Shaping Demand: Institute’s for Healthcare Optimization Variability Methodology

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Objectives

Demonstrate the effect of patient flow management on quality of care, patient safety, mortality rate and hospital margins
Patient driven health care?

- Do patients want to spend hours/days in overcrowded EDs?
- Do they want to be taken care of by stressed nurses and as a result be subjected to medical errors?
- Do they want to acquire hospital infection?
- Do they want to be readmitted and start all over again?
- Do they want to deteriorate during their hospital stay?
Management of health care delivery system is a science

Health care delivery systems cannot be managed based just on feelings, experience, benchmarking and brainstorming

Which problem is easier to solve:

\[ \int \cos(ln x) \, dx = \frac{x}{2} \cdot [\sin(ln x) - \cos(ln x)] \]

or ... to design effective and efficient health care delivery system?
<table>
<thead>
<tr>
<th>Bed Count</th>
<th>Average LOS</th>
<th>Admission Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 beds</td>
<td>2.5 days</td>
<td>1 pt/day</td>
</tr>
<tr>
<td>10 beds</td>
<td>2.5 days</td>
<td>2 pts/day</td>
</tr>
</tbody>
</table>

Do they have the same waiting times to be admitted to these units?
Answer is…

1\textsuperscript{st} ICU

\( \tilde{T}_w = 0.13 \text{ days} \)

2\textsuperscript{nd} ICU

\( \tilde{T}_w = 0.018 \text{ days} \)
Gaps Cited by the Institute of Medicine in Crossing the Quality Chasm (2001)

- Ineffectiveness of care
- Lack of efficiency in delivery system
- Inadequate safety
- Insufficient patient-centeredness
- Inadequate timeliness of care
Major health care delivery problems:

- Patient Safety
- Nurse understaffing/overloading
- ED diversions/access to care
- High cost

Addressing variability is necessary, although not sufficient, to satisfactorily resolve these problems.
How unsmooth census looks like?
(no holidays, no weekends, weekdays only)
How did we staff, and how do we staff

Past staffing level

Current staffing level

Medical errors, readmissions, overcrowding, infections, mortality,…

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Variability is the key

- Litvak E, Bisognano M; More Patients Less Payment; Health Affairs, January 2011, vol. 30 no. 1 76-80
The Ideal Healthcare System

(100% efficiency)

1. All patients have the same disease with the same severity.
2. All patients arrive at the same rate.
3. All providers (physicians, nurses) are equal in their ability to provide quality care.
I) Clinical Variability
II) Flow Variability
III) Professional Variability

• Random
• Can not be eliminated (or even reduced)
• Must be optimally managed
Can your health care delivery system become a Toyota product line?
Designing and Testing Complex Mechanical Systems: The Family Car

- Hitting a pothole vs. high speed impact against the wall
- Health care “financial bumper”

Are the stresses an intrinsic part of health care delivery?
What Makes Hospital Census Variable?

Which would you expect to be the **largest** source of census variability?

- **ED Cases**: 50%
- **Other**: 20%
- **Elective-scheduled OR Cases**: 30%
The Answer Is…

The ED and elective-scheduled OR have approximately equal effects on census variability.

Why?

Because of another (hidden) type of variability…
Artificial Variability

• Non-random
• Non-predictable (driven by unknown individual priorities)
• Should not be managed, must be identified and eliminated
A key root cause of hospital bottlenecks and inefficiency

Daily Weekday Emergency and Elective Surgical Admissions June - August 2008

Artificial Variability

Source: Slide provided by Sandeep Green Vaswani, Institute for Healthcare Optimization

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Elective Surgical Requests vs. Total Refusals

Impact of Artificial Variability

Managing variability is necessary, although may not be sufficient, to satisfactorily resolve these problems.

- Decreased access, particularly for some of the sickest patients
- Extended delays in care delivery
- External and internal diversion of patients
- Nurse understaffing / overloading resulting in lower quality and safety
  
  “Census increases up to 25% above an adequate staffing level subject all patients in the nursing unit in question to the 7% increase in [mortality] risk…” ¹
- Decreased provider and staff satisfaction, decreased retention / recruitment
- Overall underutilization of assets leading to decreased revenue and increased cost

Artificial Variability is undesirable for

- Patients
- Providers
- Administration
- Payers (Govt. and private)

Why managing variability today is more important than before?
Does the healthcare system need more capacity?
At What Cost?

• Typical cost of new capacity
  • Inpatient beds - $1-3M in capital and $250K-800K annual operating expense
  • Operating rooms - $2 – 7 Million, $250K+ annual operating expense
  • Major imaging (CT, MRI, PET/CT, etc.) – approx. $1M+
  • Cardiac Catheterization Lab – approx. $2M
• Nursing and other provider shortages?
Alternative to Managing Variability!?
Can one achieve high quality of care without addressing variability in patient flow?
Variability and Quality of Care

• Variability has a significant effect on patient mortality, HAIs, readmissions, overcrowding, staff satisfaction and retention, etc.
• Details to be discussed at 3:45 p.m.
Variability Methodology and Operations Management Science allow you to determine your hospital potential rather than benchmarking yourself against other less successful hospital!
Where should we start with quality improvement?

Imagine that you have already implemented all your quality initiatives … except for smoothing peaks in hospital census/admissions, then

- Would your ED still be overcrowded?
- Would your nurses taking care of more patients than they should?
- Would you still have unsatisfactory levels of mortality, HAIs and readmissions?

Answers to these questions would direct you to the starting point in quality improvement.
Only after elective (mostly surgical) inpatient flow is smoothed the right size of the surgical hospital units could be determined for both scheduled and unscheduled admissions
Why Operating Room is a starting point?
How do you do this?

Questions that you may have:

- Why are we doing this project?
- Why will this project succeed?
- What exactly are we going to do?
- How much additional work is this going to mean for me?
- How will we ensure this project doesn’t do damage to what currently works?
Why do this project?

- Bumped or delayed elective surgery cases
- Delays in securing OR access for urgent and emergent cases (transplantations)
- Overburdened nurses, medical errors, high overtime, excessive nurse vacancies
- Lack of timely access to nursing units
- ED overcrowding and boarding
- Unsatisfactory quality of care
- Inadequate patient, provider and staff satisfaction

“By smoothing the inherent peaks and valleys in patient flow, and eliminating the artificial variabilities that unnecessarily impair patient flow, hospitals can improve patient safety and quality while simultaneously reducing hospital waste and cost.”  Institute of Medicine, June 2006

JCAHO’s Patient Flow Leadership Standard - "LD.3.15 The leaders develop and implement plans to identify and mitigate impediments to efficient patient flow throughout the hospital.”
Expected Results

Phase I
Separation of Scheduled v. Unscheduled OR Flow

Expected Benefits
- Increase in surgical capacity / volume (Note: there will be no decrease in any individual surgeon’s volume as a result of this project)
- Decrease in patient wait times for emergent and urgent surgeries
- Decrease in OR overtime
- Increase in staff and patient satisfaction

Phases II and IIb
OR and Cath Lab Smoothing

Expected Benefits
- Further increases in capacity / throughput
- Enhanced patient placement in preferred beds
- Decrease in nursing stress
- Decrease in mortality and medical errors related to delays and patient misplacement
- Increase in transplantations volume
- Prevention of ED overcrowding

Phase III
Determination of Bed And Staffing needs

Expected Benefits
- Further decreases in patient wait times where they exist
- Further enhancement of patient placement
- Decrease in staffing expense
- Enhanced utilization of existing resources
- Accurate determination of capacity growth need (Additional Med/Surg bed requires ≈ $1 million in capital cost + over $.25 million annual operational cost)
How to make sure that there is an ROI?

- While the methodology and the sequence of phases is the same, this is not a cookie cutter approach. Every hospital is different.

- A few hospital examples
Surgical throughput up 10%
Bumped surgeries down 99.5%
ED waiting time down 33%
2.8 hour wait in one of state’s busiest EDs vs. 4 to 5+ hours for most of the academic hospitals in Boston
Phase II: Reduced nurse stress; 1/2 hour reduction (6%) in nurse hours per patient day in one unit ($130,000 annual saving)

Source: John Chessare, MD, then Chief Medical Officer at Boston Medical Center
### Case Study: Mayo Clinic (FL)

<table>
<thead>
<tr>
<th>CHANGES IN OPERATIONAL PERFORMANCE OF OPERATING ROOMS</th>
<th>Pre-Re-Design</th>
<th>Post-Re-Design</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surgical Cases (count)</td>
<td>11,874</td>
<td>12,367</td>
<td>4%</td>
</tr>
<tr>
<td>Surgical Minutes</td>
<td>1,757,008</td>
<td>1,844,479</td>
<td>5%</td>
</tr>
<tr>
<td>Prime Time OR Utilization</td>
<td>61%</td>
<td>64%</td>
<td>5%</td>
</tr>
<tr>
<td>Number of Overtime FTE's (average)</td>
<td>7.4</td>
<td>5.4</td>
<td>-27%</td>
</tr>
<tr>
<td>Staff Turnover Rate</td>
<td>20.3%</td>
<td>11.5%</td>
<td>-43%</td>
</tr>
<tr>
<td>Daily Elective Room Changes (Average/Mon)</td>
<td>80</td>
<td>25</td>
<td>-69%</td>
</tr>
<tr>
<td>Daily Elective Room Changes (%)</td>
<td>8%</td>
<td>2%</td>
<td>-70%</td>
</tr>
<tr>
<td>Cost/Case (added 15 OR Staff FTEs)</td>
<td>$1,062</td>
<td>$1,070</td>
<td>0%</td>
</tr>
<tr>
<td>Cost/Minute of Surgery (added 15 OR Staff FTEs)</td>
<td>$7.18</td>
<td>$7.26</td>
<td>1%</td>
</tr>
<tr>
<td>Staff Turnover Cost (millions)</td>
<td>$2.47</td>
<td>$1.40</td>
<td>-43%</td>
</tr>
<tr>
<td>Overtime Cost Savings</td>
<td>$111,488</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total OR Net Revenue (fee increase adjusted)</td>
<td>$93,929,569</td>
<td>$98,686,693</td>
<td>5%</td>
</tr>
<tr>
<td>Net Operating Income</td>
<td>$15,877,986</td>
<td>$21,957,708</td>
<td>38%</td>
</tr>
<tr>
<td>Operating margin</td>
<td>17%</td>
<td>22%</td>
<td>28%</td>
</tr>
</tbody>
</table>


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Johns Hopkins Hospital

- Waiting time decreased by 39%
- Compliance increased by 16.7% despite no dedicated Cardiac or Pediatric level rooms
  - Level I compliance increased from 24% to 81%
- Throughput increased
  - 5 cases per day in the GOR/Weinberg
  - 4 cases per day in JHOC
- Prime Time Utilization provides additional room for substantially more throughput
  - Additional 7 cases per NHW at 85% PT utilization
- No increase in afterhours case minutes
- 6.6% decrease in the proportion of overtime minutes
- Case length decrease reflects increased team performance
  - Provides 1 “free” additional room per day

Source: Dr. Jackie Martin, Medical Director of Perioperative Services for the Johns Hopkins Hospital; Professor, Anesthesiology and Critical Care Medicine
## Phase I Estimated ROI

<table>
<thead>
<tr>
<th></th>
<th>Relative to Assessment (Mar-Jun 2010)</th>
<th>Relative to Pre-Implementation (Sep-Nov 2011)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Previous Cases/ NHW</td>
<td>87</td>
<td>89</td>
</tr>
<tr>
<td>Current Cases/ NHW</td>
<td>92</td>
<td>92</td>
</tr>
<tr>
<td>Incremental Cases/ NHW</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Incremental Margin/ Year*</td>
<td>$6,350,000</td>
<td>$3,810,000</td>
</tr>
</tbody>
</table>

*Assumes $5,000 margin per case x 254 Non-Holiday Weekdays per Year

Source: Dr. Jackie Martin, Medical Director of Perioperative Services for the Johns Hopkins Hospital; Professor, Anesthesiology and Critical Care Medicine
Case Study: The Ottawa Hospital

- Improved access for patients needing emergency surgery within 24 hours from 60% to 90%
- Reduced mortality rate for patients requiring urgent surgery from 3.9% to 3%, resulting in 40 lives saved
- Achieved efficiency gain equivalent to $9million by decreasing length of stay and better use of beds
- Reduced surgery cancellations due to bed shortages from more than 600 per year to zero
- Reduced Neurosurgery inpatient census from 46 to 33, resulting in a savings of 13 beds

Source: Jack Kitts, President and CEO: Re-engineering surgical patient flow saves lives, Canadian Healthcare Technology, December 19, 2013
Case Study: Cincinnati Children’s

Presentations at 9:15 and 10:30 a.m.

Source: Frederic Ryckman, MD, Cincinnati Children’s Hospital Medical Center
Eliminated 26 telemetry beds, resulting in a savings of over $10 million per annum while reducing cost of care and improving quality of care.

Decreased ALOS of telemetry patients by one full day leading to fewer hospital-acquired infections.

Wait time for telemetry bed decreased from 15 hours average (30 hours max) to three hours or less for 90 percent patients.

"The results have been remarkable. The average wait time for admission to a telemetry bed has been reduced, along with other savings." - Robert Lahita, MD, Chairman of Medicine.

Greater Baltimore Medical Center, Towson, Maryland (Phase III)
- Savings of approximately $2 million in avoided capital expenditures by opening needed medical beds rather than building telemetry beds
- Savings of more than $1 million per year in staffing costs

CentraState Healthcare System, Freehold, NJ (Phase III)
- Telemetry beds required decreased from 54 to 42 while providing adequate clinically appropriate access
- Inappropriate telemetry admissions decreased from 18% to 1%
- Average waiting times for incoming patients (i.e. ED boarding) decreased from 18.2 hours to about 9 hours
- Telemetry length of stay decreased 31% from 4.4 days to just under 3 days
- Delays in discharging patients out of telemetry decreased from 8.3 hours to 3.5 hours on average
- Patient satisfaction increased from 56% to 73%
Ocean Medical Center, Brick, NJ (Phase III)
- Telemetry ALOS decreased by 6%
- Patient waiting time (i.e., average ED boarding time) decreased 56%
- $1.07 million cost reduction

Overlook Medical Center, Summit, NJ (Phase III)
- ED boarding time for ICU admissions decreased by 21%
- ICU ALOS decreased by over 14% from 3.5 to 3 days
- 40% reduction in mortality
- Waiting time of discharge- and transfer-ready patients in the ICU decreased by 34% and 84% respectively
Improved capacity by 35% thereby improving access to care for patients

Increased number of patients treated by 25% by proper allocation of resources and scheduling practice

Reduced patient waiting time

Timely access to same day and next day service

Improved team performance, provider and patient satisfaction

Increased operational efficiency and quality of care

The impact of the IHO Variability Methodology® on Healthcare Performance (surgical, medical, outpatient) could be found here>>

Financial returns on investment at hospitals that have implemented this methodology range between $17,000 and $300,000/bed/year coupled with improvement in quality of care.
After surgical and medical inpatient flow are smoothed (and only then!) the right size of the hospital surgical units could be determined for both scheduled and unscheduled admissions.

Reminder: capital cost of one bed is between over $1 million and $3 million. Annual operating cost of one bed is greater than $0.25 million.
Quotes from the 2006 IOM report

The Future of Emergency Care in the U.S. Health System (Hospital-Based Emergency Care: At the Breaking Point)

- "Hospitals have direct control over operational efficiency, and have a number of variables within their control. They include such factors as impatient bed capacity, ancillary service delays, the scheduling of services and support staff…"

- "4.1 Hospital chief executive officers should adopt enterprise-wide operations management and related strategies to improve the quality and efficiency of emergency care."

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BEST CARE AT LOWER COST
The Path to Continuously Learning Health Care in America

INSTITUTE OF MEDICINE
OF THE NATIONAL ACADEMY
Transforming Health Care Scheduling and Access
Resource Utilization

“Optimized use of personnel, physical space, and other resources. Providing high-value care requires the efficient use of finite resources, yet much of health care today is suboptimal on both counts. Operations-management tools can help improve returns on fixed capital investments. Variability in the flow of patients into a hospital unit results in overcrowding, worse health outcomes due to fluctuations in staffing levels, increased staff stress, lower patient and staff satisfaction, reduced access to care, and higher costs. Strategies such as Queuing Theory and Variability Methodology can be used to eliminate sources of artificial variability, improving occupancy without increasing staffing or capacity or reducing lengths of stay. Furthermore, systematic process improvement efforts such as Lean can be used to make more efficient use of personnel and other resources. Structured analysis of daily work can eliminate inefficiencies, increase value-added time spent with patients, reduce staff stress, and optimize the use of supplies and other resources.”
IHO State-wide collaborative to improve patient safety and quality of care while reducing its cost

Partnership for Patients - New Jersey

News

On January 30, NJHA in collaboration with The Institute for Healthcare Optimization kicked off Partnership for Patients-NJ, part of a national initiative from the U.S. Department of Health and Human Services to improve the quality, safety and affordability of healthcare, Learn more»

Patient Flow/Throughput
The New Jersey Hospital Association has provided IHO Variability Methodology™ to NJ hospitals to help them improve patient safety and flow/throughput. Some of these resources and the list of the NJ Patient Flow Collaborative Members have been publicly disseminated, Learn more»

U.S. Senator Robert Menendez (Senate Finance Committee) at the Partnership for Patients New Jersey kick-off on January 30, 2012
IHO State-wide collaborative to improve patient safety and quality of care while reducing its cost

- 11,800 to 17,300 additional patients that could be treated without adding inpatient beds or operating rooms
- Roughly 20,000 additional patients that could be accommodated in hospital emergency departments
- 21 percent to 85 percent decrease in wait times for emergency department patients to be admitted to a hospital bed
- Reductions in the length of hospital stays ranging from 3 percent to 47 percent for certain groups of patients

Learn more here: http://www.ihooptimize.org/who-we-work-with-aho-impact-multi.htm
What is here for me?

**Patients:**
- Reduced waiting time
- Improved access to care
- Reduced mortality and medical errors

**Nurses:**
- Reduced overtime
- Reduced workload
<table>
<thead>
<tr>
<th>Physicians:</th>
<th>Hospital:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduced waste of time</td>
<td>Better utilization of resources</td>
</tr>
<tr>
<td>Increased patient throughput</td>
<td>Reduced hours of ED overcrowding</td>
</tr>
<tr>
<td>Reduced overtime</td>
<td>Staff and patient satisfaction</td>
</tr>
<tr>
<td>Improve quality of care</td>
<td>More staffing resources</td>
</tr>
<tr>
<td></td>
<td>Reduced mortality and medical errors</td>
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<tr>
<td></td>
<td>Reduced length of stay</td>
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<td></td>
<td>Increased hospital throughput and revenue</td>
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</table>
IHO Variability Methodology® has been endorsed by…

- **American Nursing Association Board**: IHO Variability Methodology has been endorsed by the ANA Board as one of the key measures to improve patient safety.

- **American Hospital Association’s Hospitals in Pursuit of Excellence**: The Institute for Healthcare Optimization’s approach is recognized by the American Hospital Association as a key principle for achieving IOM’s Six Aims for Improvement: care that is safe, timely, effective, efficient, equitable, and patient-centered.


- **Government Accountability Office**: The Government Accountability Office recognizes variability in elective admissions as one of the key drivers of ED overcrowding.

- **American College of Emergency Physicians**: ACEP has recommended Variability Methodology as a key measure to reduce ED overcrowding.

- **The Leapfrog Group**: made reducing artificial variability in patient flow one of their Leaps for all US hospitals.
What is next?
Three alternatives:

1. Provide the resources (e.g., staffing) sufficient to meet current patient peaks in demand - historical scenario *(a dream about the old good times)*

2. Staff below the peaks and tolerate ED diversions, nursing overloading and medical errors - current scenario *(status quo)*

3. **Smooth artificial variability and provide the resources to meet patient (vs. provider) driven peaks in demand. Variability methodology can quantify and justify such additional resources**
“Off hand, I’d say you’re suffering from an arrow through your head, but just to play it safe, I’m ordering a bunch of tests.”
Stepping on the same rake

Ignoring Variability in Patient Flow
Effects of Flow Variability on Quality of Care and Patient Safety

2-4% increase in mortality risk for each exposure to an understaffed shift

Unmanageable Nurse: Patient staffing leading to overwork and stress

Up to 500%+ increase in odds of readmission

Diversion and delays for Emergency Department patients

Unnecessary launches of Rapid Response Teams

Increased medical errors, infections, and non-compliance with NQF safe practices

Managing Patient Flow in Hospitals: Strategies and Solutions, Second Edition


Patient Safety and Quality of Care:
http://www.ihoptimize.org/knowledge-center-publications.htm
Summary

- **Scientific** managing variability in patient flow is absolutely necessary to increase overall hospital patient throughput while improving quality of care, patient safety and reducing nursing workload.

- It requires *rigorous data analysis, scientific management of operations, clinical and organizational behavior expertise.*
Questions:

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