TMC: Operations Management

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Objectives

- Recognize operations management principles in your practice
- Reduce artificial variability in your practice as a cause of waits and delays
- Apply queuing theory to justify resource utilization and requests
- Or at least know that intuition can be misleading in these matters

Perspective

- Inpatient
- Outpatient
- Grocery store
- Bank
- Telephone systems
- Computer server traffic
- Workflow in really any context

Implications

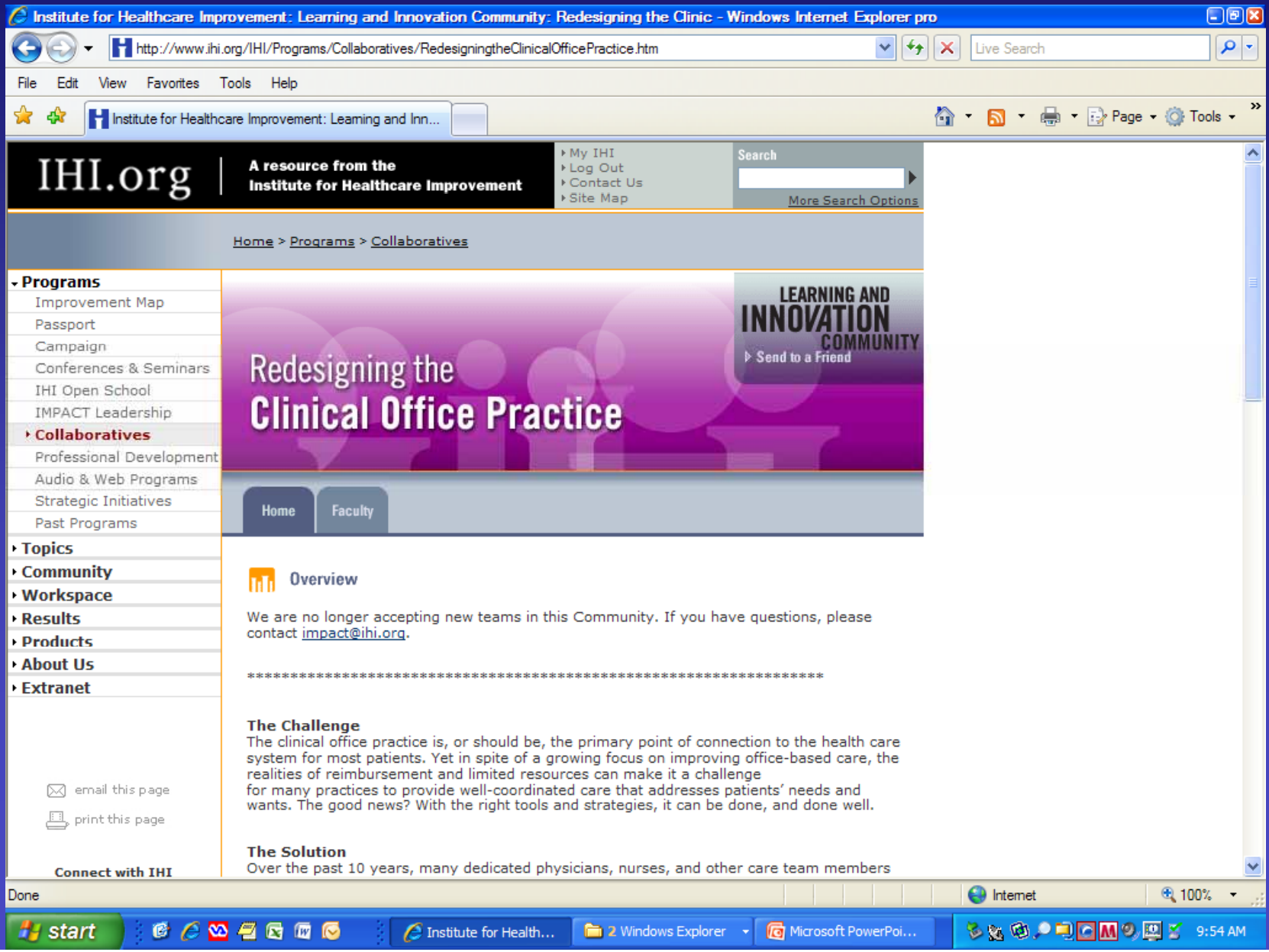
- Boston Medical Center
  - Annual number of cancelled or delayed surgeries decreased from 700 to less than 7
- Cincinnati Children's Hospital
  - $137 million annually in additional revenue
  - $100 million in avoided capital costs
  - With the same staffing!
- Nationally – if only 10% of Cincinnati gained
  - Across 5700 hospitals = $78 billion annually
  - Increased access by 15% would be > 13% uninsured

Joint Commission Leadership

- "Leaders develop and implement plans to identify and mitigate impediments to efficient patient flow throughout the hospital."

Standard LD 04.03.11

But what about the office…



But what about the office…

- Reduce next available PCP appt to within 1 day as measured by third next available appt
- For specialists, within 7 days
- Reduce patient cycle time in the office to no more than 1.5 times the actual time spent with the clinician
- Increase by 50% the proportion of patient receiving evidence based care
- Medical Home

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White Papers

20. Reducing Costs Through the Appropriate Use of Specialty Services → DOWNLOAD NOW

NEW

This white paper describes a framework that primarily focuses on changing professional practice culture by engaging physicians in developing and implementing practice standards that will work best in local circumstances to reduce high or escalating costs, reduce exposure to risk of harms, sustain or improve health outcomes, and improve the patient experience.

19. Increasing Efficiency and Enhancing Value in Health Care: Ways to Achieve Savings in Operating Costs per Year → DOWNLOAD NOW

This white paper proposes a set of steps health care organizations can undertake to systematically identify and eliminate inefficiencies to create a portfolio of work leading to a 1 percent to 3 percent savings in operating costs per year. Methods for developing a balanced portfolio of projects and for calculating and tracking cost savings are also described.

"First, they do an on-line search."

OM: Definition

- The business science that manages the conversion of inputs (materials, labor, energy) into outputs (goods and services)
- Manufacturing
- Service industry
- Healthcare…only recently

PROFESSIONAL DEVELOPMENT

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Managing Hospital Operations

Using the Science of Management to Ensure Continuity, Maximize Capacity, and Improve Quality of Care

Begins January 2006 A six-month professional development program

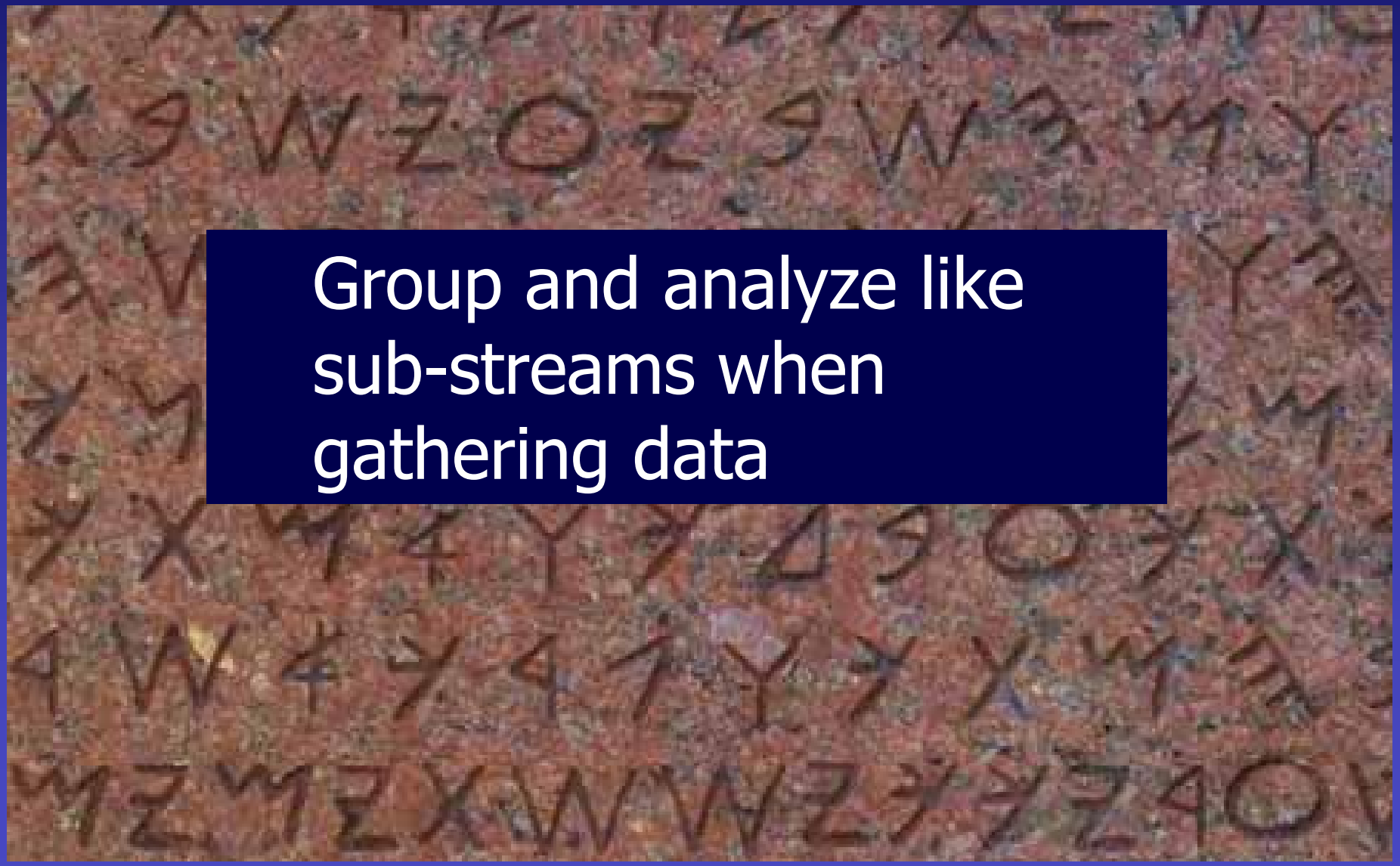
Overview

Managing Hospital Operations
Using the Science of Management to Ensure Continuity, Maximize Capacity and Improve Quality of Care

****Enrollment for this program has reached maximum capacity.** If you are interested in receiving information for the next offering of this program, please send an email to info@ihi.org.

"We have to bring the science of management back into health care."

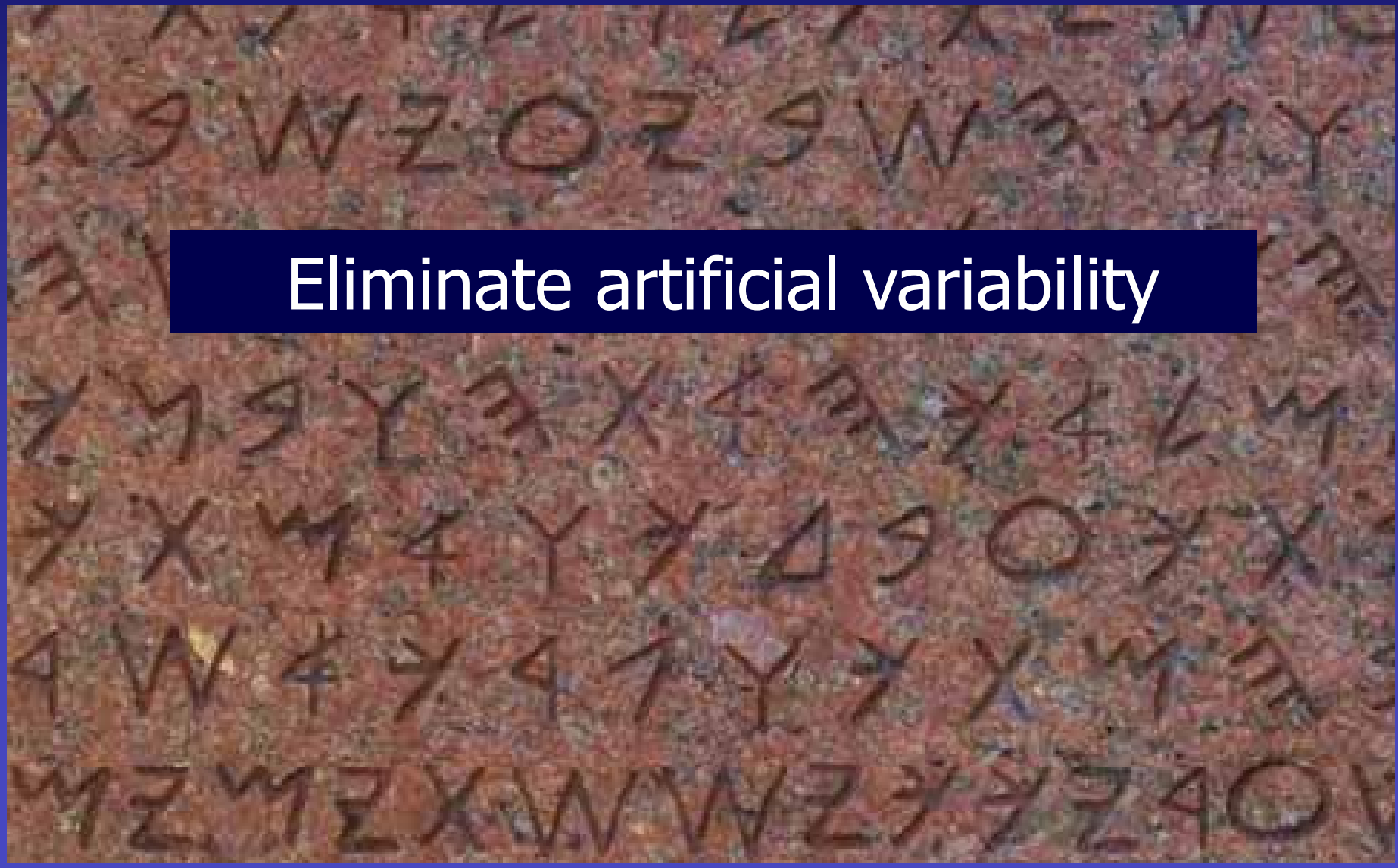
(patient) Flow Principle I



Examples

- Elective admissions per day, day of the week, per month, etc.
- ER admissions
- Scheduled clinic patients
- Acute clinic patients
- Phone calls
- Radiology or lab requests

(patient) Flow Principle II



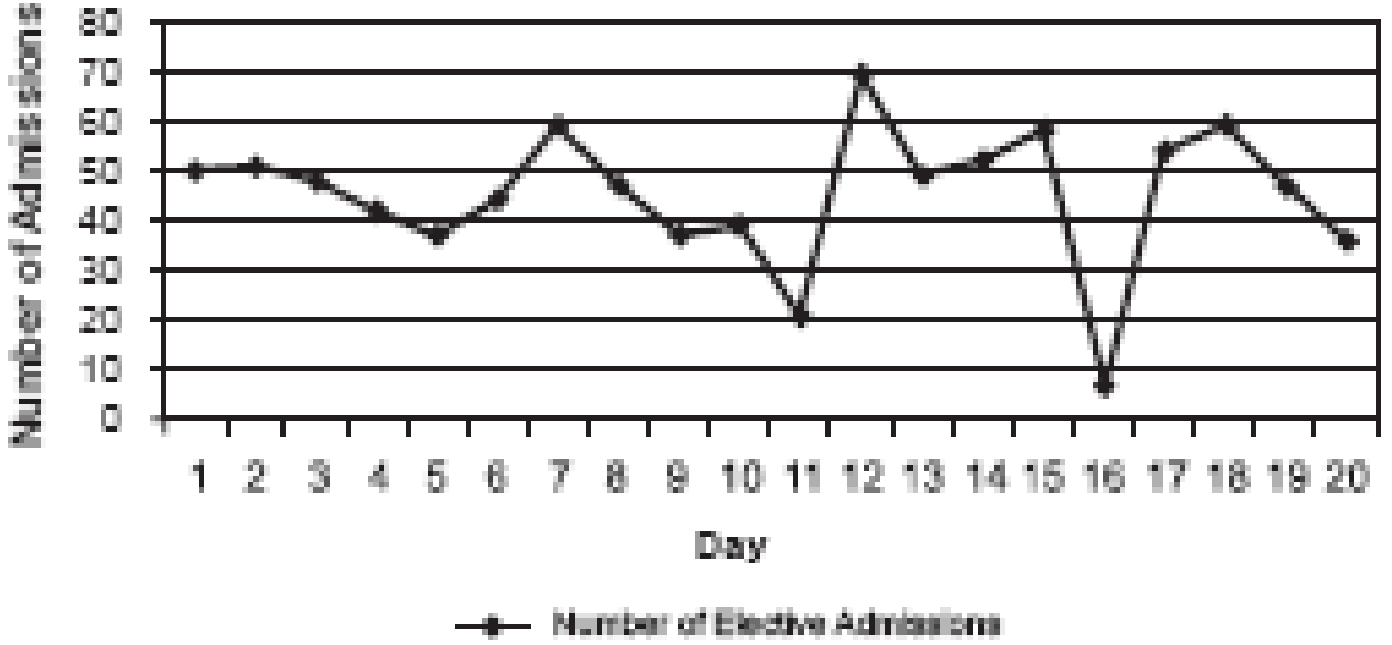
Artificial vs. Natural Variability

- Artificial: we cause it (scheduled admissions, scheduled clinic appointments, scheduled surgeries; weekday vs. weekend; business hours vs. non)
- Natural: we don't (ER presentation of new illnesses; acute clinic appointments)
- Huge problem

DVAMC: Artificial Variability

- Scheduled OR cases needing a bed: 0 to 10 per day
- Scheduled Med admissions: 0 to 6 / d
- Chemo admissions always on Monday
- Cardiac caths on Tuesday
- No ortho cases on Friday
- ERCP on Tuesday
- On call every fourth night…

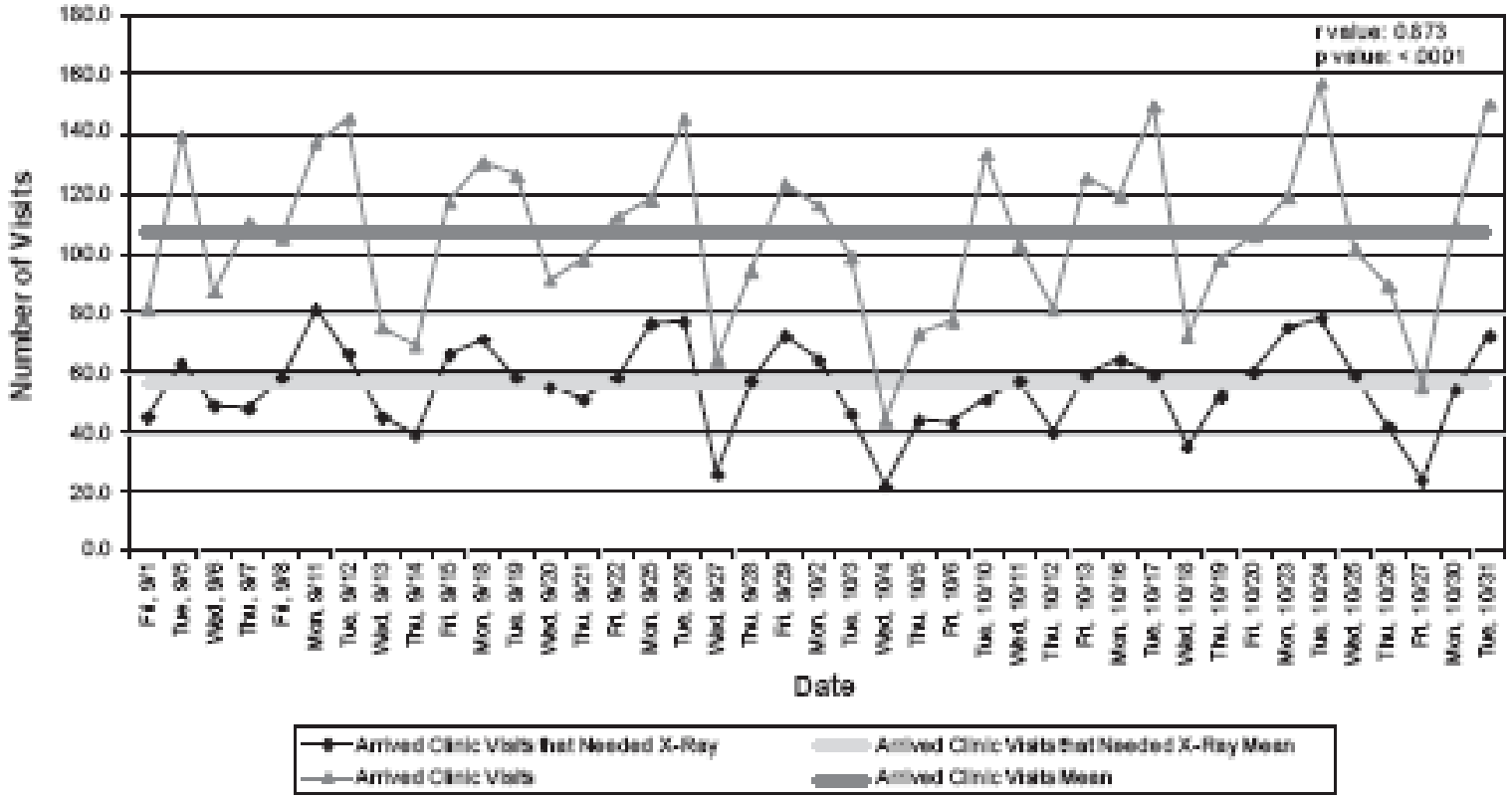
Figure 1-2. Elective Admissions, Monday–Friday, in a 20-Day Period



This figure shows the number of elective surgical admissions for Monday through Friday for a 20-day period.

Managing Patient Flow in Hospitals: Strategies and Solutions, 2nd Ed, 2010, p. 6.

Figure 3-1. Arrived Clinic Visits That Needed X-ray by Date, Nonholiday Weekdays, September 1–30



Ancillary services, such as radiology, as reflected in this figure, can be subject to patient flow and operational problems imposed by demand patterns dictated elsewhere.

Managing Patient Flow in Hospitals: Strategies and Solutions, 2nd Ed, 2010, p. 32.

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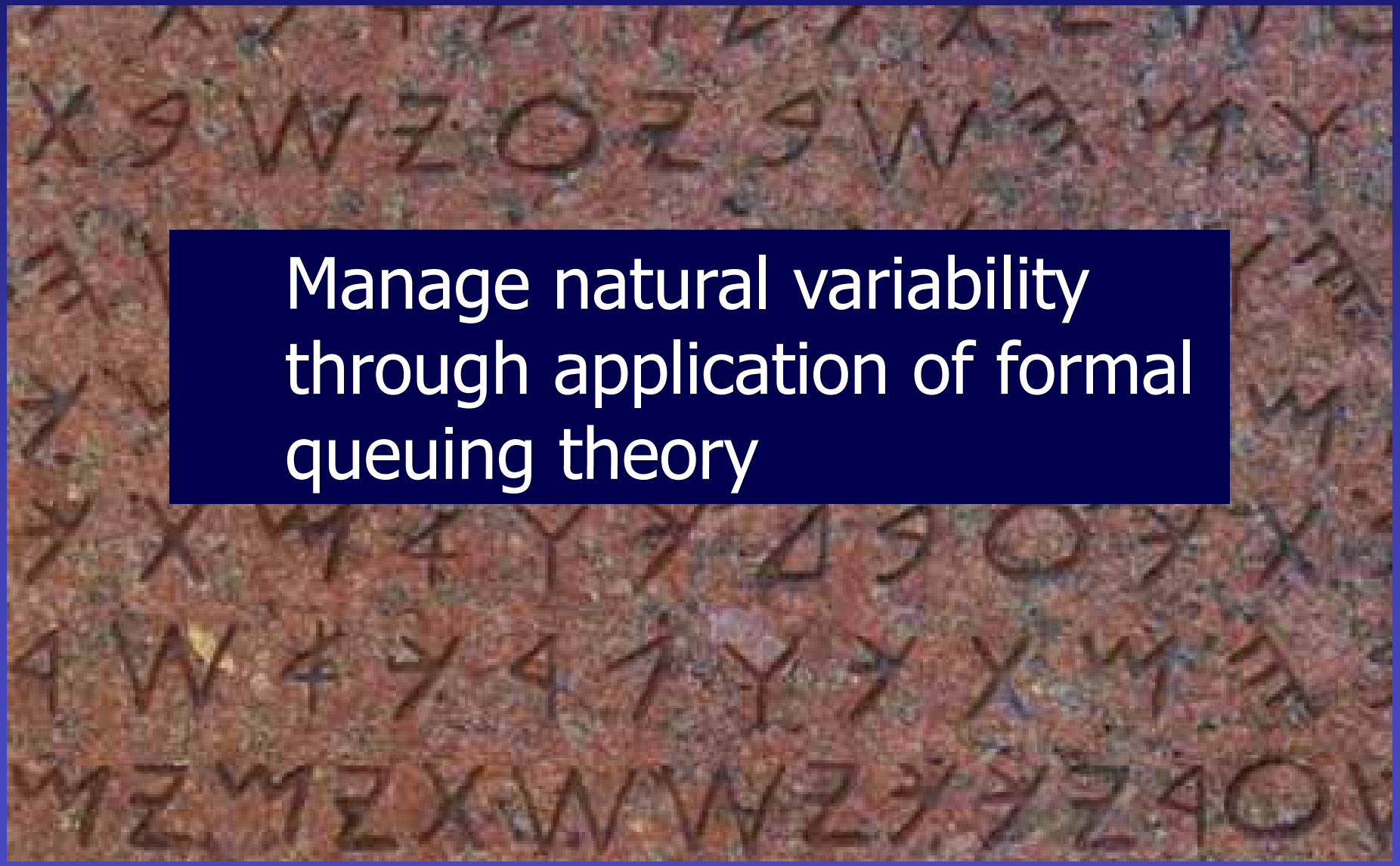
(patient) Flow Principle III



Bank or grocery?

- Bank: 4 tellers, 40 customers per hour, each visit takes 5 minutes
- Grocery: 4 checkers, 40 customers per hour, each visit takes 5 minutes

Bank or grocery?

- Bank: 4 tellers, 40 customers per hour, each visit takes 5 minutes: ONE LINE
- Grocery: 4 checkers, 40 customers per hour, each visit takes 5 minutes: FOUR LINES
- Is the wait any different in one versus the other?

Bank or grocery?

- Bank average wait = 5 minutes
- Grocery average wait = 25 minutes
- SINGLE QUEUE is inherently more efficient in a random arrival rate system

How many ICU beds?

- 10 beds, 60 pts/month, LOS 2.5 days
- New patients being added to the system
- Anticipate doubling of demand to 120 pts/m
- Each ICU bed construction cost $1 million

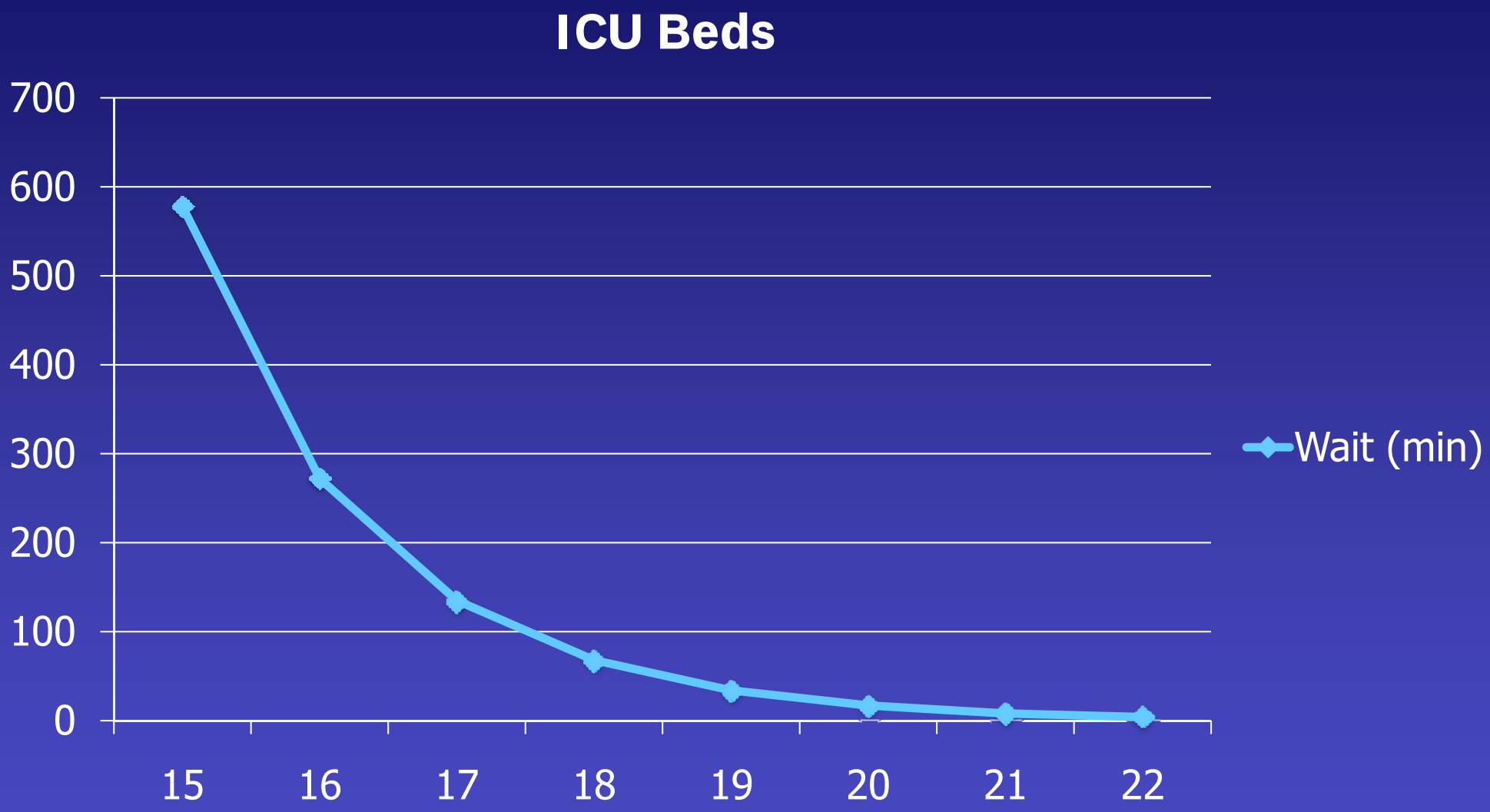
- How many beds will you need to build to maintain current availability?

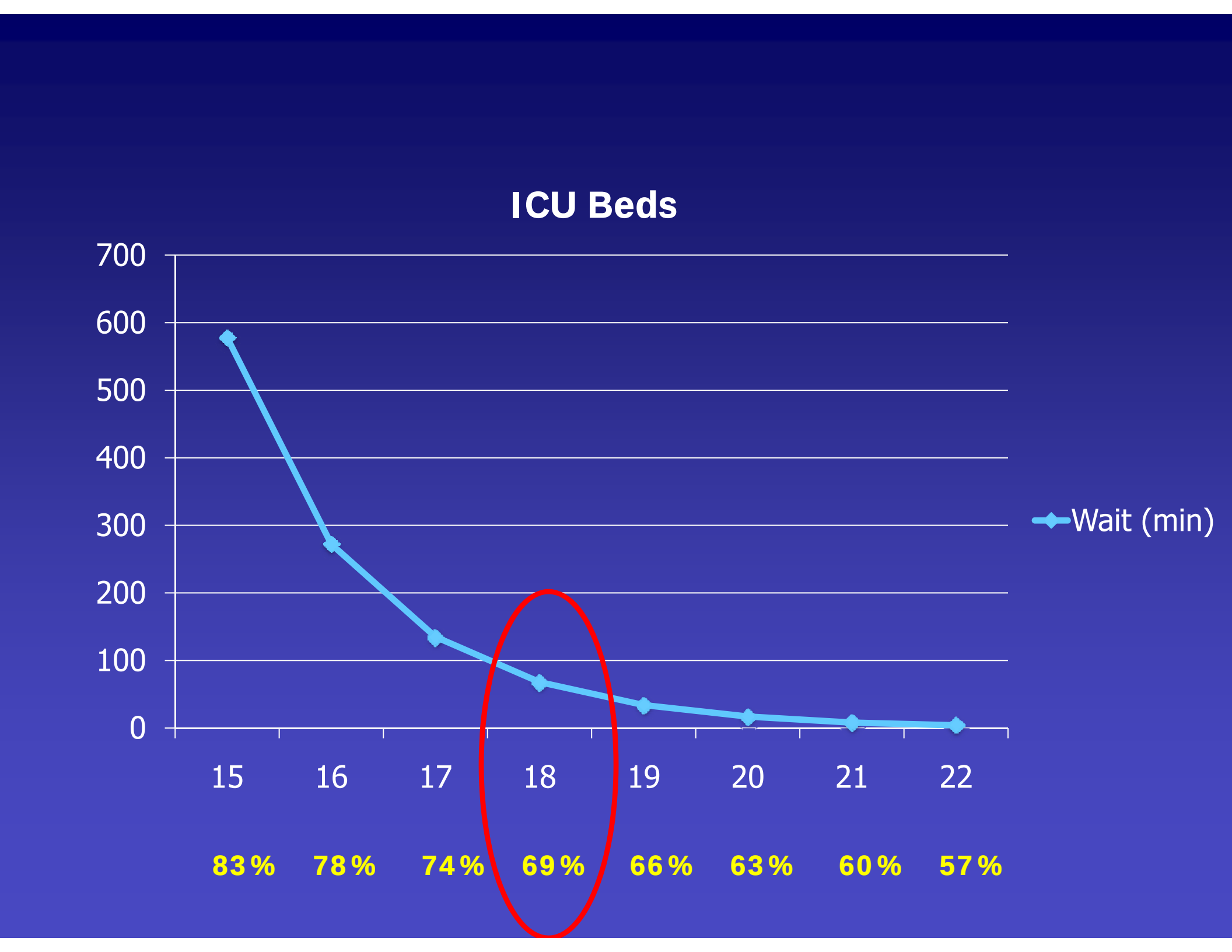
How many ICU beds?

1. Double the demand means double the supply. 20 beds will be needed.
2. I'm a good test taker and am sensitive to the context of this question, suspect that 1 isn't the answer, but am uncertain yet curious about the correct answer.

How many ICU beds?

1. Current state: 121 minutes average wait for an ICU bed
2. Future state 20 beds: 17 minute wait
3. Future state 19 beds: 34 minute wait
4. Future state 18 beds: 68 minute wait
5. Future state 17 beds: 135 minute wait


ICU Beds
700
600
500
400
300
200
100
0
15
16
17
18
19
20
21
22
Wait (min)


ICU Beds
700
600
500
400
300
200
100
0
15
16
17
18
19
20
21
22
83%
78%
74%
69%
66%
63%
60%
57%
Wait (min)

Queuing Theory

- Business/economic model of supply, demand, waits and delays
- Applies to NATURAL variability only
- Assumes Poisson distribution of demand
- Non-linear
- Once you get past about 80% occupancy, exponential rise in waits and delays
- Intuition can fail you…

Queuing Theory

- Only three variables:

- S = servers (beds, outpatient docs, X-ray machines)
- Lambda = arrival rate (demand)
- Mu = service time (inverse of LOS)
- Rho = traffic intensity - derives from above, and from which can calculate average waits, numbers in the system, probabilities

Queuing Theory

- Queues without rejection
- Queues with rejection
- Multiple queue flavors

Example

- On a network gateway, measurements show that the packets arrive at a mean rate of 125 packets per second (pps) and the gateway takes about 2 millisecs to forward them. Assuming an M/M/1 model, what is the probability of buffer overflow if the gateway had only 13 buffers. How many buffers are needed to keep packet loss below one packet per million?

Queuing Theory Pitfalls

- Non-random inputs into system: artificial variability creeping in
- Inaccurate input data: ok because you can model by changing variables slightly
- A little intimidating on the math side, but
- There are Excel spreadsheets that compute for you
- And there is modeling software (Arena) that allows you to create queuing models

"She's texting me, but I think she's also subtexting me."

Putting it all together

- Problem: patients are unable to get through on the office phones at certain times of the day, leading to frustration, un-necessary ER visits, and a lot of acrimony
- Your practice relies heavily on phone access to make appointments, request medication refills, relay acute changes in patient condition, and the like
- Hiring is expensive…

Step 1

- Group and analyze like sub-streams to gather data:

- Total number of calls per day / time of day / day of the week / even per month
- Sub-streams key: clerical vs. nursing vs. pharmacy
- Service time for each
- Number of servers (clerks, nurses)

Step 2a

- Eliminate artificial variability:

- You learn that appointment cards for follow-up are mailed in monthly batches, leading to a flood of scheduling calls a few days later
- All those answering phones have the same lunch time, the number of servers drops
- Answering service nights and weekends poor, leading to peaks Monday / am

Step 2a

- Eliminate artificial variability:

- Appointment reminders now emailed daily
- Rotating lunch and break times to keep numbers even
- Decision to analyze Monday and before 10 am demand periods as a separate stream; considering alternate answering service

Step 2b

- REASSESS the data – simply by limiting artificial variability you may have gained sufficient system efficiency that you no longer have waits / complaints from patients
- But you may still want to perform a queuing analysis – maybe now you're paying for TOO MANY people to answer the phones…

Step 3

- Apply queuing theory:
- For clerical calls (scheduling, insurance information, routine med renewals)

- Number of servers = 3
- Arrival rate = 30 calls per hour
- Service rate (1/service time) = 14 / hour
- Average wait = 3 minutes

Step 3

- Apply queuing theory:
- For nursing calls (triage, MD messages)

- Number of servers = 1
- Arrival rate = 5 calls per hour
- Service rate (1/service time) = 8 / hour
- Average wait = 13 minutes

Proposal

- Measures to eliminate artificial variability and to track same in the future
- You learn that another office very similar to yours is having the exact same problem. You consider the effects of joining forces with them:

Proposal

- For clerical calls (scheduling, insurance information, routine med renewals)

- Number of servers = 6
- Arrival rate = 60 calls per hour
- Service rate (1/service time) = 14 / hour
- Average wait = < 1 minute

Proposal

- For nursing calls (triage, MD messages)

- Number of servers = 2
- Arrival rate = 10 calls per hour
- Service rate (1/service time) = 8 / hour
- Average wait = 5 minutes

Proposal

- Bottom Line: with no extra personnel (admittedly with the up front cost of re-organizing) overall:
- Improved wait from 3 min to < 1 min for clerical calls
- Improved wait from 13 min to 5 min for nursing calls
- You also learn by modeling that operating with 5 clerks = 4 minutes, and 4 clerks = ∞

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"For God's sake, Edwards. Put the laser pointer away."