	24.0
24.0	25.0	24.0	24.0	25.0	25.0	24.0
24.0	25.0	24.0	24.0	25.0	25.0	24.0
24.0	25.0	24.0	24.0	25.0	25.0	24.0
24.0	25.0	24.0	24.0	25.0	25.0	24.0
24.0	25.0	24.0	24.0	25.0	25.0	24.0
24.0	25.0	24.0	24.0	25.0	25.0	24.0
24.0	25.0	24.0	24.0	25.0	25.0	24.0
24.0	25.0	24.0	24.0	25.0	25.0	24.0
497.0	522.0	516.0	512.0	521.0	525.0	505.0
3,598.0						

Change from Current

Sun	Mon	Tues	Wed	Thur	Fri	Sat
-2.0	0.0	1.0	0.0	0.0	1.0	1.0
-2.0	-2.0	1.0	0.0	0.0	1.0	1.0
-4.0	-4.0	-2.0	-4.0	-4.0	-2.0	-2.0
-4.0	-4.0	-4.0	-4.0	-4.0	-4.0	-4.0
-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0
-1.0	1.0	1.0	1.0	1.0	1.0	-1.0
1.0	5.0	4.0	4.0	4.0	4.0	1.0
1.0	5.0	4.0	4.0	4.0	4.0	1.0
1.0	5.0	4.0	4.0	4.0	4.0	1.0
0.0	1.0	0.0	0.0	1.0	1.0	0.0
0.0	1.0	0.0	0.0	1.0	1.0	0.0
0.0	1.0	0.0	0.0	1.0	1.0	0.0
0.0	1.0	0.0	0.0	1.0	1.0	0.0
0.0	1.0	0.0	0.0	1.0	1.0	0.0
0.0	1.0	0.0	0.0	1.0	1.0	0.0
0.0	1.0	0.0	0.0	1.0	1.0	0.0
0.0	1.0	0.0	0.0	1.0	1.0	0.0
-1.0	0.0	-1.0	-1.0	0.0	0.0	-1.0
-16.0	9.0	3.0	-1.0	8.0	12.0	-8.0
7.0						



Sched Summ

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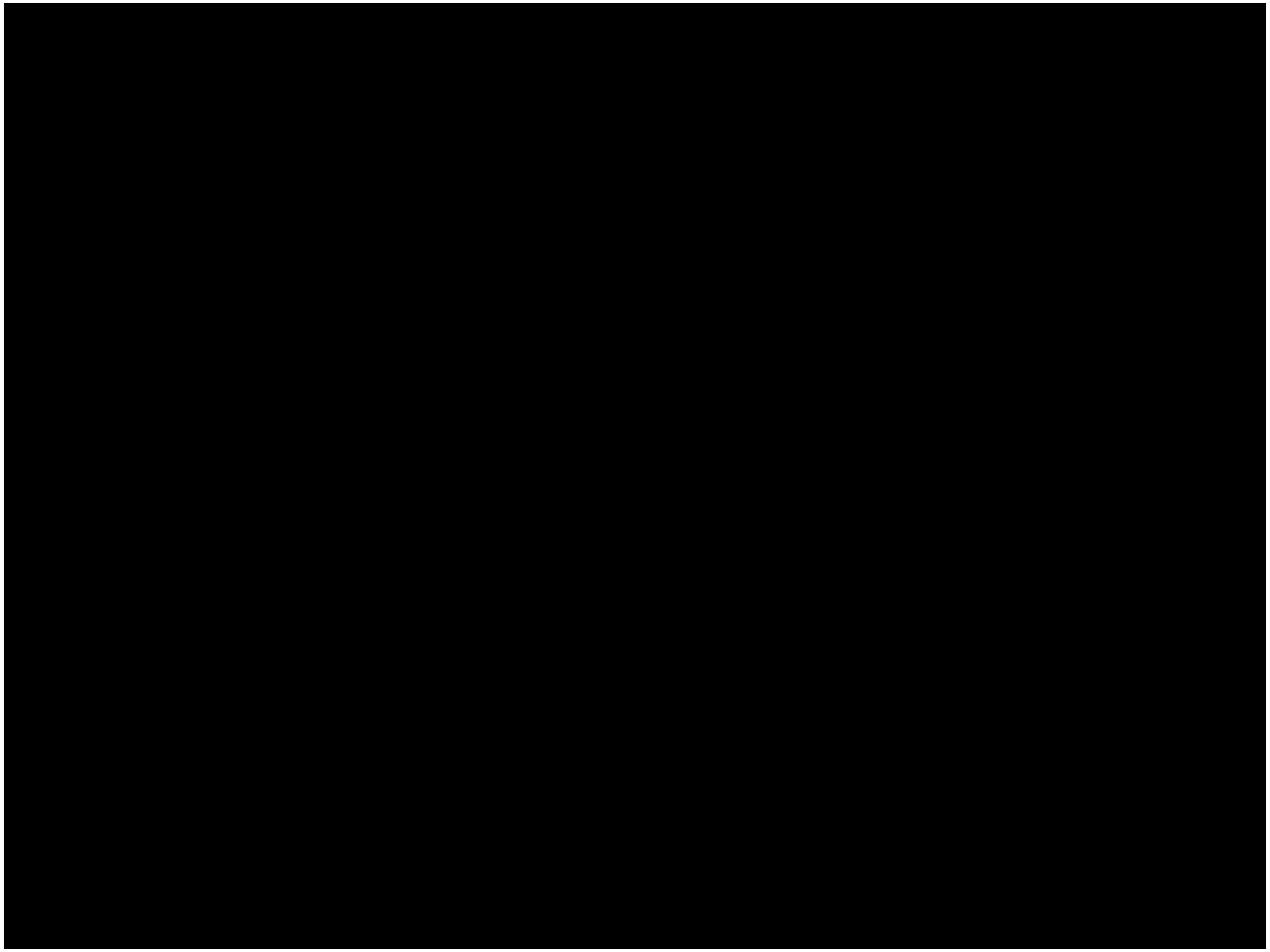
What Are You Sinking About?



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Conclusions

- Optimizing staffing in the emergency department requires understanding core flow concepts like queuing theory and the theory of constraints
- An accurate assessment of demand, capacity, and variation is necessary to be successful
- A consistent approach to staffing is necessary to achieve consistent results
- Physician staffing cannot be looked at in isolation and must be contextualized relative to nurse staffing, bed constraints, physical space, skill mix and acuity mix

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