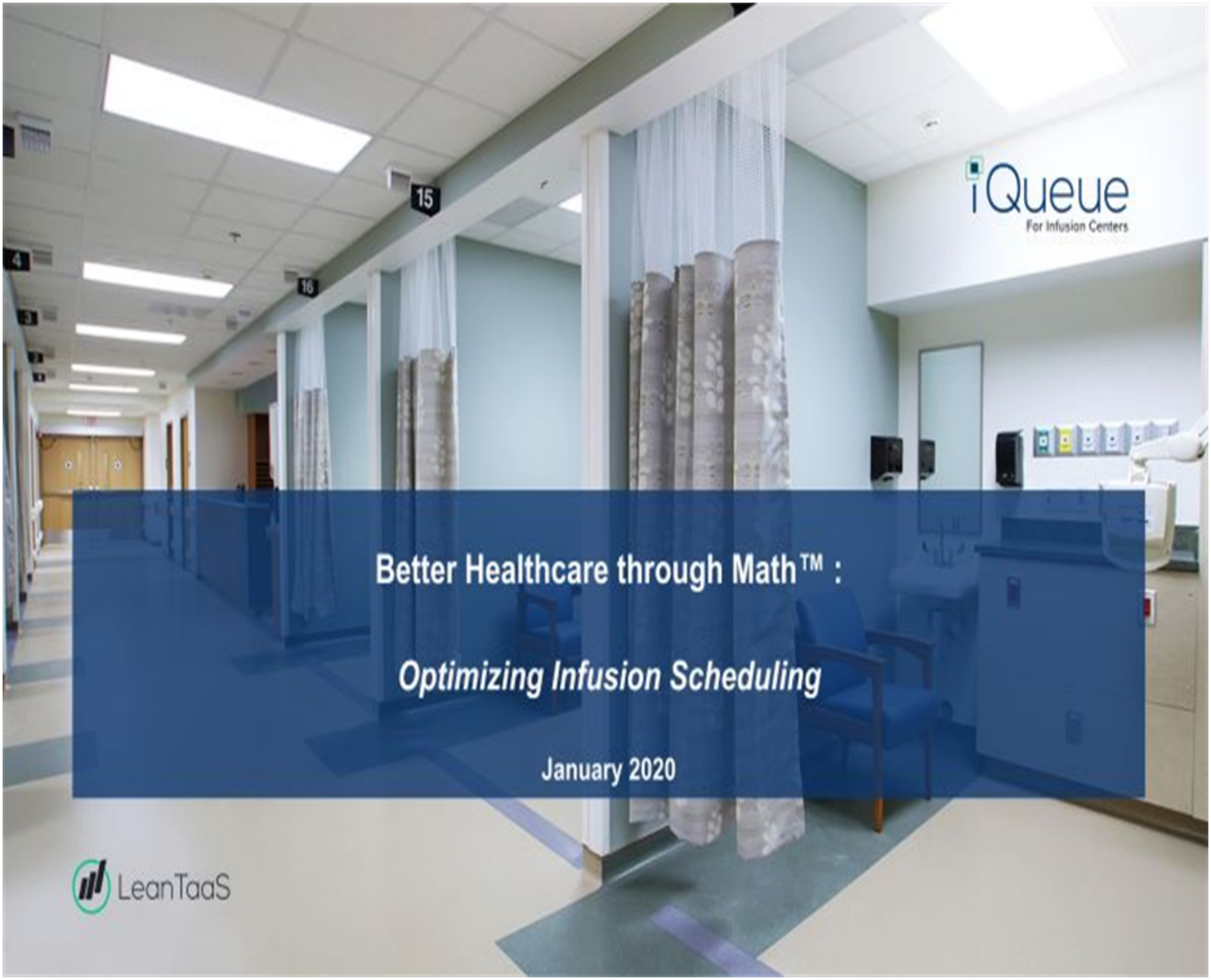
iQueue
For Infusion Centers
Better Healthcare through Math™ :
Optimizing Infusion Scheduling
January 2020
LeanTaaS

Objectives for today's discussion

1.	Introduction	05 minutes
2.	Describe the typical challenges facing infusion centers	20 minutes
3.	Explain the underlying mathematical reality that creates these challenges	20 minutes
4.	Describe best practices in scheduling infusion treatments	15 minutes
5.	Q&A	15 minutes

Introduction

Pamela F. Tobias, MS, RHIA, CHDA

Pamela earned her Masters of Science in Health Care Administration from King's College, is a Registered Health Information Administrator and Certified Health Data Analyst. She has over 20 years of experience in progressive leadership roles in healthcare and oncology. Most recently she served as the Administrator for Oncology Services at the Lehigh Valley Health Network Cancer Institute where she was a critical link between care providers, patients, payers, and diverse internal customers. She is currently the Head of Customer Engagement, Infusion at LeanTaaS, where they are using complex math and predictive analytics to improve efficiency and unlock capacity for healthcare systems.

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Bridget Roell

Bridget holds a Bachelors of Science in Industrial Engineering & Operations Research from the University of California, Berkeley. She has worked with over 50 infusion centers across 20+ healthcare systems around the country to improve scheduling practices & operational performance. She is currently the Lead Product Manager for the iQueue for Infusion Centers product at LeanTaaS, where she drives the development of innovative solutions to the key operational problems facing infusion centers using data science and predictive analytics.

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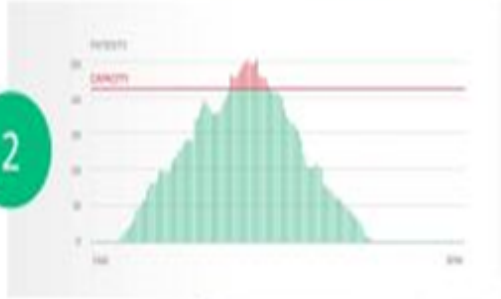
Most infusion centers face the following challenges on a daily basis

Problem

1

Patients tend to **wait a long time** for their infusion appointments – especially in the middle of the day

2

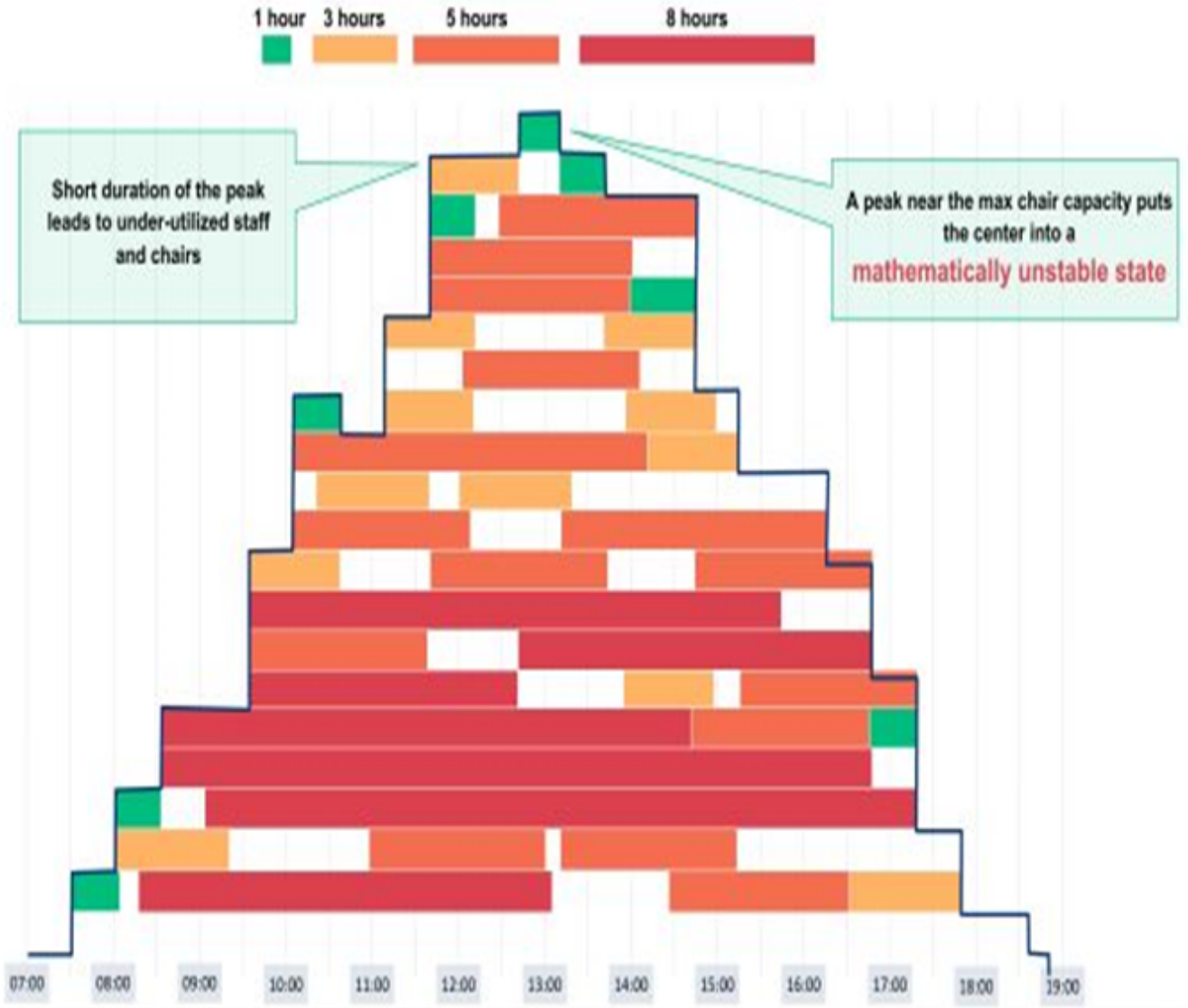


Chair utilization starts out low and ends low – but has a **midday peak** that is at (or above) chair capacity virtually every weekday

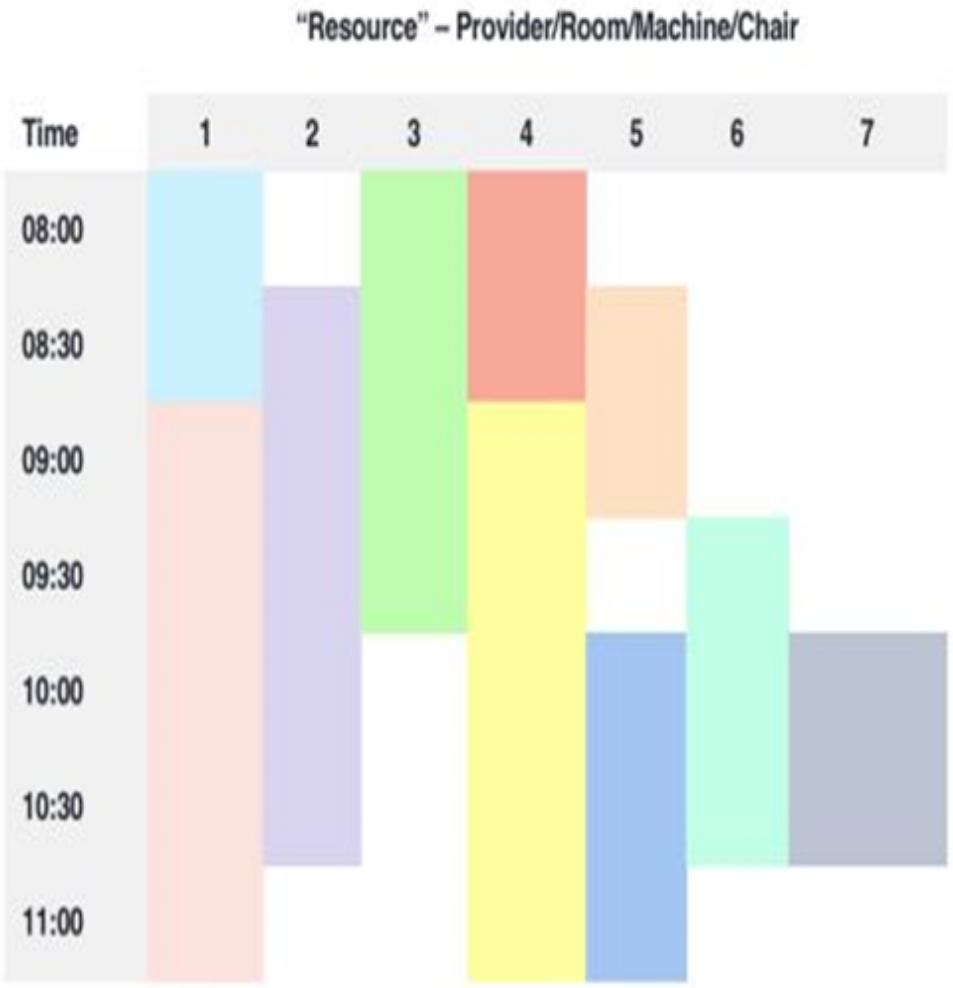
3

Infusion nurses miss their lunch breaks several times each week, have high levels of overtime and emergency callbacks from their days off

Current scheduling methods result in Infusion Centers losing the game of Tetris



Why can't my EHR fix this? #1 of 4



A grid-based scheduling approach works for tennis courts and spa scheduling because they are **deterministic** (i.e., start and end times are accurate and known in advance).

It does not work in healthcare as clinical appointments are **stochastic** ("random and highly variable") and cannot be stopped based on the clock.

EHRs have an incredibly weak mathematical foundation - #2 of 4

EHRs take a "first-come-first-served" approach to scheduling clinical appointments. This is **mathematically incorrect** – the **ONLY WAY** to improve patient flow is to sequence the appointments based on constraint-based **optimization algorithms** that match the supply and demand patterns

EHRs have an incredibly weak mathematical foundation - #3 of 4

EHRs **do not enable the use of probability theory and simulation algorithms** to account for delays, overbooking, cancellations and add-ons which are unavoidable every single day

EHRs have an incredibly weak mathematical foundation - #4 of 4

EHRs attempt to solve the problem by providing Reports, Dashboards, and Targeted Alerts. These are **NICE - BUT NOT ENOUGH.**

It takes Constraint-Based Optimization Methods, Machine Learning, Artificial Intelligence and Simulation Algorithms to improve asset utilization and patient flow – **EHRs don't have those tools.**

Challenges with Conventional Approaches

Deploy a comprehensive Lean / Six Sigma / Process Improvement effort across the organization

Benefits

- Engages the entire workforce in process improvements.
- Establishes the discipline if making metrics visible
- Cascades leadership goals down though each level of the organization

Challenges

- Consumes enormous resources.
- Requires resilience - changes in team result in setbacks
- Relies on simplistic math (Excel) that cannot capture operational complexity

Optimization algorithms are complex because the solution spaces are enormous

The solution space for the number of possible ways to organize an infusion template for **1 day for a 30-chair center**

$$ {}^{n}C_{k} = \frac{n}{k!*(n-k)!} $$

= 3.3 x 10^{106} which is 3,300,000,000,000,.....,000,000

Number of potential templates for a single day has 105 zeroes

Objectives for today's discussion

1. Introduce LeanTaaS
2. Describe the typical challenges facing infusion centers
3. Explain the underlying mathematical reality that creates these challenges
4. Describe best practices in scheduling infusion treatments
5. Q&A

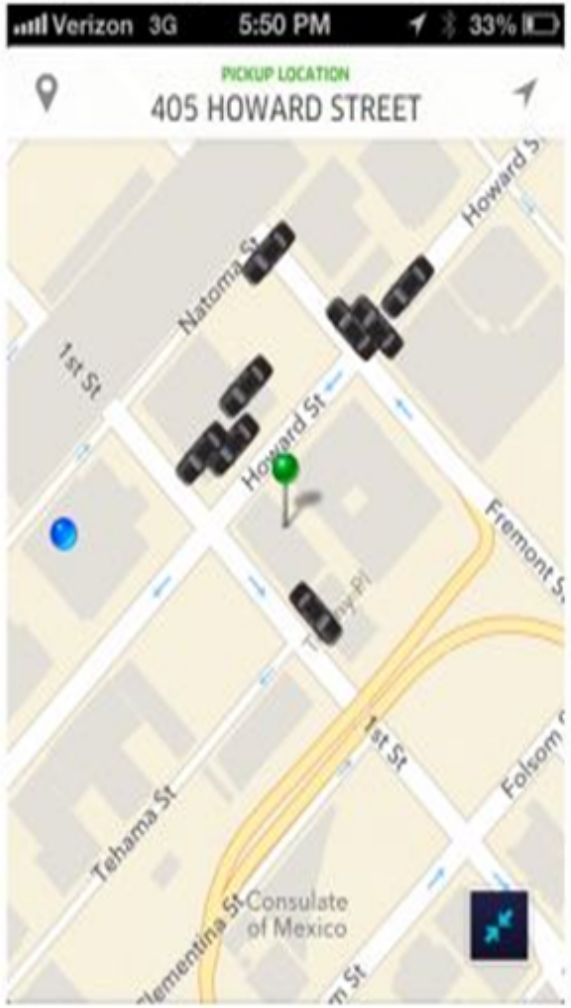
Optimizing Asset Utilization requires matching the demand and supply signals

Matching the demand and supply signals

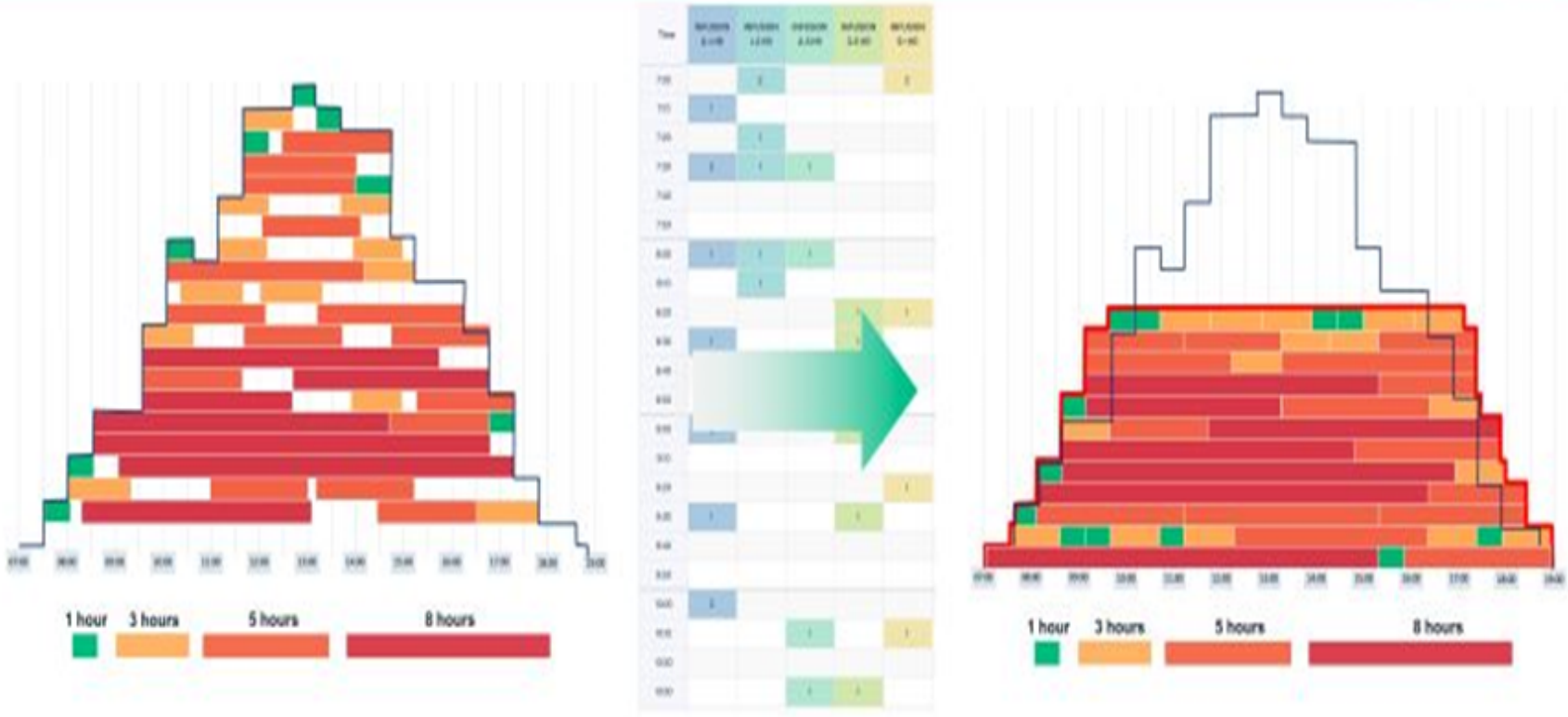
All three levers must be pulled in order to achieve demand/supply balance

1. **Shape** the demand pattern
2. **Unlock** supply capacity proactively
3. **Nudge** both demand and supply to remain in balance

An example that actually works



Lever #1: **Shaping** the demand pattern in Infusion Centers



Understand historical volumes in order to build a schedule that level-loads appointments across the day, aiming to achieve a steady ramp-up, flat utilization throughout the day, and smooth ramp-down.

Actively steer eligible appointments to the early morning and later afternoon in order to avoid pile-ups in the middle of the day.

Lever #2: **Unlocking** supply in a proactive manner

Evaluate the system as a whole in order to identify opportunities to re-distribute supply

Example 1:

Rebalance chair resources to better match typical demand patterns across disease groups

Example 2:

Pool Fast Track resources that *could* be used for other activities (e.g. RNs) in order to reduce the total supply needed

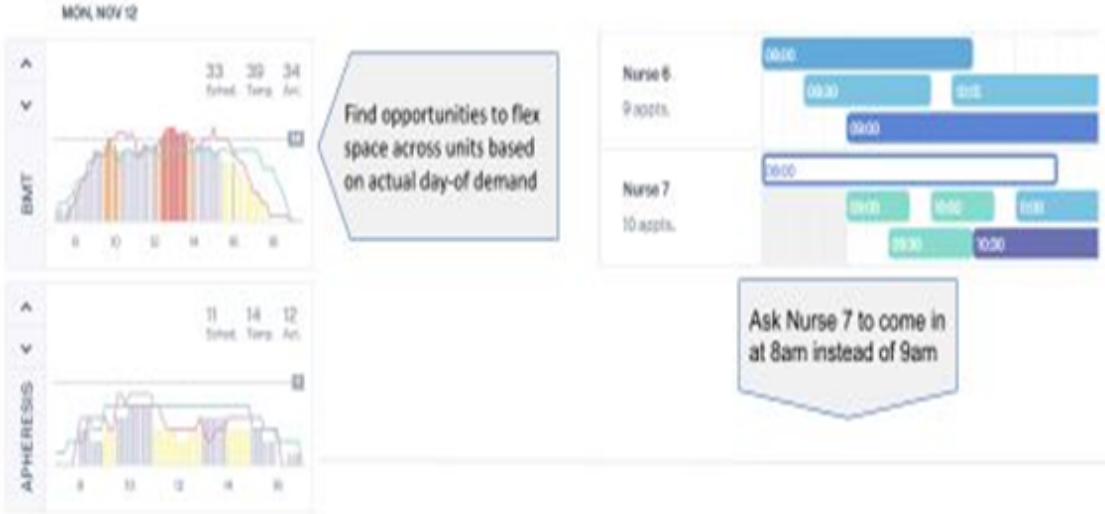
Lever #3: **Nudging** both demand and supply to remain in balance

Look ahead to adjust demand:

- Proactively push incoming appointments towards less busy days in order to avoid creating bottlenecks
- Reactively shift existing appointments away from busy parts of the day in order to avoid bottlenecks before they happen

Look ahead to adjust supply:

- Understand how the day is stacking up and make staffing adjustments accordingly



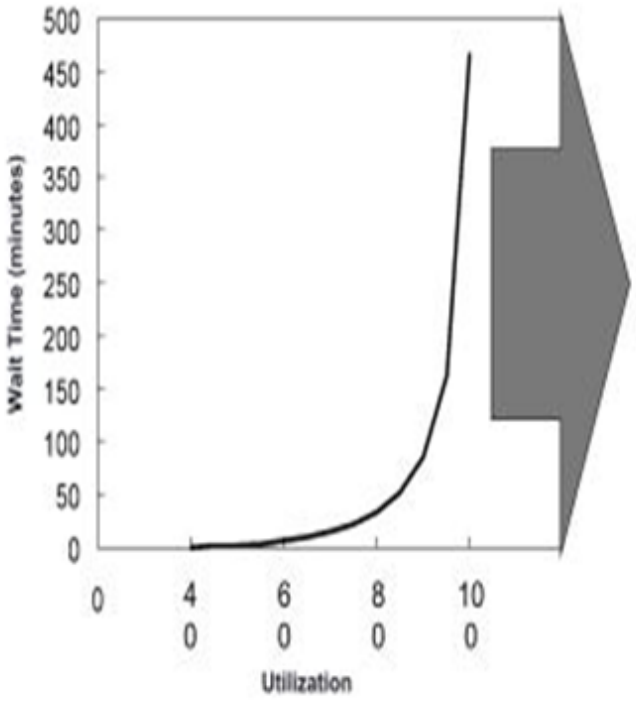
Optimizing Asset Utilization also requires the coordination of connected visits

All three levers must be pulled in order to improve flow across connected services

4. **Establish** a realistic upper-limit on utilization for each node
5. **Capture** the choreography of each node into a mathematical model
6. **Simulate** the flow of patients across each node

An example that actually works

Lever #4: **Establishing** a realistic upper-limit on utilization for each node



When a node approaches MAX UTILIZATION, it goes into complete gridlock like the freeway at rush-hour

The upper limit on utilization depends entirely on:

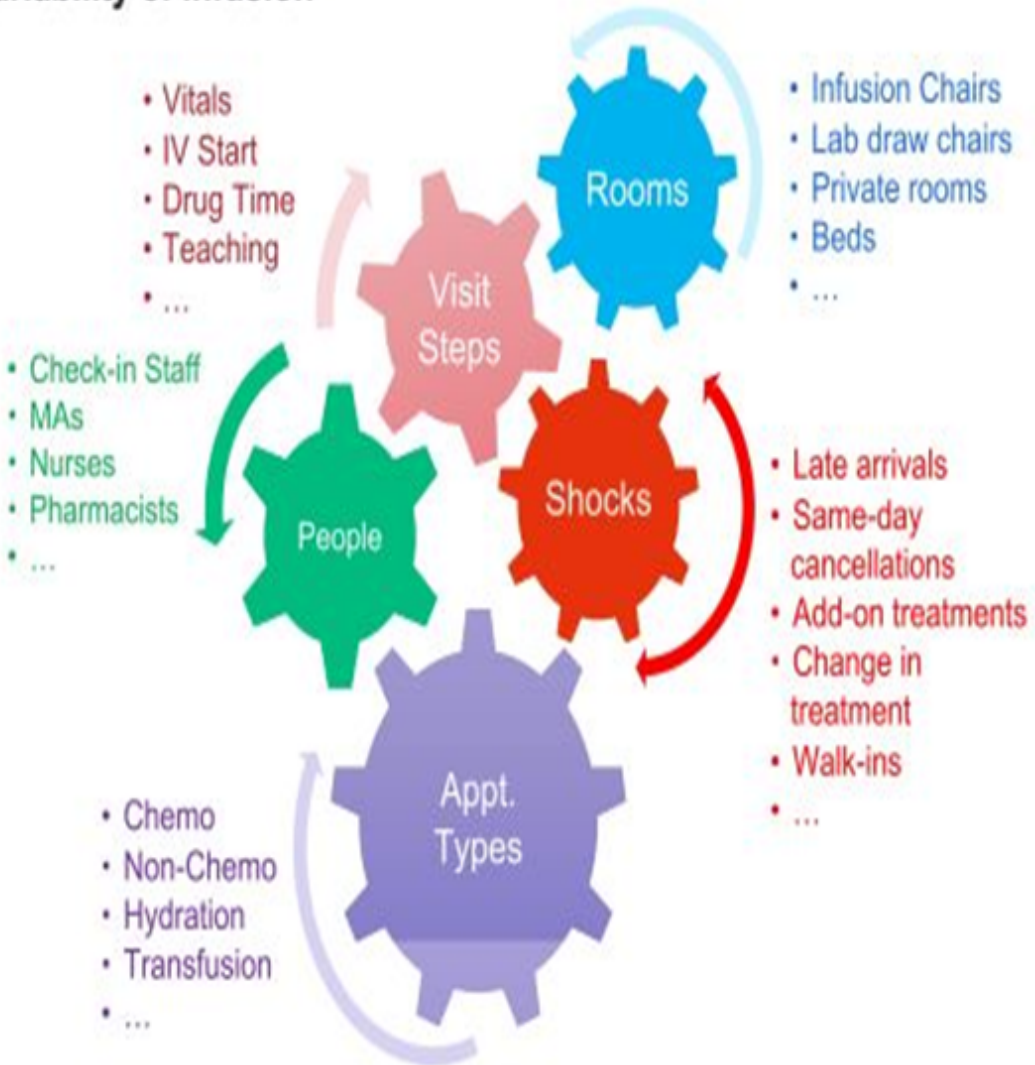
- Consistency of arrival rate of demand
- Predictability of the duration of service
- Availability of the asset providing the service

Therefore, a machine that always produces widgets at a constant rate (e.g., 1 per minute) and **has near-zero downtime** can expect to operate at ~95+% utilization

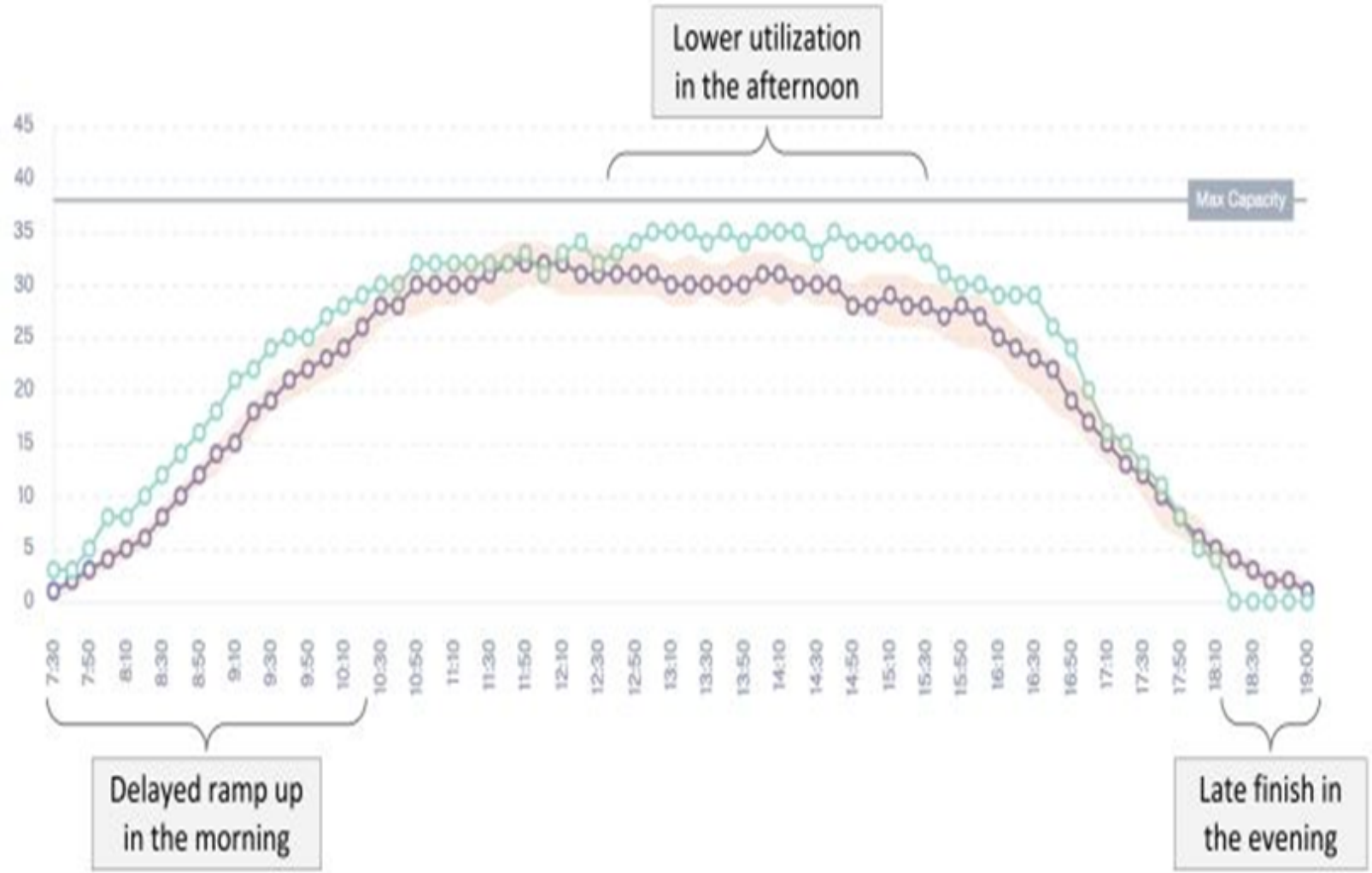
Healthcare services are highly variable on all 3 dimensions and therefore must be designed to operate at a lower utilization level

Lever #5: **Capturing** the choreography of each node into a mathematical model

Incorporating the variability of Infusion



Lever #6: **Simulating** the flow of patients across each node



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Throughput - Access - Capacity

Reduce constraints where able in order to maximize utilization

Consider Uncoupling when you need increase capacity

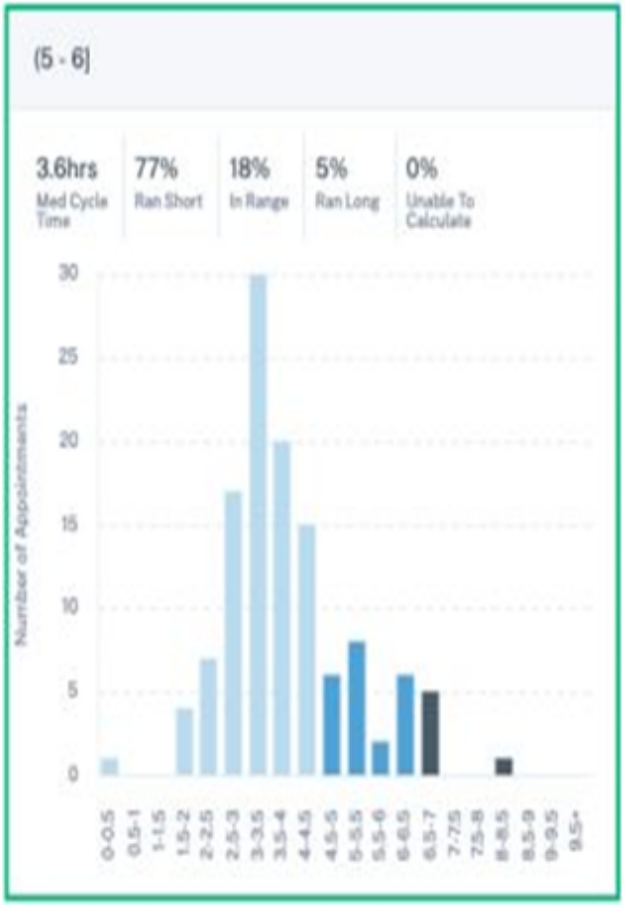
Throughput - Access - Capacity

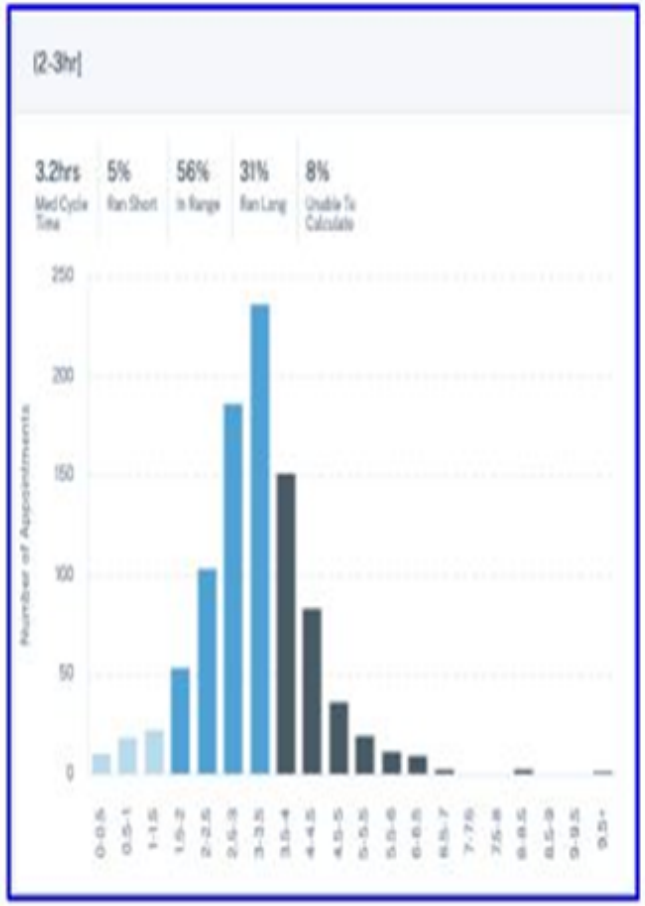
Pooling resources is best for maximizing capacity

Fast Tracks work when you have enough volume

Throughput - Access - Capacity

Analyze **CYCLE TIMES** at least quarterly





Throughput - Access - Capacity

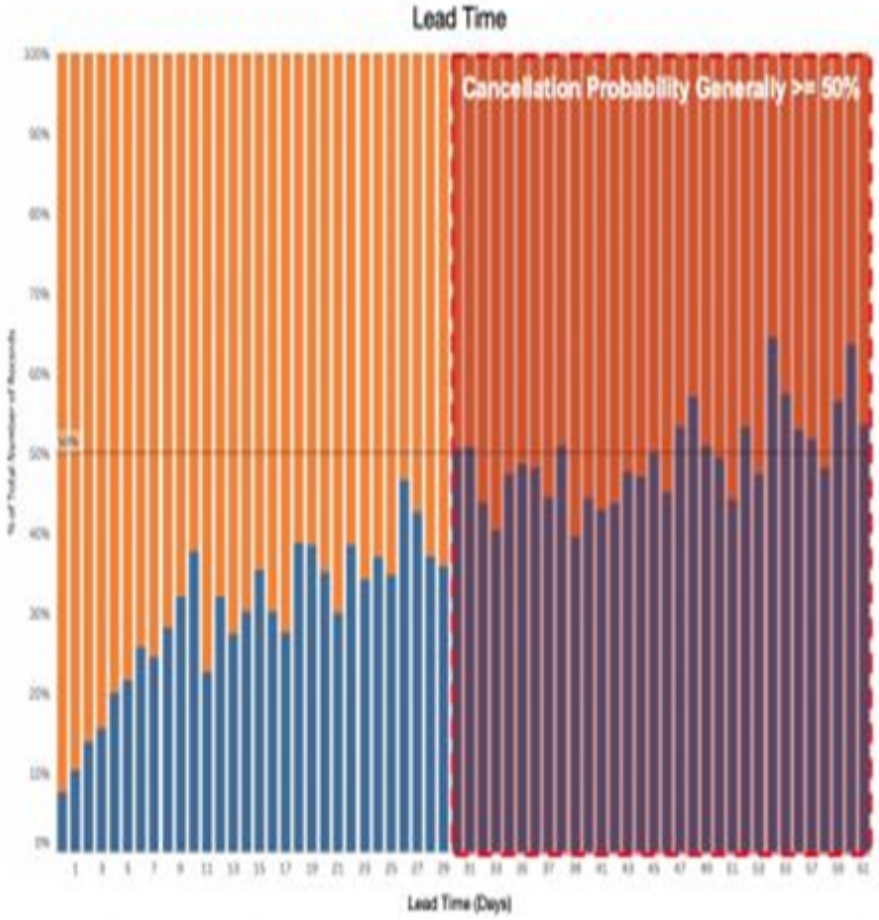
Premixing medications

Prework Accuracy/Ticket to Ride

Transfusions / Pre Scheduling Lead Time Analysis

- As lead times increase, the cancellation rates also increase

Example - the lead time beyond 30 days, there is a 50% chance that the appointment will get cancelled



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THANK YOU