

The presenters have nothing to
disclose

Engineering Patient Flow: *Theory, Metrics & Application*

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Basic Principles: Setting Up a Program

- Leadership
- Set a vision
- Look at every process critically
- Goal: Better for patients- easier for staff
- Involve frontline staff
- Continuous improvement
- Open data with clear metrics
- Have fun!

Case Study In One ED: Kaiser South Sacramento



Performance: Oncoming Disaster!



Kaiser South Sacramento ED

Became a County Hospital for Sacramento

- Busiest ED In Sacramento
- Kaiser Facility
- Serves mixed payer/socioeconomic population (almost 40% Medi-Cal/Uninsured)
- Level 2 Trauma Center
- UC Davis ED residency teaching
- On pace for 130,000 visits
- Continuous volume grown annually

Space Constrained

- 46 Official ED bays
- Lost 2 for Trauma
- 4 were dedicated to psych
- Over 3200 patients per ED bay!



Past State



Prior Baseline Data

- 450 hours of diversion annually
 - LWOT rates 6.6% on average, but over 12% some months
 - Average door to doctor: 55 minutes
 - Total time in ED on average
 - 4 ½ hours for discharged patients
 - 8 hours for admitted patients
 - But...wide variability day to day with much longer times some days
- In general... we never knew what was coming or how to prepare for it!***

MD perspective

- May work a 12 hour shift and only see 8 patients with 30 or more patients in the waiting room
- Poor flow made it impossible to see patients
- Doctors were frustrated, complaining to administration about ED function
- Patients angry, staff angry, chaos!
- Unnecessary tests ordered



For patients

- Waits for hours to see a doctor
- 30-40 patients in the waiting room every night at 11pm
- Calls to “see if I could get them in quicker”



The crisis was coming...

- Volume increases from 67,000 to 130,000
- Trauma center initiated
- County psychiatric failures
- Hospital space constraints: 180 IP beds



Worried it could happen here...

Sacramento girl needed amputations after 5-hour wait at emergency room

By Cynthia Hubert
chubert@sacbee.com

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Published: Friday, Dec. 31, 2010 - 12:00
am | Page 1B

Last Modified: Sunday, Feb. 13, 2011 - 2:16 pm

As his tiny daughter's skin turned blotchy and her body went limp during a lengthy wait at Methodist Hospital's emergency room, Ryan



Jeffers family

Malvia Jeffers. 2. has Streptococcus A. which has led to

After Improvement State



After Improvement State

- Time to Physician 19 minutes
- LWOT: 0.4% all of last year
- Diversion hours: ***Zero!***
- Length of Stay Down
 - ESI Level 4,5: 43 minutes
 - Discharged patients: 2 hours 9 minutes

After Improvement: Patient Side

- March, 2011: Typical ED day
- 3 year old girl, brought in by mom...vomiting and diarrhea for 3 days, no fever
- Quickly evaluated by MD who said she “just doesn’t look right”
- LP showed >7000 white cells, culture grows out meningococcus



Dr. Cooke ✓

Just thought we would
send you an update. Thanks
to you Savannah beat
Meningitis 100%. She went
last may for her year check
up and she is perfect!!
Enclosed is her 5 year old
picture. She starts kindergarten
in the fall. I will always
be grateful to you because
without you my life could
have been very different.

Thank you

Kirsten Barron

Recap

Measure	Before	After
Hours on Divert per year	450	0
Percent LWOBS	6.6%	0.4%
Door-to-Doc (minutes)	55	19
LOS – Treat & Release (hours)	4.5	2.4

So, how is it possible to go from Before to After?

How to get started?

- Two key elements:

- ***Process***



- ***Culture***



Principle #1: Create a Vision

- “Our Vision is to be the best Emergency Department in America”
- “Our patients do not wait”

This vision was developed when we were terrible!

Created cultural change over time...

- Worked to empower all employees to own the change and think about process improvement in their everyday life.
- Told all new hires... “if you don’t like change you probably don’t want to work here”
- Gave all physicians leadership books and challenged them to do projects that would help the department
- Is precedent- Toyota got over 80,000 suggestions from employees and implemented 99% of them.
- Easier said than done!

Principle #2: Decrease Length of Stay

- **Key Principles:**

- Small reductions in service time can really make an impact in times of high utilization
- Decreasing length of stay is the most key metric for dramatic improvement quickly



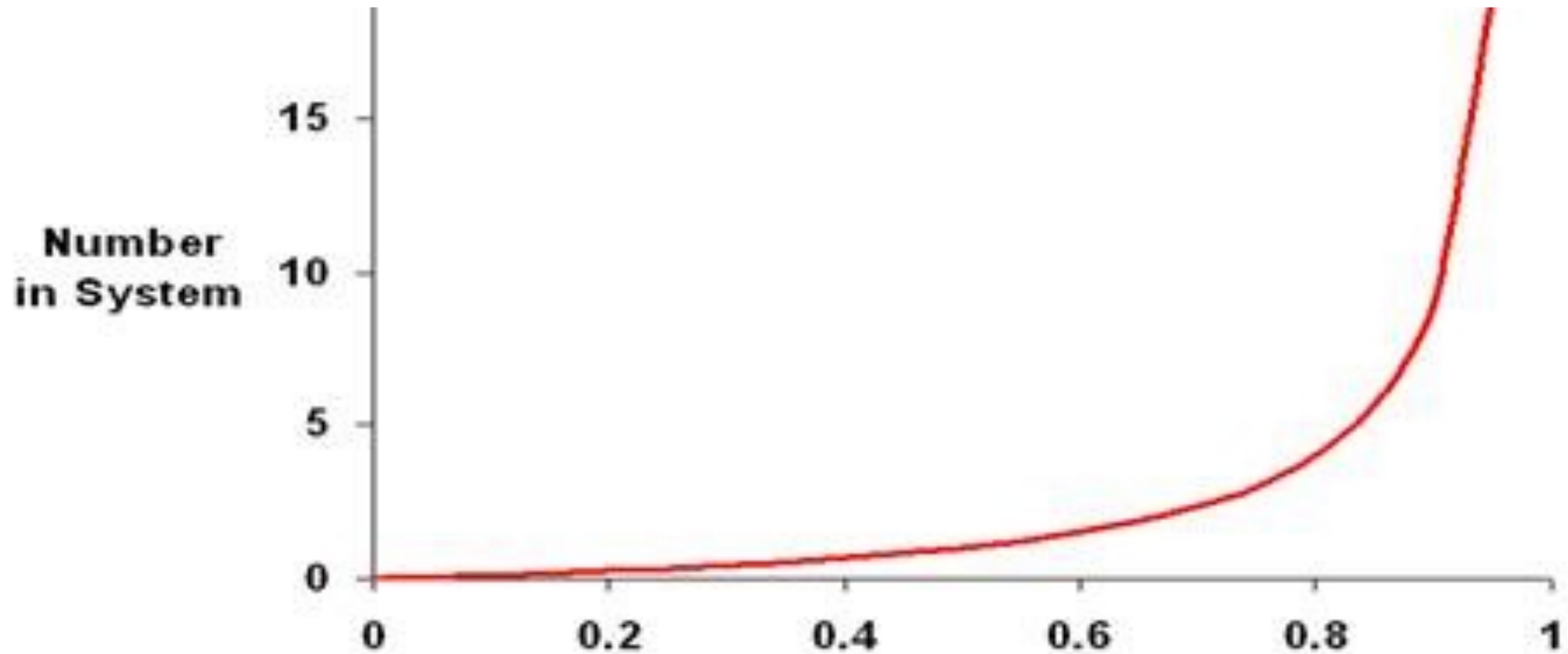
Only three ways to create capacity!



-
- **Decrease length of stay**
 - **Decrease arrivals**
 - **Increase capacity**

Focus on decreasing length of stay and decreasing arrivals to high acuity beds...

Remember this graph...



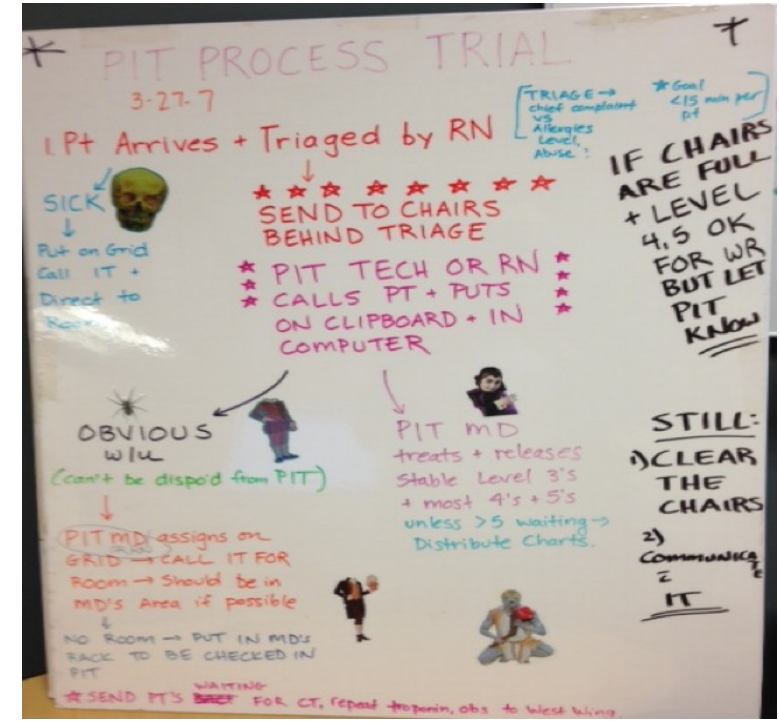
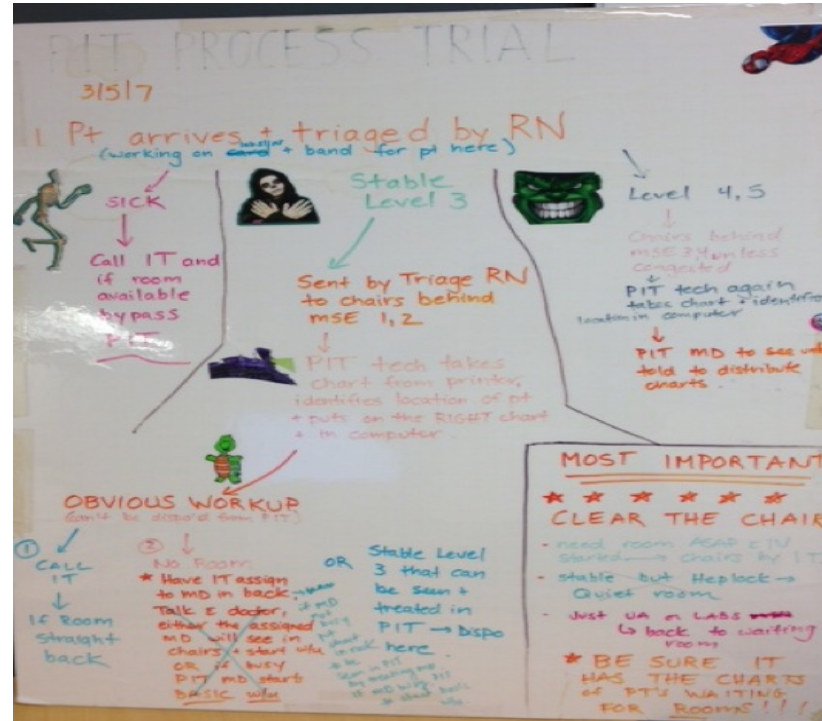
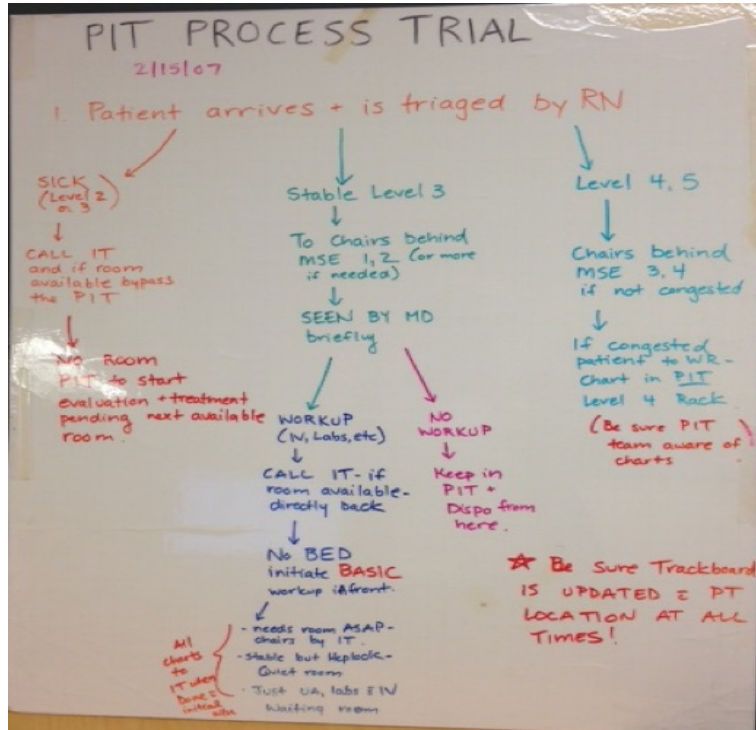
Principle #3: Optimize working conditions

- Look at every system: make it better for patients, but ***easier for people doing the work***
- Ask people to think outside of the box
- Training in Lean operations or bring in an expert to help

Example: Low Acuity Flow: Triage

- Remember, a “non-value added” necessity in many cases
- Eliminate when possible
- Directly pull into an area: if you guessed wrong just shift the patient!
- 90% of the time, first impression is the right one

Example: Low Acuity Flow Project



Example: Low Acuity Flow

- Think about things in a new way
- Low acuity patients can be “**triaged to home**” (see a provider quickly, get all care done, and go home)
- Clears the waiting room quickly and creates capacity for high acuity patients



How many patients waited for a bed?

Example: low acuity flow principles

- Small constrained area
- Well defined teams that work well together
- “One Contact” as much as possible
- Minimize movement
- Uniform work stations & stocking



Flow Prior To Changes

Flow was controlled by the IT RN. Same MD could own patients on opposite sides of the ED!

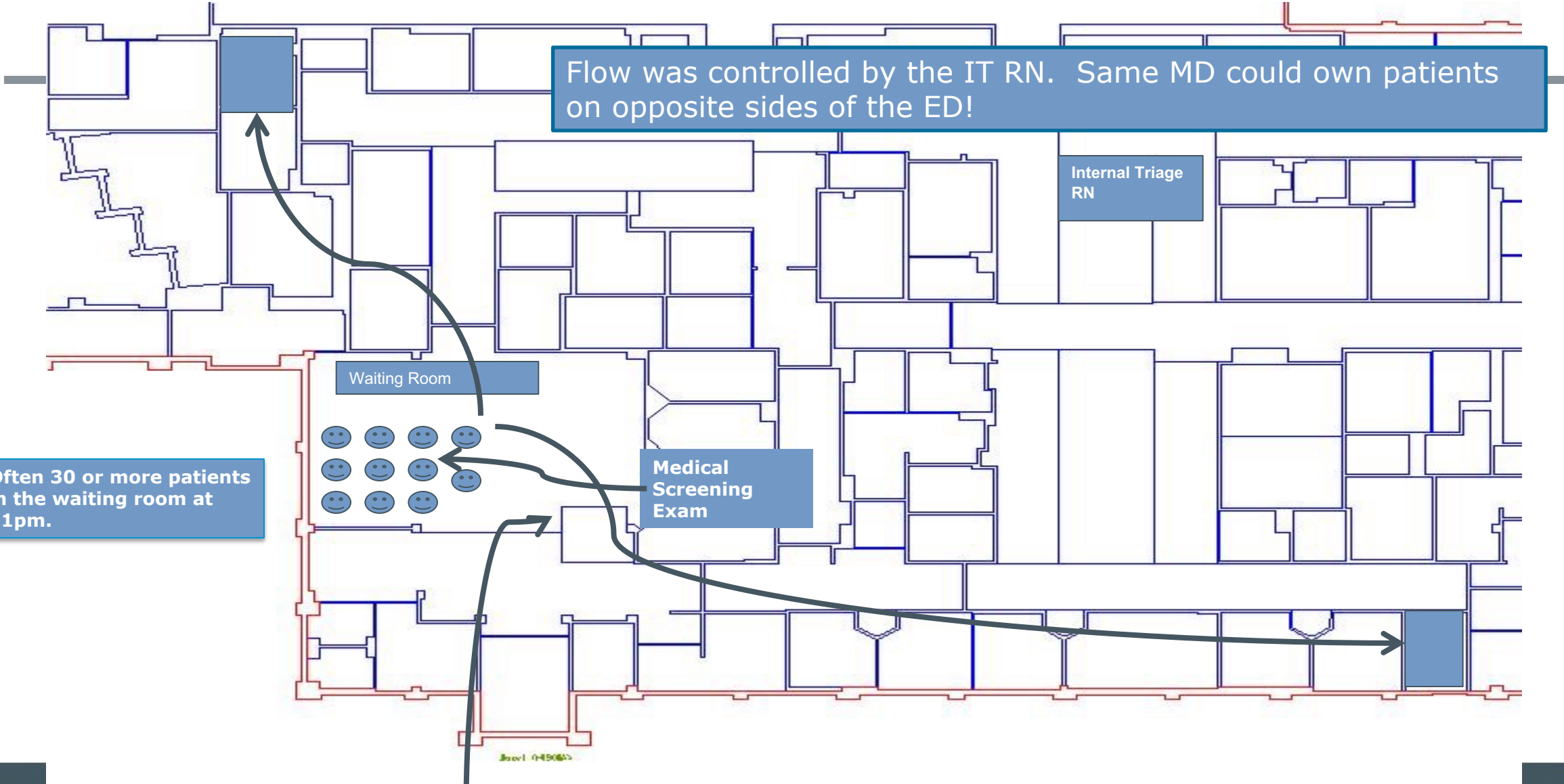
Internal Triage RN

Waiting Room

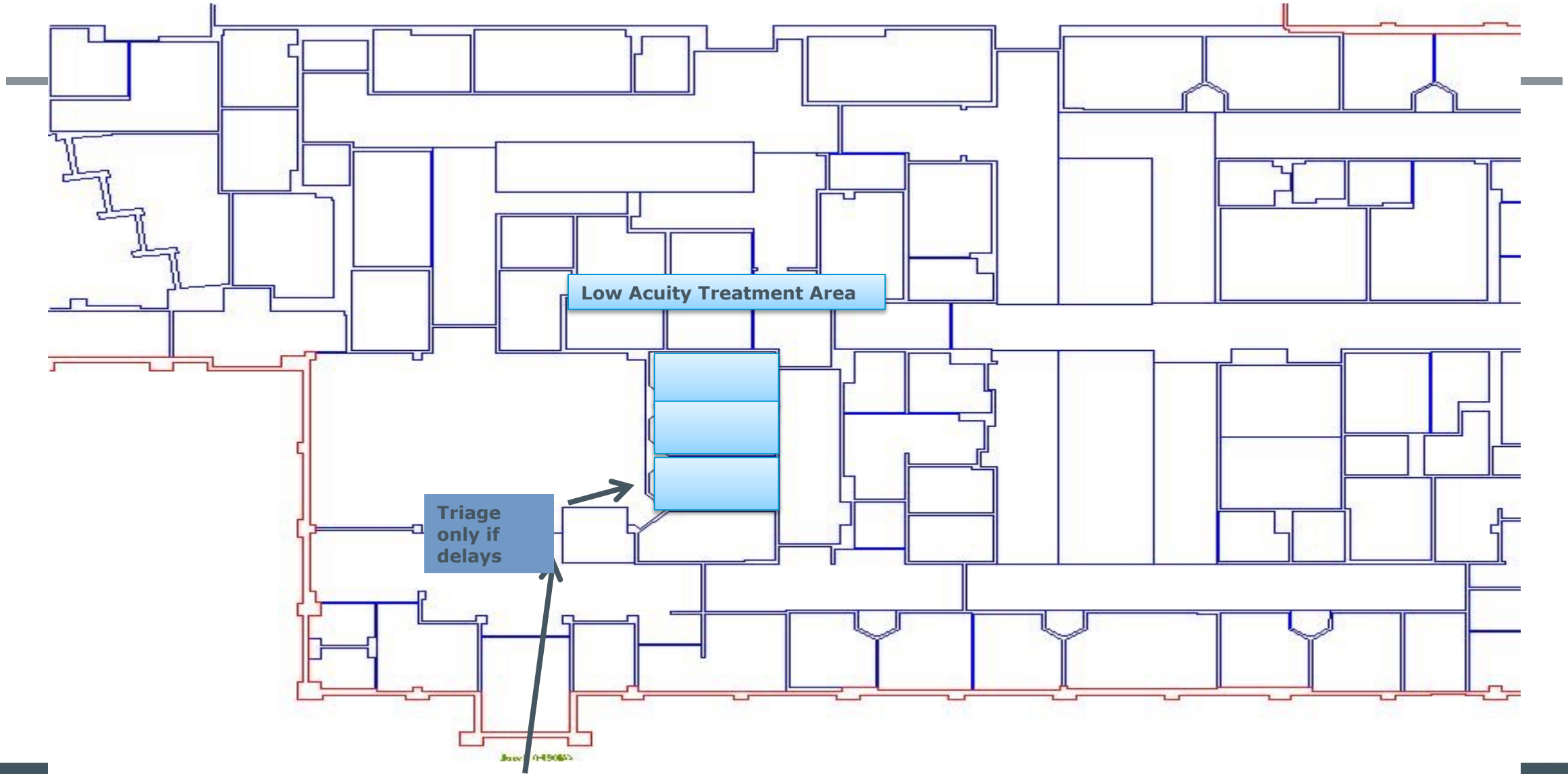
Medical Screening Exam

Often 30 or more patients in the waiting room at 11pm.

Patient Arrives



Low Acuity Flow



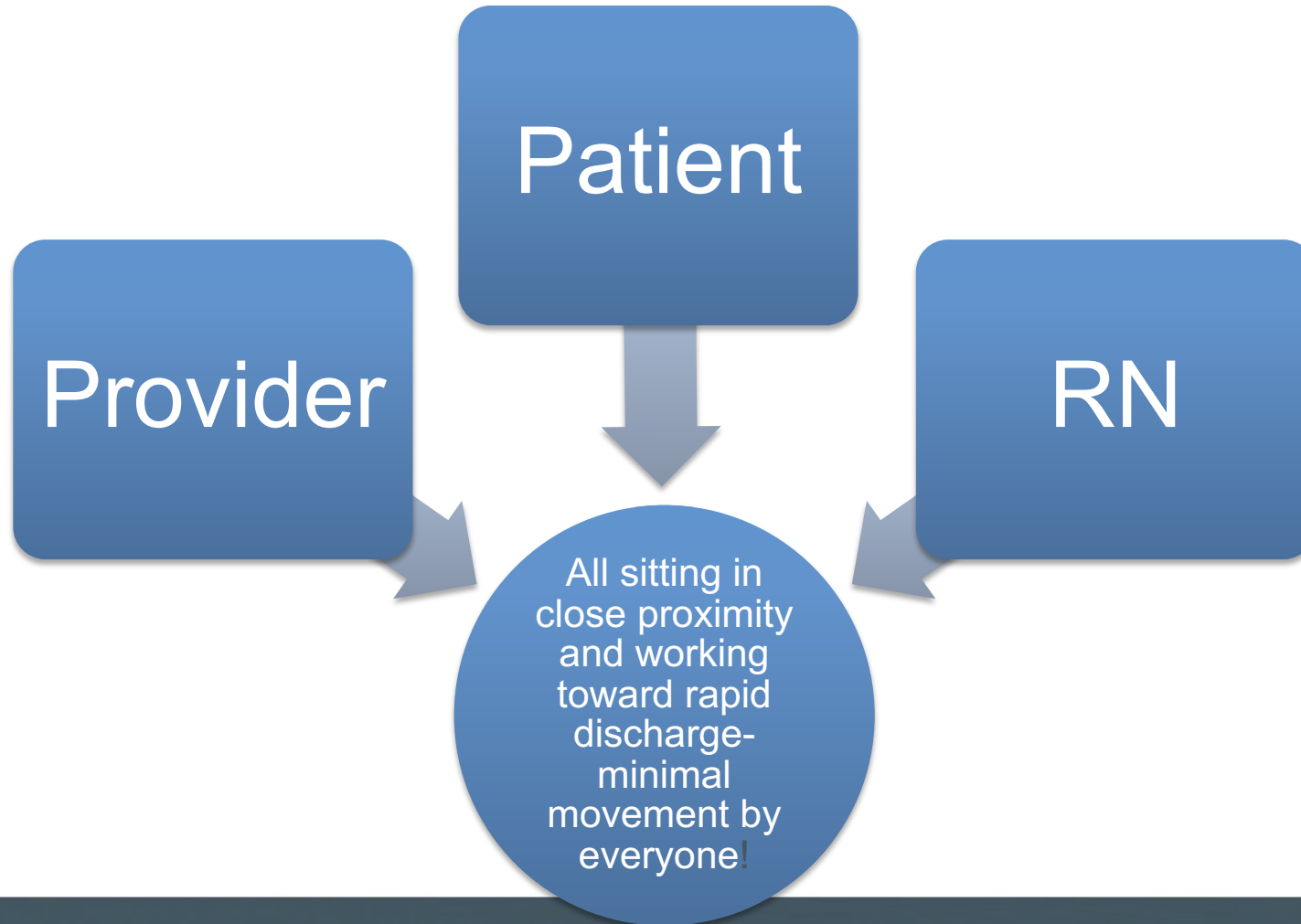
Patient Arrives

Example Low Acuity (Video)



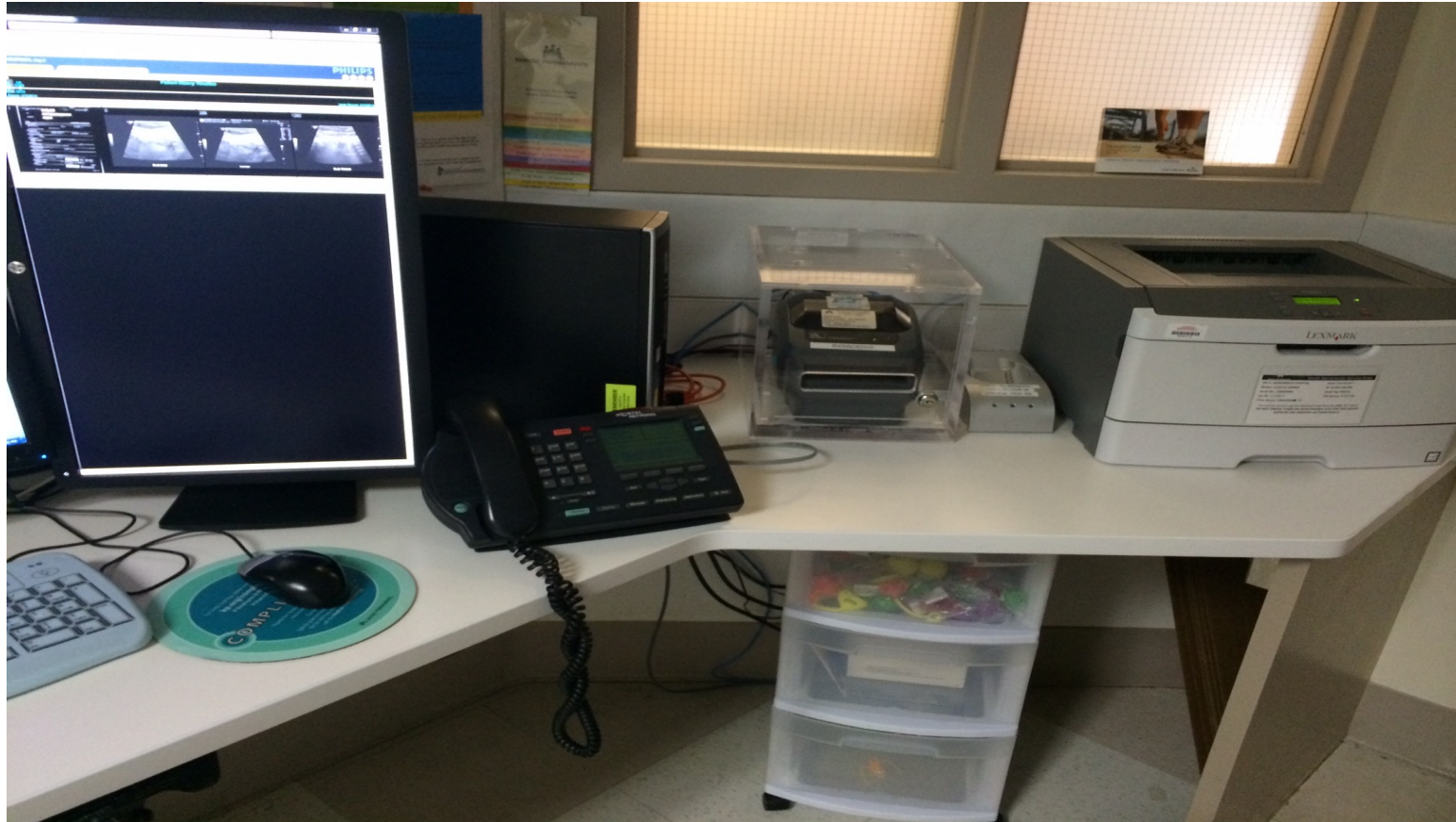


Example: Low Acuity Flow

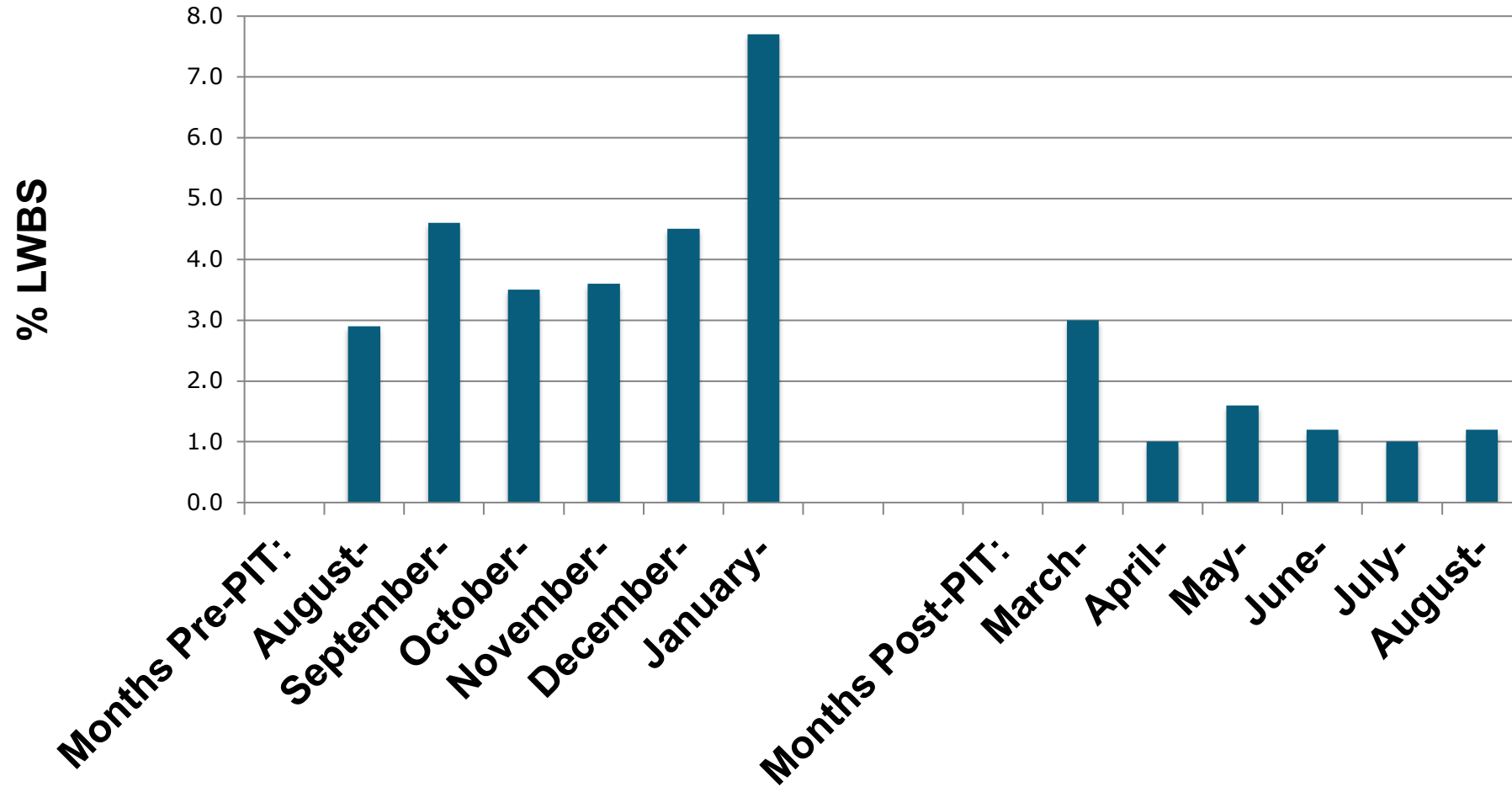




Example: Low Acuity Flow



Immediate Results



Principle #4: The Discharging Provider

- Get patients in front of the **discharging** provider as soon as possible
- Place customized orders designated by the provider who “owns” the patient
- If you use an initial provider to “start” orders ask yourself:
 - How many patients had to go back for additional testing
 - Did the process decrease your total length of stay or increase your patient satisfaction scores? Don’t use just to make a “door to doctor” metric

Principle #5: Segmentation

- **High volume ED: different patient streams based on acuity**

- Low

- Medium

- High

*-All with very clear & **different** workflows with the goal of decreasing length of stay to create capacity.*

*-Treat as many patients **vertically** as possible to create bed capacity*

Principle #5: Segmentation

- Set different productivities for providers in each area
- Example:
 - High acuity: about 2 per hour
 - Mid acuity: about 2.5-3 per hour
 - Low acuity: 3-4 per hour
- This will allow you to create your staffing model as well

Principle #5: Segmentation

- Segment healthy patients who need more testing
- Consider old habits: does the patient need an IV?
- Goal to save high acuity beds in the main ED
- Patients like it better, improves the system

The primary reason to treat patients vertically is to preserve the high acuity beds in the Main ED for sicker patients

Key Points:

KEEP VERTICAL PATIENTS VERTICAL!

- PO meds instead of IV meds: patients like it better!
- Never change your diagnostics
 - Partner with radiology to eliminate contrast
 - Have a phlebotomist if possible
- Results waiting room for patients who need testing
- Partner with the Main ED if more treatment or admission is needed

Patient Examples: no one in extremis!

- Abdominal pain
- Back pain- <40 years
- Chest pain-< 30 years
- DVT rule out
- Flank pain-<40 years
- Headache with migraine history
- Pelvic pain (stable r/o ectopic)
- Pediatric fever over 6 months
- Gastroenteritis

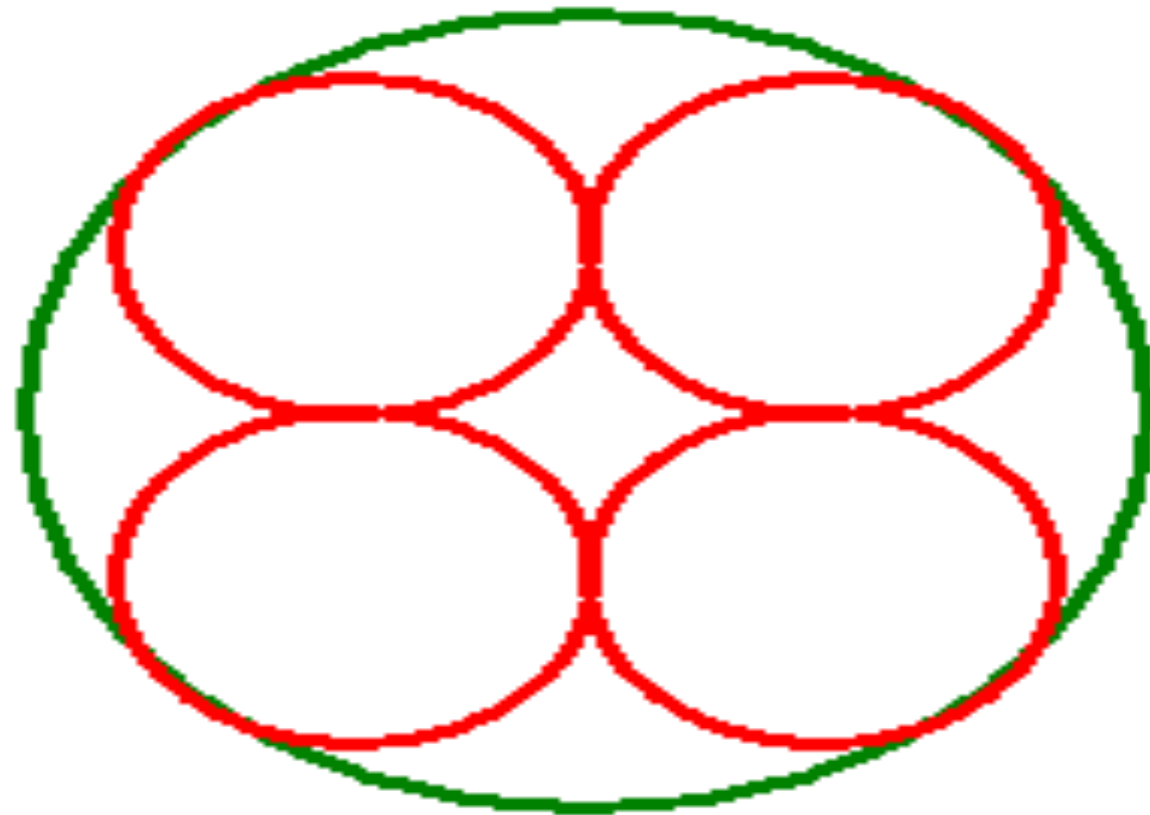


Can adjust based on your patient arrivals. Many patients can be treated this way!

Principle #6: Own the Waiting Room



Need to make the main ED more manageable in large ED's...



Consider Main ED Teams

Teams of doctors and nurses sitting together minimizes movement, improves communication, balances workload



One Option: Assignment System

- Assign patients are assigned to a team in the main ED ***on arrival!***
- This creates ownership for patients and decreases time to MD dramatically
- Care Teams like it because they are front loaded with patients, then tapered at the end of their shift

Team Assignment System



Sacramento Care Model Improves Multiple ED Operations Metrics in a High-Volume ED

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ABSTRACT

Description: Sentara Leigh Hospital, a 70,000+ visit Emergency Department in Norfolk, VA, developed and implemented a care delivery model based on lessons learned from a Kaiser Sacramento-based Emergency Department. After introduction through an IHI Patient Flow conference, Sentara Healthcare began collaboration with the Kaiser ED Leadership team to learn from their recognized best practice model for high volume ED patient flow based on LEAN concepts. Sentara Leigh took key concepts from the Sacramento care model to develop a six phase implementation plan. This plan includes team and acuity based zoned care, rotational assigned patient flow utilizing a cloud based software system or PASS, demand capacity matching nursing and provider resources into zoned teams, minimizing front-end care prior to team evaluation, and synchronized nursing and provider work. Sentara Leigh was able to convert ED operations to this new model over a three-month period.

Results: During 2016, Sentara Leigh Hospital treated 70,497 patients versus 67,890 in 2015. The median treat and release time in 2015 was 198 median minutes, in the first 3 months of 2016 was 219 median minutes, and in the last 3 months of 2016 after full implementation it was 143 median minutes. Treat and admit times in 2015 were 376 median minutes, first half of 2016 were 336 median minutes, and after full implementation were 316 minutes. LWBS was 1.2% in 2015, in the first 6 months of 2016 was 1.1%, and in the last 3 months of 2016 after full implementation was 0.4%. LRTC was 3.4% in 2015, 3.7% in first 6 months of 2016, and 1.4% after full implementation. Treat and release times for ESI 4/5 patients improved from 118 median minutes to 67 median minutes after implementation of the Fast track/synchronized work process. Treat and release times for ESI 3 patients improved from 214 median minutes to 169 median minutes after implementation of focused care teams. Treat and release times for ESI 1/2 patients improved from 291 minutes to 242 median minutes after implementation of acute care teams. Door to provider improved from 48 minutes to 22 minutes after initiation of team assignment system software, PASS sm. Door to triage improved from 2015 baseline of 7 median minutes to 1 median minute after PIVOT. Volume increased after full implementation from 183 patients per day to 200 patients per day despite volume losses at similar Sentara ED's in the region. Early trends show reduction in lab and radiology testing per patient compared to baseline which we feel is due to elimination of pre-emptive testing. Sentara Leigh is a space constrained facility that saw 5,14 visits per square foot and 2,400 visits per bed in 2016.

Lessons Learned: The Sacramento patient flow model is a novel approach to emergency medicine operations based on LEAN concepts. Core components include a no-wait culture, ownership of patient flow through team assignments and load balancing using the Patient Assignment and Sorting System (PASS sm), a three acuity zoned and modular team care approach, eliminating waste and unneeded front end care, and the concept of synchronized work. Several aspects of the model, such as eliminating all pre-emptive testing, nurses and providers assessing patients simultaneously, and using cloud based rotational assignment software through PASS sm, to route and assign patients, are not commonly used in ED operations. Placing providers and nurses in small teams and using acuity based care zones increases efficiency and ownership of patients. The successes at several Kaiser Sacramento EDs were reproducible at Sentara Leigh. Sentara Healthcare believes this care model can succeed at all high volume ED's and produce similar gains. Furthermore, it can be installed in a modular fashion. Sentara will begin a 12-month period to transition all ED's in our system with volume greater than 40K to this care model using the template developed at Sentara Leigh. Sentara will further refine operations utilizing ongoing LEAN concepts.

BACKGROUND

Sentara Leigh Hospital, a 35 bed emergency department in Norfolk VA, faces many flow struggles commonly found in busy emergency departments around the country. Sentara Leigh treated 67,890 patients in 2015 and had a visit:space ratio of 1,139 which would rank 82 out of 102 ED's reporting this metric in the 60,000-80,000 EDBA Cohort. During the 2015 year, Sentara Leigh was below EDBA cohort coverage in LWBS, LRTC, door to provider, and treat and release time. A system commitment to improve operations led us to seek out collaboration with another health system that was using novel approaches to improve ED care. The goal was to improve ED operations at Sentara Leigh to top quartile in the EDBA cohort database and use lessons learned from performance improvement at Sentara Leigh to improve ED operations at all Sentara emergency departments.

After introduction through an IHI Patient Flow conference, Sentara Healthcare began collaboration with the Kaiser ED Leadership teams to learn from their novel best practice model for high volume ED patient flow. Kaiser Sacramento based ED, in particular, have utilized LEAN strategies, zoned team based care, and rotational, acuity based, assigned patient flow to create a novel care model. This model focuses on vertical care, appropriate use of limited bed space, ownership of patients by providers and teams upon entry, and simultaneous nursing and provider work to improve operational efficiency. Each care team works utilizing SWARM (Synchronized Work And Rooming Method), that was developed at Kaiser, during which nursing and provider work is done simultaneously. With this process all pre-emptive testing is eliminated. All staff is encouraged to have the patient only tell the story once and perform most needed tasks simultaneously. This model also is driven by a cloud based rotational team assignment protocol utilizing the Patient Assignment and Sorting System (PASS) to load balance and manage flow. Kaiser Sacramento Emergency Departments have been able to achieve near national best practice results on numerous operational metrics using this model. Sentara refined this model and created a modular implementation schedule. This is intended to serve as a model for similar volume emergency departments in our system.

The Sacramento model modular implementation is composed of six phases

- PIVOT Triage
- Demand Capacity Analysis/Matching nursing and provider resources
- Fast Track (ESI 4/5 flow) low acuity teams
- Patient Assignment and Sorting System (PASS) driven flow using cloud based software provided by UBQ
- Focused care middle acuity Teams (ESI 3 flow)
- Acute Care Teams (ESI 1/2 flow and complex ESI 3 flow)

OBJECTIVES

- Identify a novel emergency department operations model with proven success to use as a framework to drive ED performance improvement in Sentara Healthcare.
- Implement a team based care concept to improve core operational metrics at Sentara Leigh with goal of top quartile performance in EDBA volume cohort
 - LWBS and LWBTC
 - Door to Triage
 - Door to Provider
 - Treat and Release median time
 - Treat and Admit Median time
- Develop a reproducible model to implement process improvement in similar volume ED's.

METHODS

PIVOT Triage

PIVOT Triage allows rapid assessment of patients in intake and entry. Using reduced data points and strong reliance on nursing visual and tactile cues, patient can be effectively sorted into ESI buckets. By reducing the time, it takes to triage and sort patient and eliminating pre-emptive testing this allows resources to be focused on care teams where efficient and effective simultaneous work can be completed.

Fast Track ESI 4/5 Care Team

Manages all ESI 4/5 flow. Nurses, Provider, ED tech assess and treat assigned patients as a team utilizing one room placed a point of entry and 1 procedure room and results waiting area. Approximately 50% of patients are dispositioned by the team as a one step process from the assessment room. Common procedures are performed in a procedure room that has pre-packed kits to expedite care of common complaints. Strong LEAN concepts are utilized to reduce non-value added work. Flow is managed utilizing the PASS system with a rolling hourly cap of 5 patients per hour to promote efficiency and manage boluses. Teams are expected to see up to 26 patients in an eight-hour shift.

Focused Care ESI 3 Teams

Manages majority of ESI 3 flow. Nurses, provider, Tech teams assess ESI 3 patients as a team at point of entry utilizing 2 intake rooms adjacent to waiting room. Patients are assigned via PASS on a rotational basis and flow is controlled utilizing a rolling cap. After initial assessment and initiating treatment and obtaining labs, needed further ancillary testing or procedures are performed. A vertical care area supports the teams along with a 7 bed treatment area. Each area is supported by nursing resources. Any patient deemed to be too complex is escalated to the acute Care teams. Each Team is expected to see up to 20 patients in an eight-hour shift.

Acute Care High Acuity teams

Each team is made up of 2-3 nurses, one ED tech, and one provider supported by 8 beds with on critical care bed and 2 call spaces. ESI 1,2, and complex/non-ambulatory ESI 3 Patients are assigned via PASS on a rotational basis, teams sit in common work area and constantly communicated about needed care, bed utilization, and future care plan. Each shift starts with a "Fast Start" protocol where they will get three patients in a row. Patients are seen in SWARM on intake where nurse and provider and tech perform simultaneous provider intake, nursing assessment and intake, completion vital signs, and obtain needed diagnostic and treatment. Teams own that patient and pull to available treatment space to see next patient with goal to room and see all patients in 20 minutes or less. Bed management becomes core concept of teams. Because team shifts are aligned, all team members are strongly motivated to progress care as fast and efficiently as possible. Long Length of Stay patients are placed in low volume area to maintain flow.

ESI based Demand Capacity/Team Staffing

With support of IT team, we reviewed demand capacity curves for our ED based on total volume and ESI score. Appropriate team staffing was determined for each day of the week. We also took a "one hour ahead" approach with the idea of being ready to accept the bolus. Further, models projected volumes for "Busy" days which we defined as 7th and 9th percentile for day. We projected needed capacity to address these peak demands. Nursing and provider shifts were matched so that all staff are working towards a common goal of seeing all assigned patients.

PASS sm / Team Assignment System

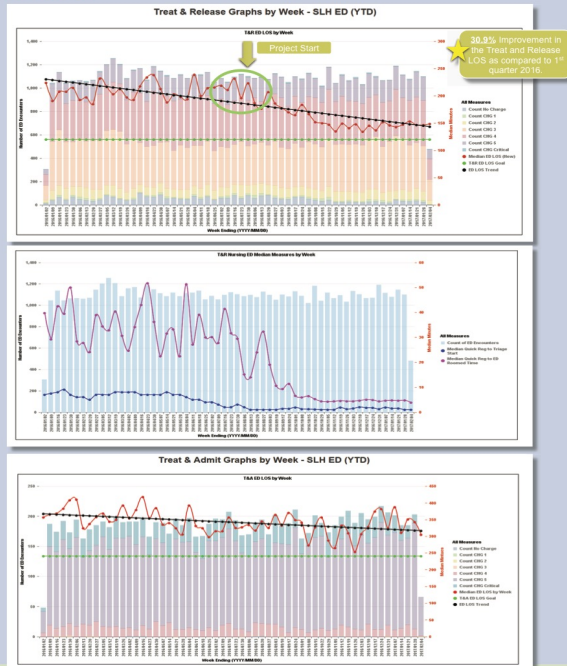
Team Assignment system is a Rotational Assignment software platform developed by UBQ ED to assign patients to provider lead teams at the point of entry. This system uses the PASS sm (Patient Assignment and Sorting System) to assign and load patients to teams based on ESI Acuity, workload balancing rules, and shift protocols. While Queuing theory suggests that assigning patients may lead to longer waits, we found PASS sm to be a powerful tool to promote ownership and a culture of accountability and drive reduction in door to provider times and ED Length of Stay. It prevents provider "cherry picking" and allows providers to focus on managing flow assigned to their team. A text push notification system was deployed via PASS sm to facilitate proactive planning by team members to start care as soon as the patients arrive. PASS sm uses a frontloading protocol and taper down approach to team workloads. Further, it sets both total shift caps and hourly bumpers for teams and providers that promotes flow and operations.

RESULTS

	2015	Jan-June 2016	Post implementation Oct-Dec 2016	EDBA 60K-80K Cohort 2015 Top 25%	EDBA 60K-80K Cohort 2015 Top 10%
Treat and Release	198	219	143	147	120
Treat/Release ESI 4/5 (Fast Track)	118	108	67	93	77
Treat/Release ESI 3	214	228	169	ND	ND
Treat/Release ESI 1/2	291	304	242	ND	ND
Treat/Admit	376	336	316	255	218
Door to Provider	48	64	22	23	13
Door to Triage	7	6	1	ND	ND
LWBS	1.2%	1.1%	0.4%	ND	ND
LWTC	3.4%	3.7%	1.4%	1.7%	1%

All times are median

RESULTS



CONCLUSIONS

- The Sacramento care model is a novel ED operations system based on LEAN concepts that utilizes three acuity care zones that focus on nurse-provider teams driven by an assigned rotational patient software system or PASS.
- The Sacramento care model can be successfully deployed in a phased approach. This process was successfully performed in three months at Sentara Leigh developing PIVOT and removing all pre-provider testing, front end/entry operations focused on effective sorting and routing to provider nurse teams and reduced door to provider.
- The Sacramento care model promotes a culture of no-wait emergency department care, having patients only tell the clinical story once on entry, and synchronized nursing and provider work or SWARM.
- Patient Assignment and Sorting System (PASS) software is an extremely effective tool to manage ED flow into care teams. Furthermore, it allows team ownership at point of entry allowing ownership of the waiting room. It also effectively load balances teams leading to improved operational efficiency.
- By organizing ED staff into teams that focus on acuity based flow, communication and teamwork are improved. Ideal team size and space for each acuity zone needs further research and data collection.
- Sentara Leigh realized improvement with most core ED operations metrics to above top quartile in EDBA database (only treat and admit fall below this threshold). Initial observations suggest improved customer service scores, reduced ancillary testing, improved staff morale, and reduction in patient safety events. Further data analysis is ongoing.
- The Sacramento care model is an effective strategy to improve multiple ED operational metrics in a high-volume emergency department.

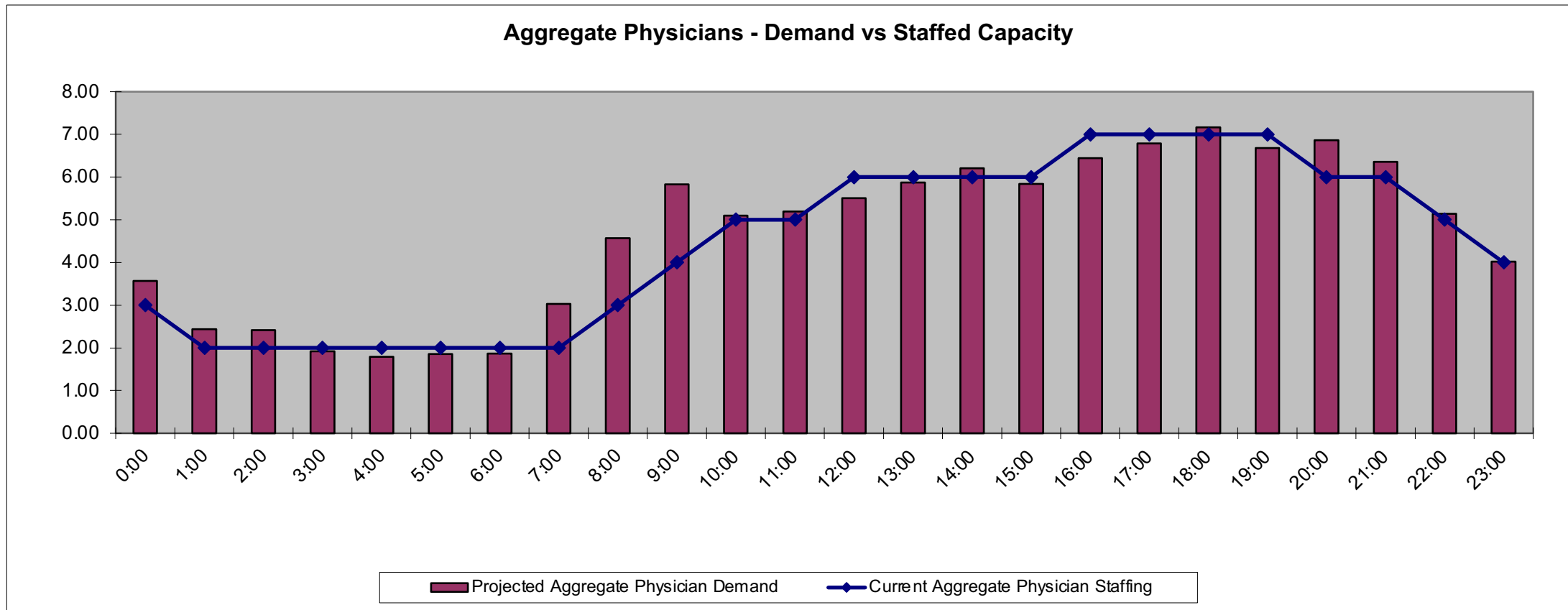


Principle #7: Match Staffing to Demand

- Consider both arrivals and workload in your staffing model
- Arrivals are predictable in Emergency Medicine but after COVID may need to look at them even monthly until it stabilizes

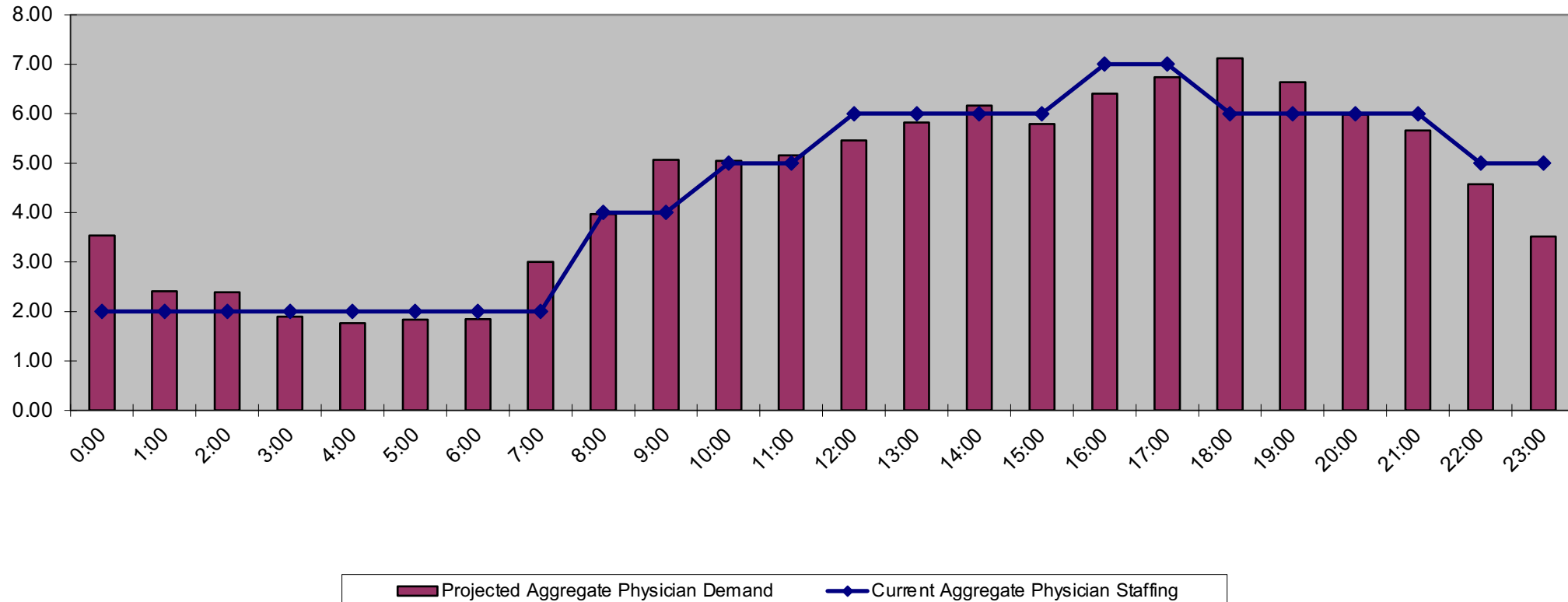


Physician Staffing: Before



Physician Staffing: Post

Aggregate Physicians - Demand vs Staffed Capacity



Principle #7: Match Staffing to Demand

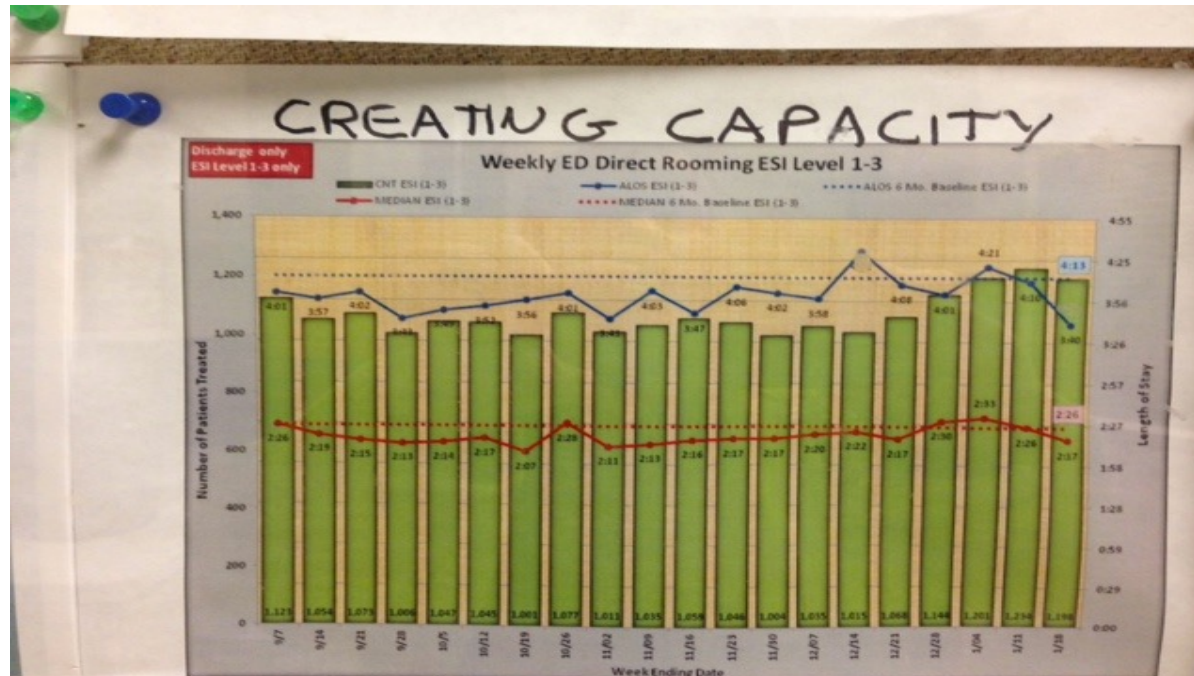
- Look at your arrivals by hour of the day, day of the week, and monthly
- Segment them by acuity and patient streams
- Use your productivity metrics to determine the number of arrivals
- Remember in the ED: *Poisson arrivals* so if you can adjust staffing up a bit to account for random arrivals
- Can create a simple Excel program to help with the models

Principle #8: Transparent Data in Context

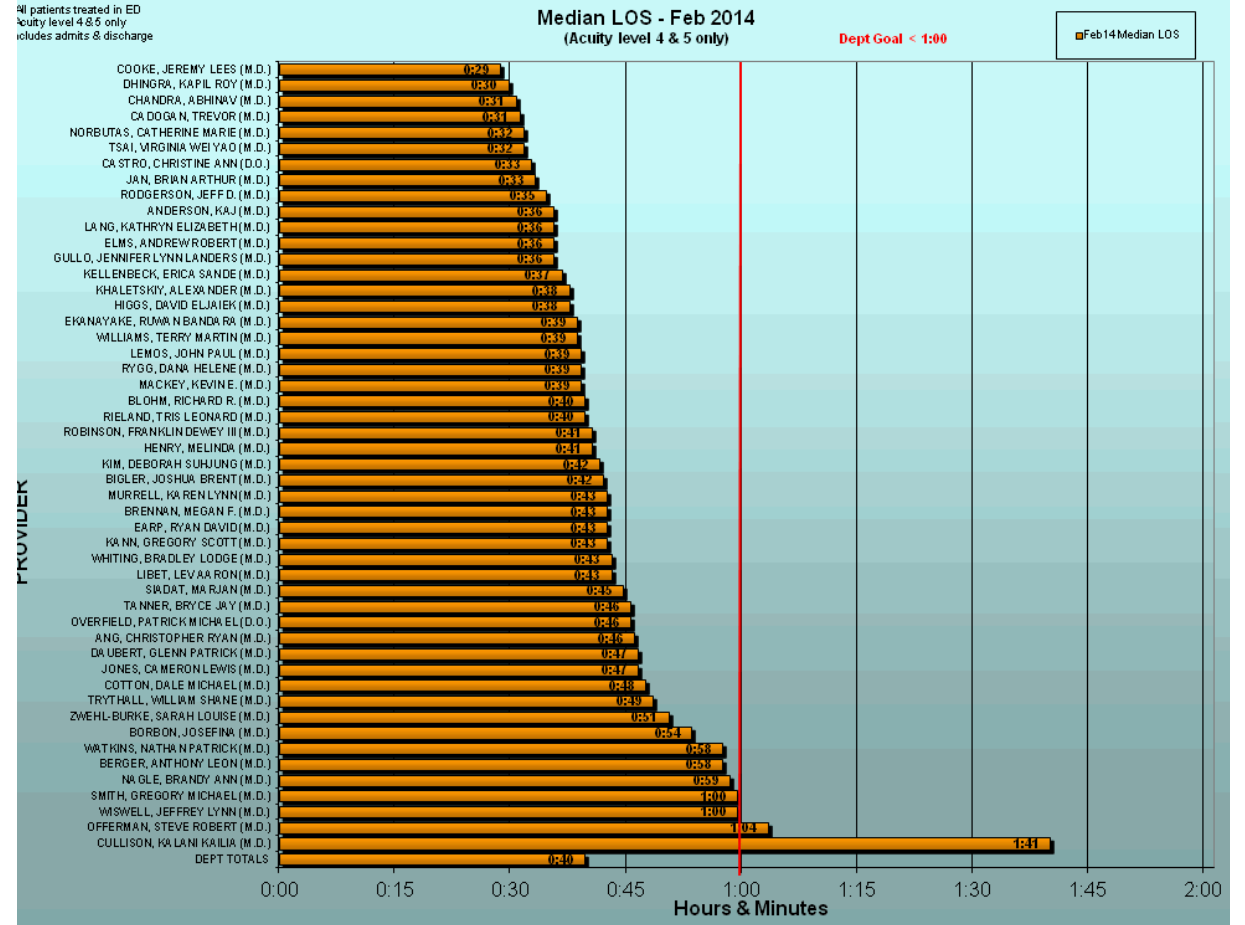
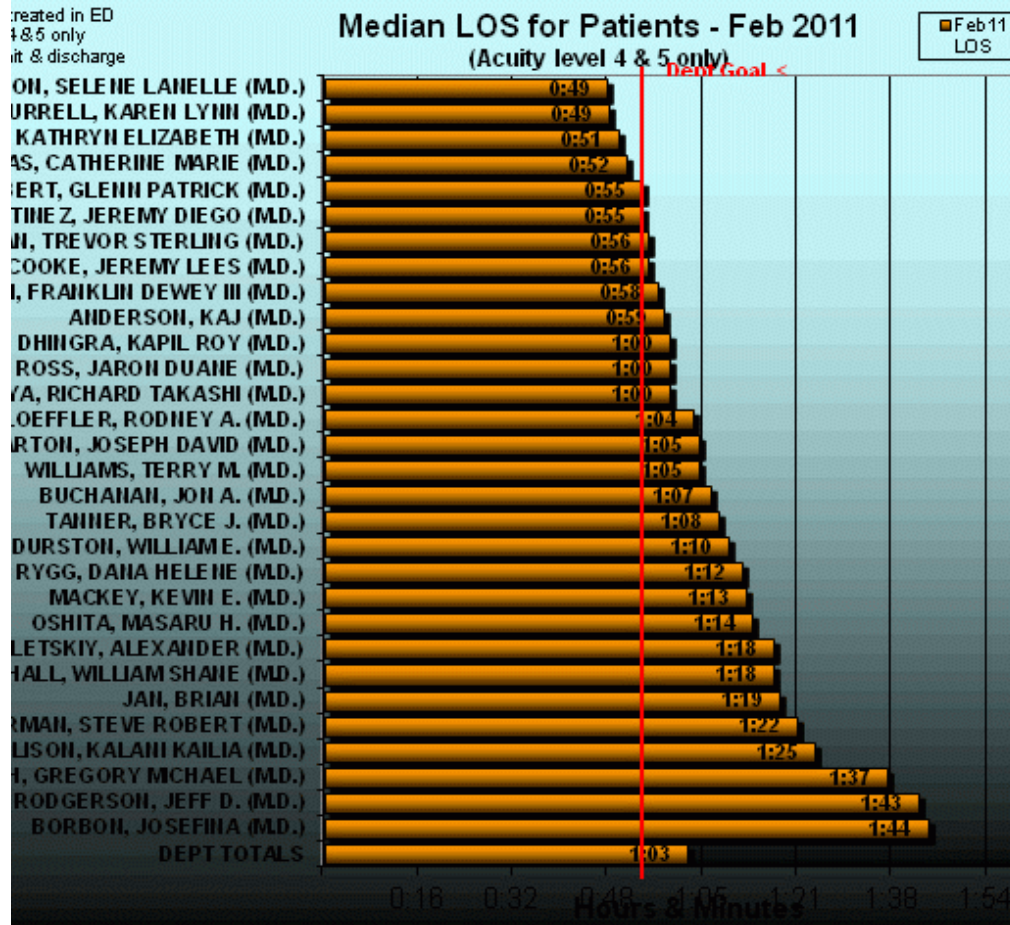
- First meet together as a group and decide goals
- Then, work on systems so team can reach goals without heroics
- Train on Lean Principles, discuss efficiency tips and share best practices
- Balance Efficiency with quality, patient satisfaction

Principle #8: Transparent Data

- Metrics are not random: choose to CREATE THE CAPACITY needed to see patients and eliminate waiting times



One Example: *standard deviation decreased, length of stay down*

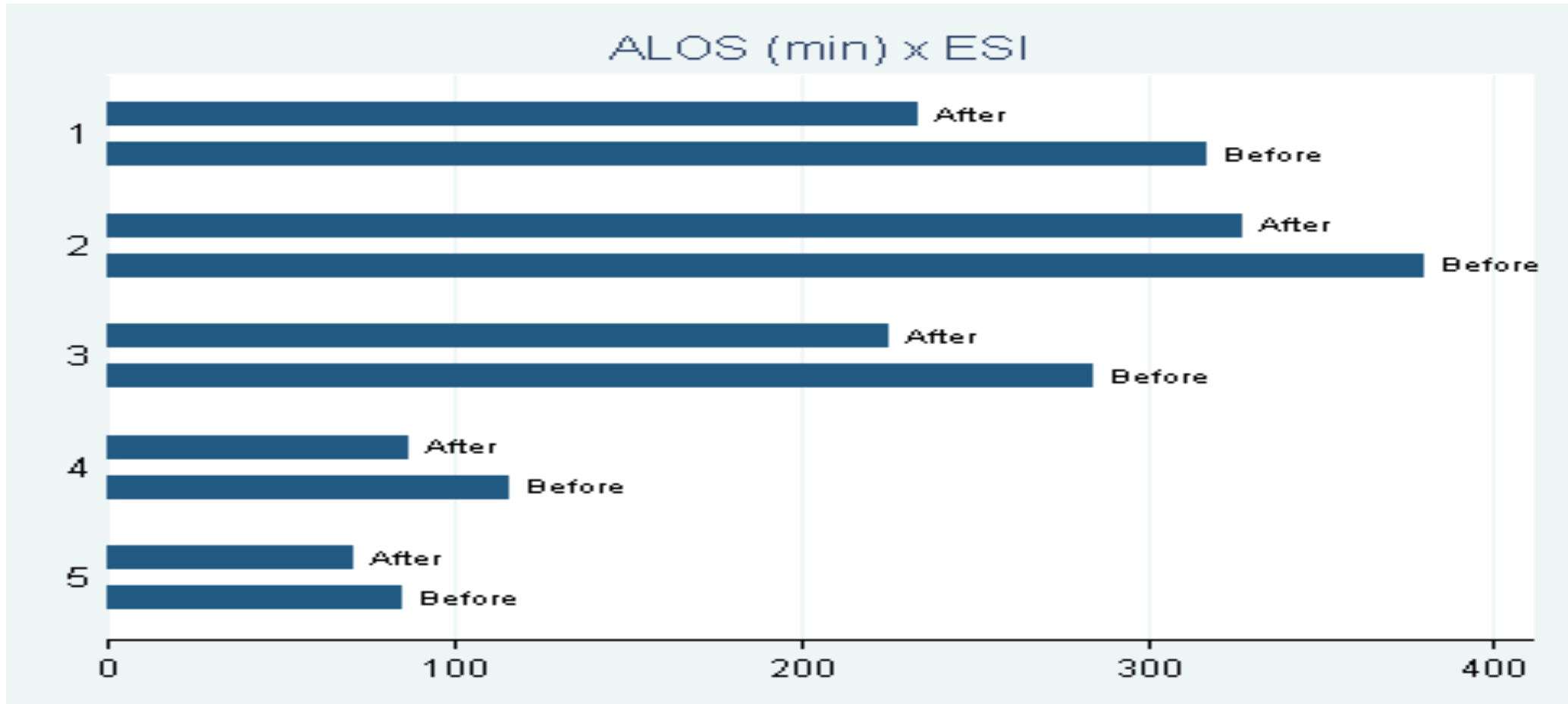


Transparent Data Paired with Training

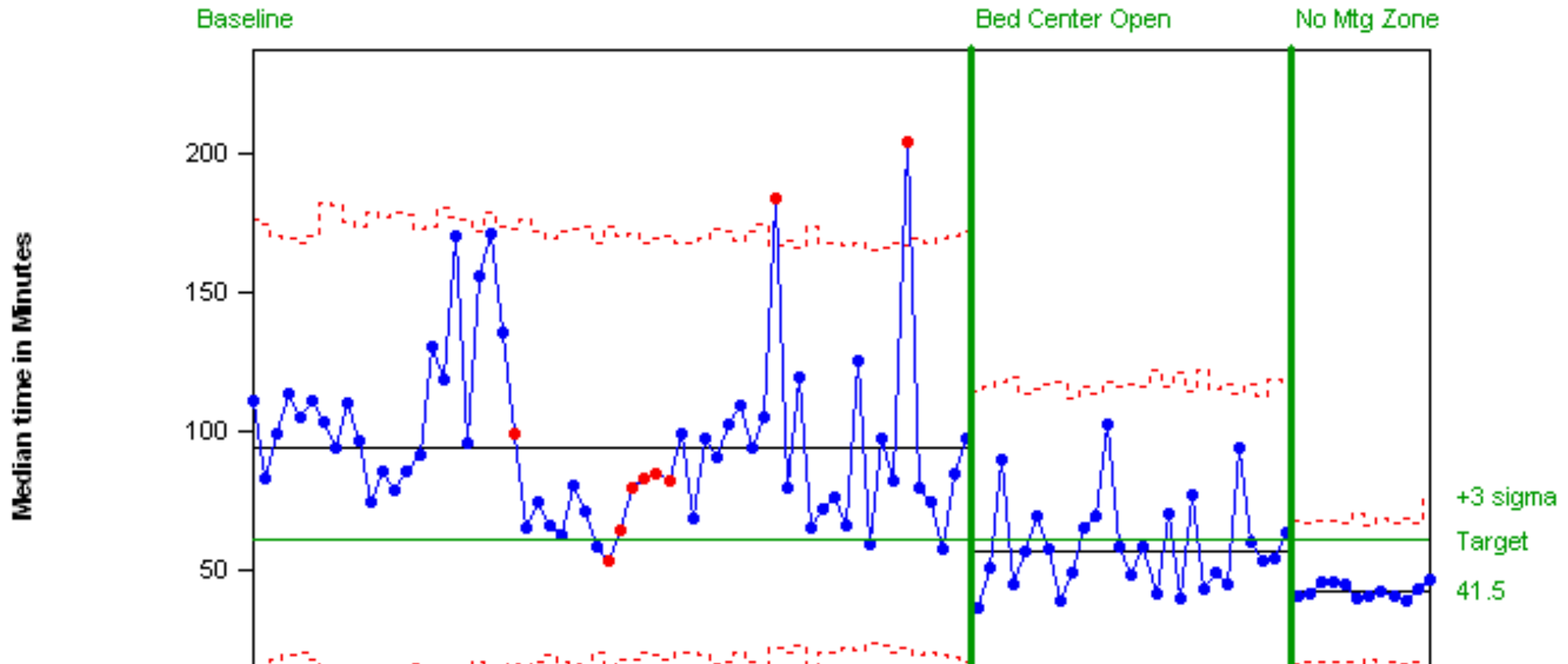


*Public Relative Performance Feedback
in Complex Service Systems: Improving
Productivity through the Adoption of Best
Practices*

Transparent Data Results Across Spectrum



General Principle #9: Continuous Improvement



Principle #9: Continuous Improvement

- Training on Basic Lean principles for all staff
- Patient observations
- Involve the people doing the work
- Kaizen events for improvement

Principle #10: Embrace New Automation Technology

What it takes for technology to successfully improve flow:

Identify problems before they occur

Predictive analytics & situational awareness

Decrease cognitive burden on frontline

Prescriptive nudges, real-time priorities & automated actions

Drive engagement and collaboration

Modern, user-centric design & behavioral science



Operationalize the technology

Project management, data science & change management

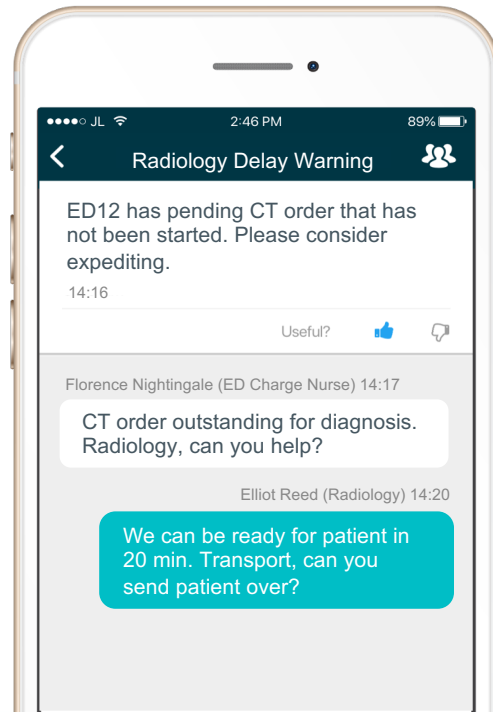
**Intelligent
Automation**

**Best
Practices**

Example: Automating ED Patient Movement

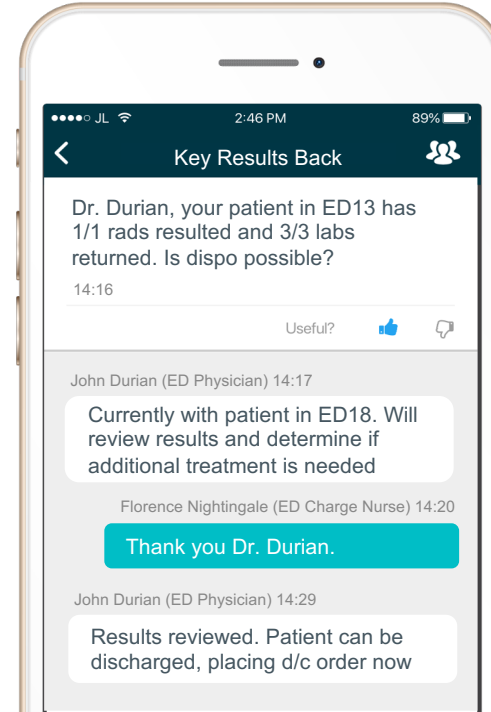
Delayed Labs / Radiology

Engages ancillaries to facilitate flow



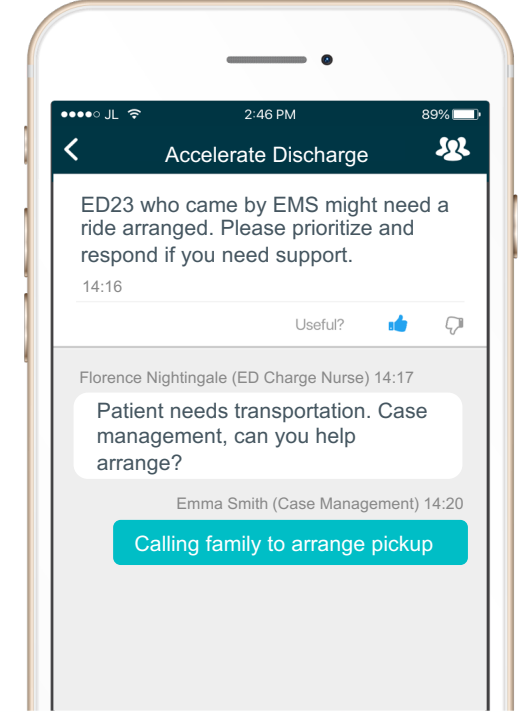
Key Results Back

Prompts physician to finalize disposition as studies completed



Accelerate Discharge

Mobilizes team to remove potential discharge barriers



Principle #11: Use your Metrics Well

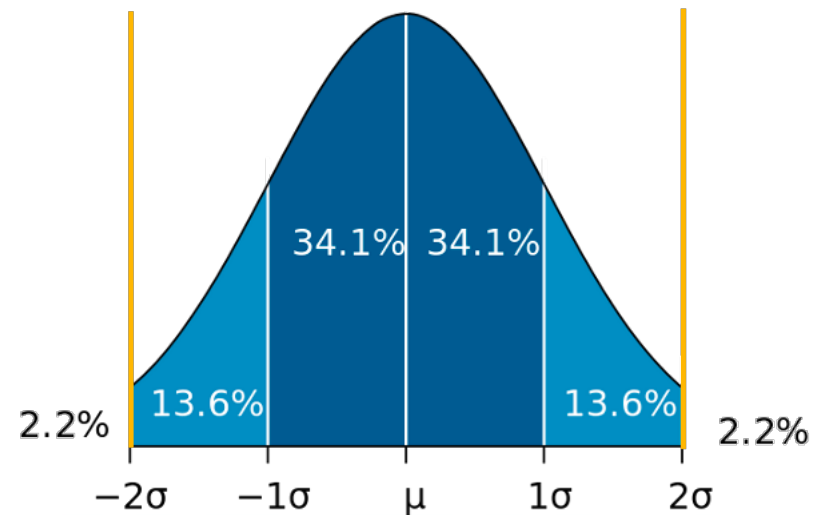
- Primary Metric: **TOTAL length of stay**
- In a perfectly aligned ED, the length of stay should be almost even across the 24 hours. This shows alignment of all areas of operations

Principle #11: Use your Metrics Well

- For focused improvements:
 - Door to doctor (the *discharging* doctor)
 - Length of stay for each ESI level and for significant diagnoses (psychiatry)
 - Doctor to disposition
 - Disposition to departure for both admitted and discharged patients
 - Patient satisfaction
- When doing improvement: the details matter
 - ED: war won in minutes across the ED
 - Inpatient: war won in hours across the hospital

Principle #11: Use your Metrics Well

- Look at your data: compare the average to the median
- If there is significant difference you have *outliers* skewing the data
- Consider **winsorizing** the data- eliminates extreme values but be aware of the data to drive improvements in your outlier patients



Principle #12: Have Fun!



Final Truths!

- The **longer** they stay... the more work they are
- The **deeper** into the ED patients get... the longer they stay



**WAIT FROM
THIS POINT:
0 MINUTES**

