

Program for Management of Variability in Health Care Delivery

<http://management.bu.edu/research/hcmrc/mvp/index.asp>

**Managing Variability in Patient Flow is the
Key to Improving Access to Care, Nursing
Staffing, Quality of Care, and Reducing Its
Cost**

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McDonald's vs. Burger King*)

Operating systems have huge impact on work climate, staffing, manageability and financial results

*) Harvard Business School, 1980, cases #681-044 and #681-045

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:

$$\int \cos(\ln x) dx = x/2 \cdot [\sin(\ln x) - \cos(\ln x)]$$

or ... to design effective and efficient health care
delivery system?

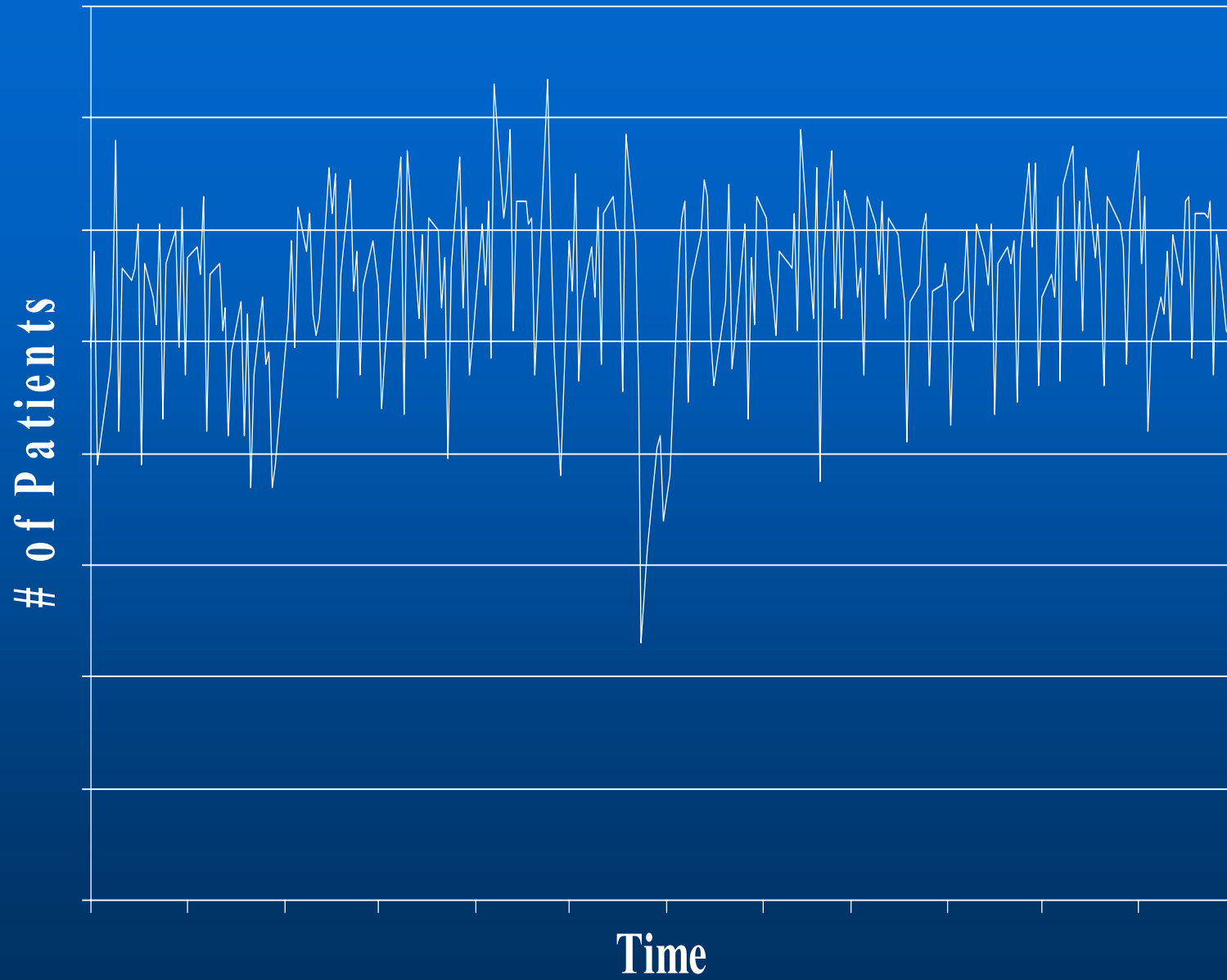
Major health care delivery problems:

- Patient Safety
- Nurse understaffing/overloading
- ED diversions/access to care
- High cost
- Hospital resources needed for bioterrorism preparedness

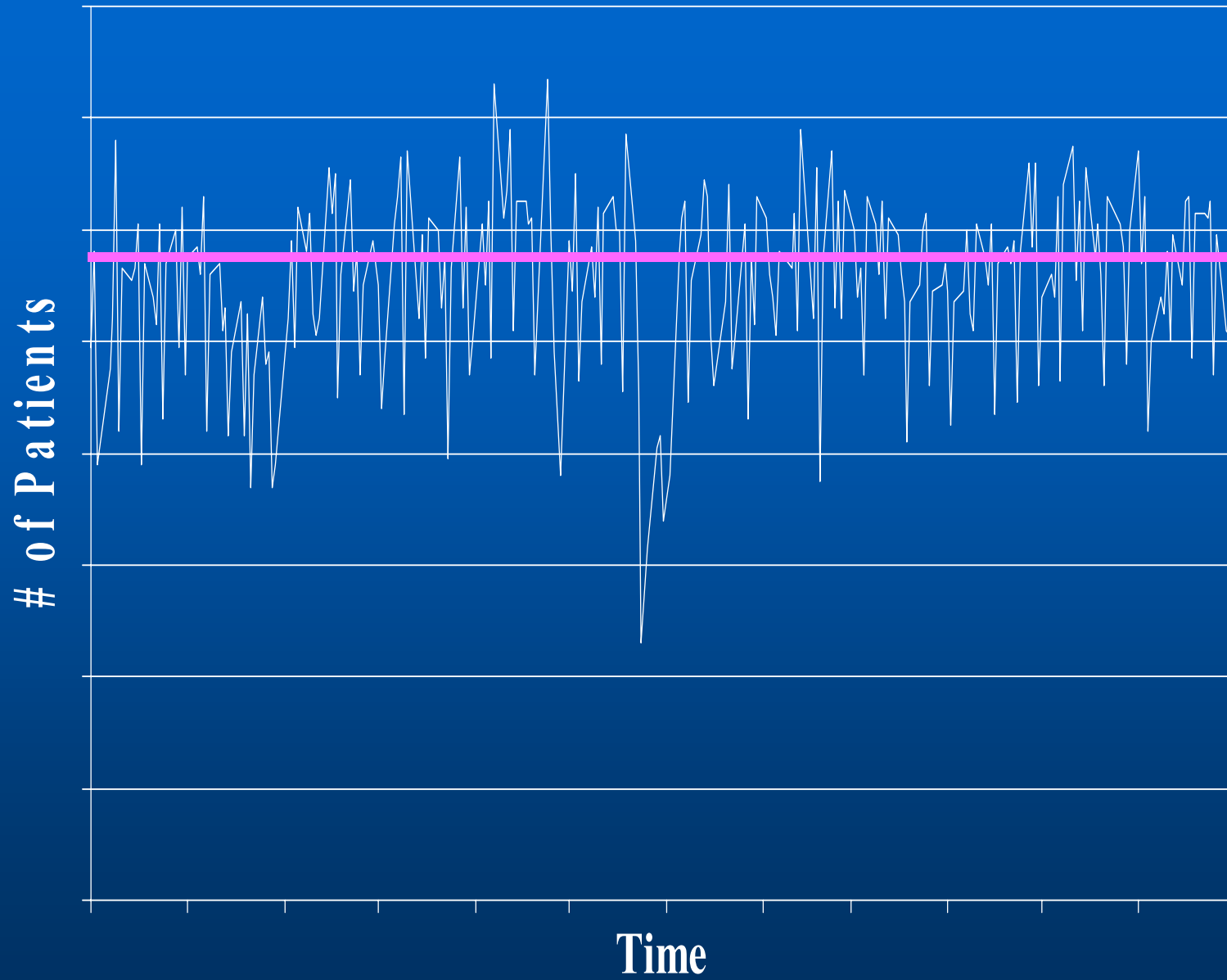
Addressing variability is necessary, although not sufficient, to satisfactorily resolve these problems.

Manifestations of variability:

How does demand look like?



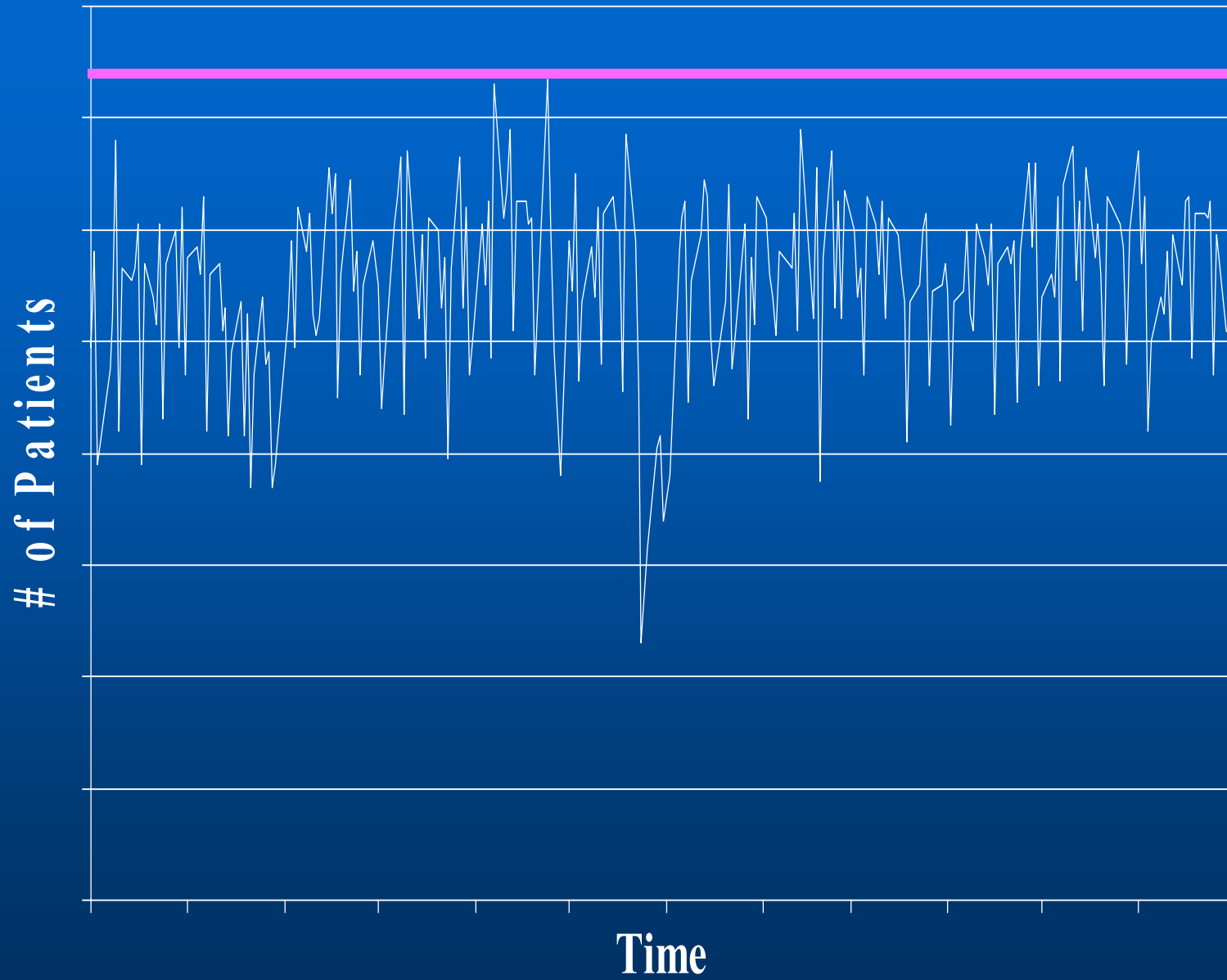
How does capacity look like?



Systemic Effects of Peak Loads

- Internal Divert –Patients sent to alternative floors\Intensive Care locations
- Internal Delays – PACU backs up
- External Divert - ED divert
- Staff overload – medical errors and inability to retain staff
- System Gridlock – Increase in LOS
- Decreased throughput and revenue

How should capacity look like to
guarantee quality care?



Assumption:

Capacity in its current form is not sufficient to guarantee quality care

What are the additional resources needed to guarantee quality care?

The answer is...

???

Will “good” staffing ratio solve
staffing problem?

Health management and cost-effectiveness: Status quo

Two main questions:

1. How much should health care cost?
2. Can we increase quality of care “free of charge”?

Take-out Pizza Example

Controlling the total cost, without knowing cost of delivery, decreases quality.

Variability is the Universal Key



Litvak E. & Long MC. Cost and Quality Under Managed Care: Irreconcilable Differences? American Journal of Managed Care, 2000; 6 (3): 305-312.

http://www.ajmc.com/files/articlefiles/AJMC2000MarLitvak305_312.pdf

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.

Variability as the source of system stress

1. Clinical stress.
2. Patient flow stress.
3. Stress by variation in professional abilities or teaching responsibilities.

I) Clinical Variability

II) Flow Variability

III) Professional Variability

**Natural
Variability**

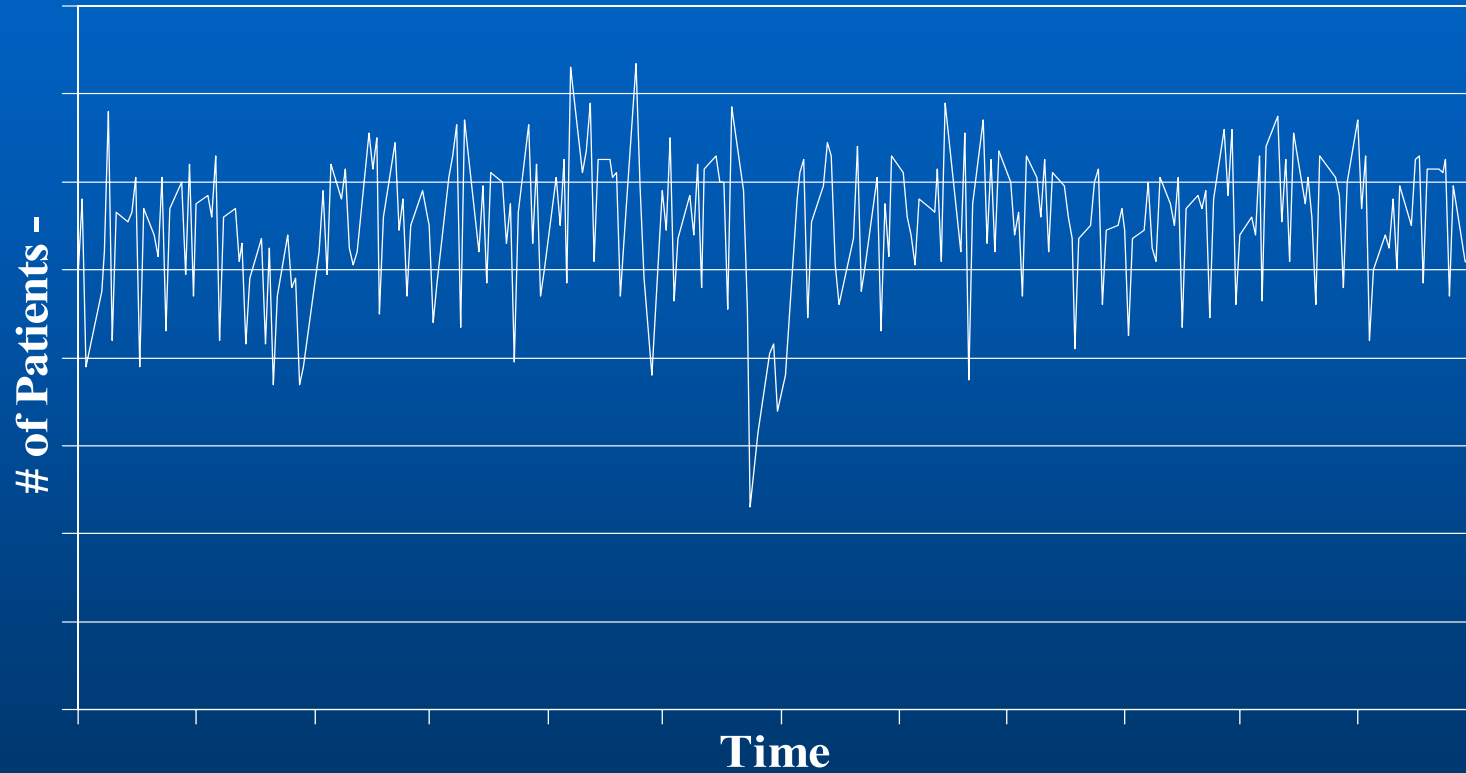
- **Random**
- **Can not be eliminated (or even reduced)**
- **Must be optimally managed**

Why managing variability today is
more important than before?

Designing and Testing Complex Mechanical Systems: 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?



What makes hospital census variable?

- If ED cases are 50% of admissions

and...

- Elective-scheduled OR cases are 35% of admissions

then...

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

The answer is...

The ED and Elective-Scheduled OR have approximately *equal* effects on census variability.

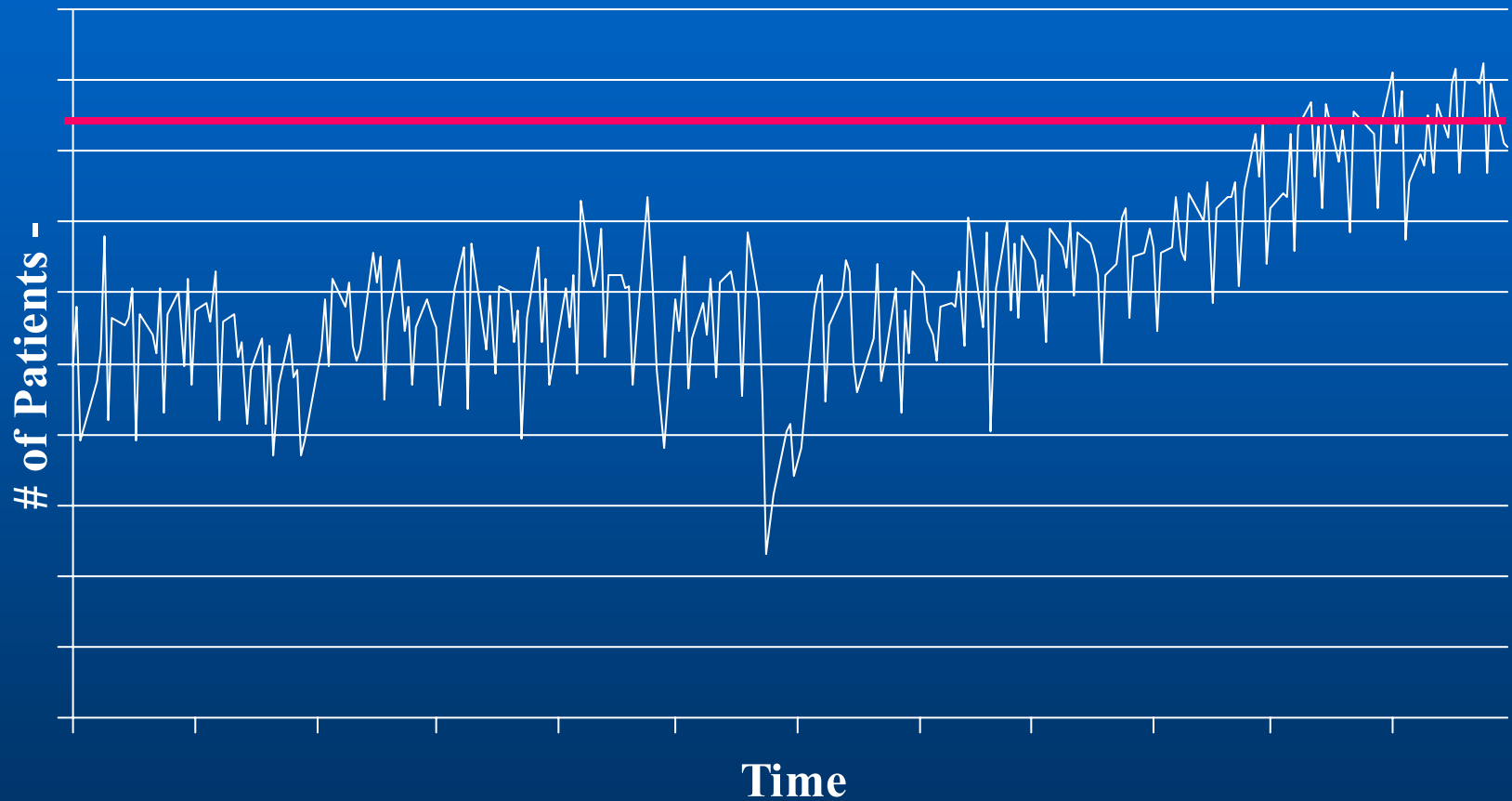
Why?

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

Variability in the Census - Rising Volume



Variability and patient mortality

“Each additional patient per nurse was associated with a 7% increase in the likelihood of dying within 30 days of admission and a 7% increase in the odds of failure-to-rescue”*

* Linda H. Aiken, Sean P. Clarke, Douglas M. Sloane, Julie Sochalski, and Jeffrey H. Silber. **Hospital Nurse Staffing and Patient Mortality, Nurse Burnout, and Job Dissatisfaction.** *JAMA*, 2002; 288: 1987:1993

Example:

Assumptions:

- 200 surgical beds
- average census for surgical beds 160
- staffing level 40 nurses (1 nurse per 4 patients)
- average residual from 160 patients census is 20% or 32 patients
- patients are distributed evenly between the nurses

How the mortality rate will change with 20% increase in surgical demand?

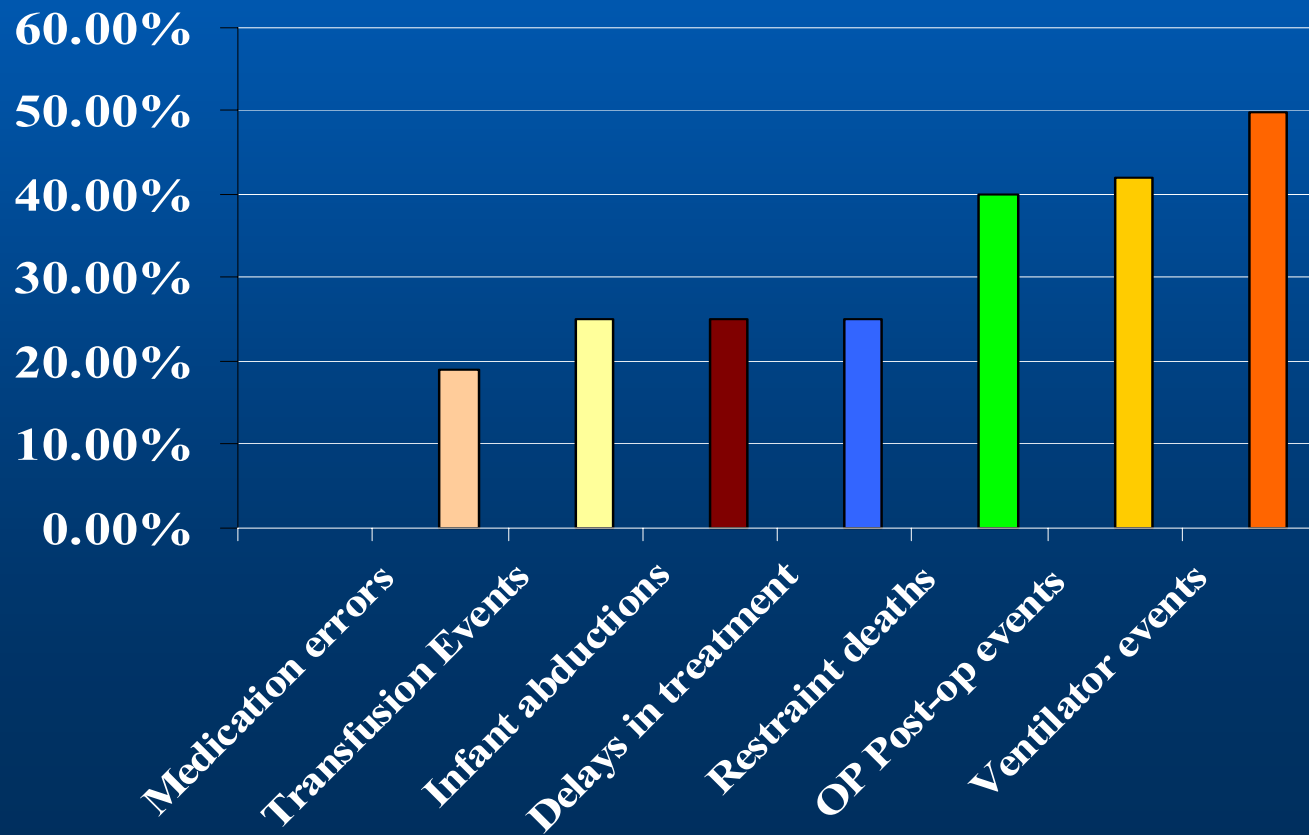
Results:

- 32 additional patients will be distributed evenly between 32 nurses: 1 additional patient per nurse or $4 + 1 = 5$ patient per nurse
- these 32 nurses now will take care of 160 patients, whose mortality rate increases by 7%
- if these additional 32 patients will be distributed evenly between 16 nurses, then each such nurse will take care of $4 + 2 = 6$ patients
- these 16 nurses now will take care of 96 patients, whose mortality rate increases by 14%

Variability and Sentinel Events

(JCAHO Sentinel Event Statistics, June 24, 2003)

Frequency of the Staffing Level Being a Root Cause of Hospital Sentinel Events

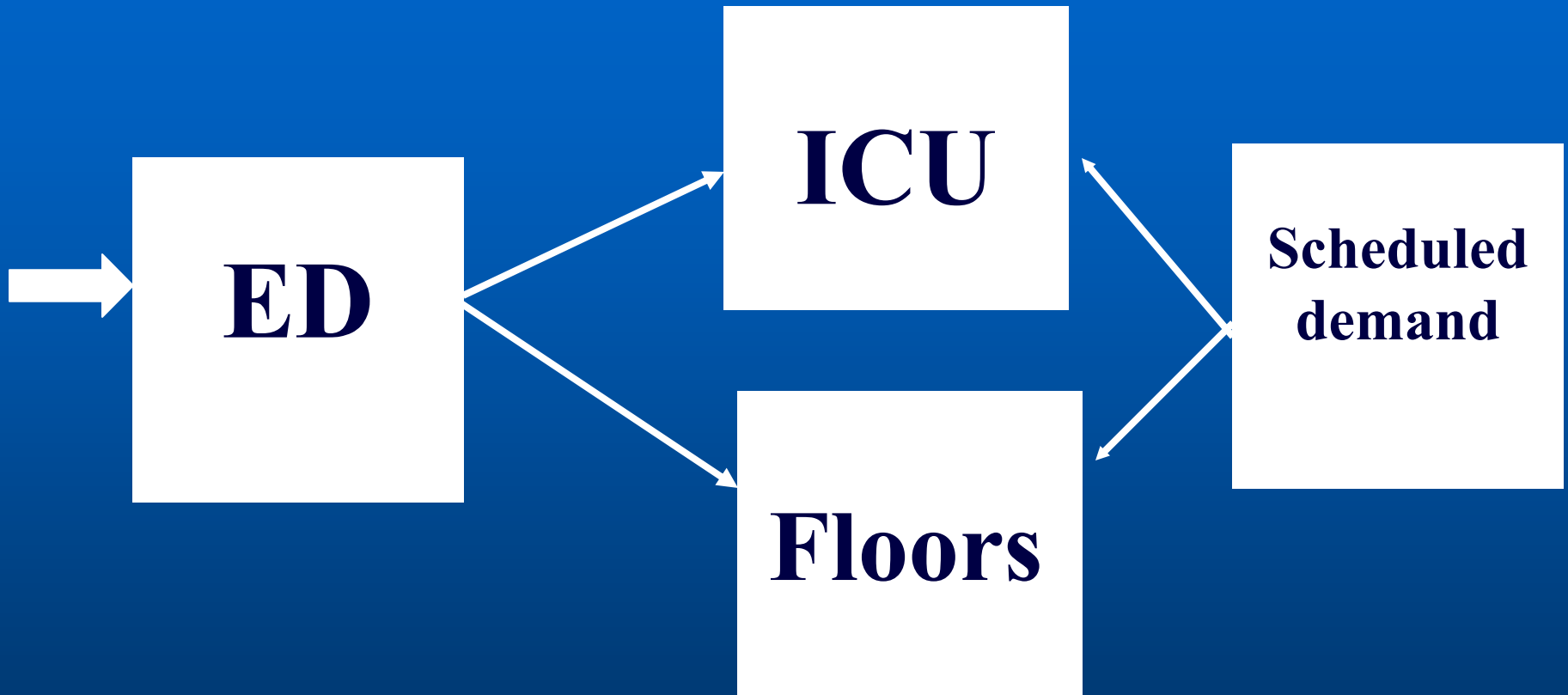


Variability and Quality of Care*

- Nurse overloading leads to 24% of all sentinel events
- When the level of training is limited, nurse overloading leads to 70% of sentinel events

*) Dennis S. O'Leary, President of JCAHO (personal communication)

Variability and access to care

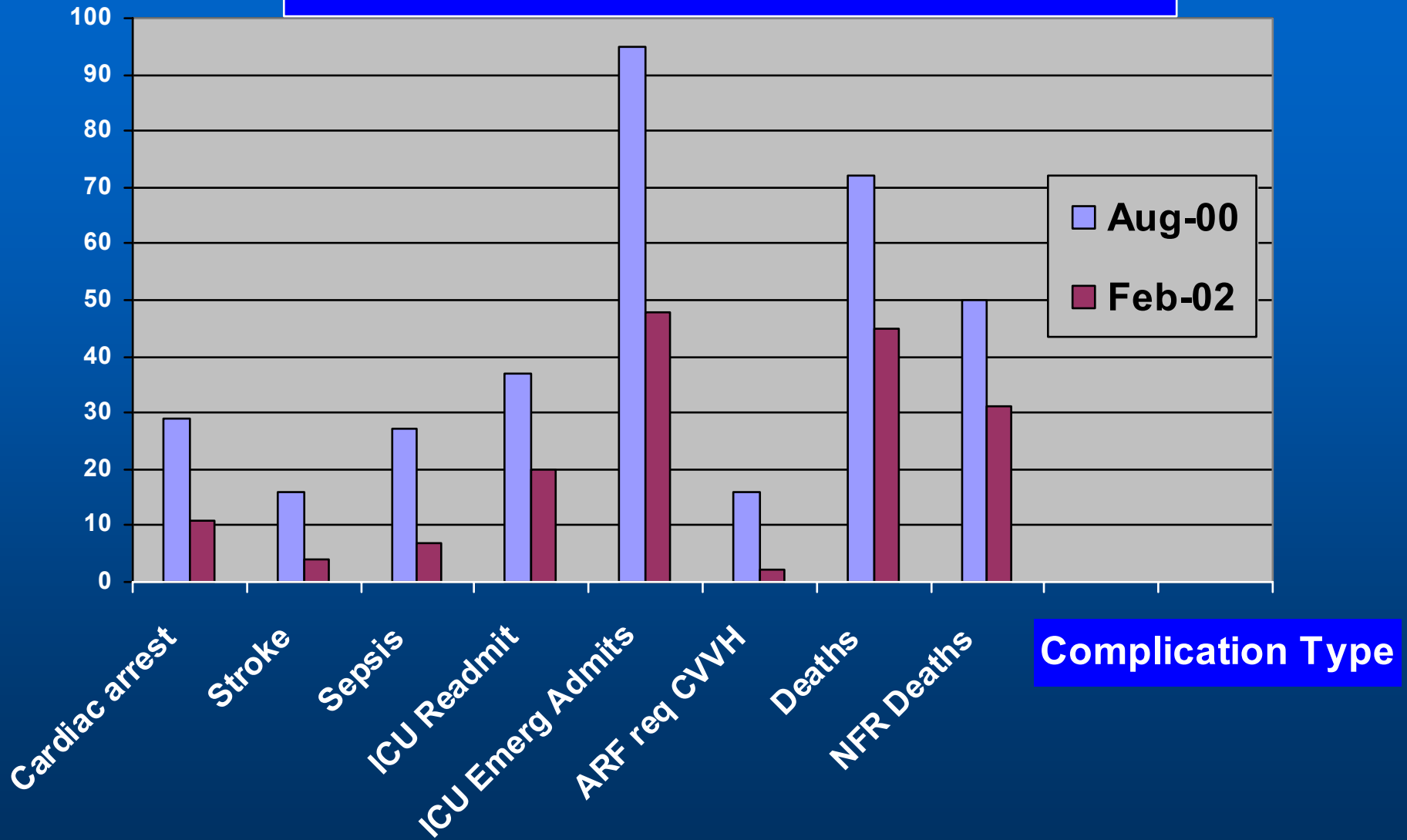


Who is Impacted by Variability

- Variability and the consequences of ED overcrowding disproportionately impact patients seeking admissions through the ED
- About $\frac{3}{4}$ of ED admissions are Medicare, Medicaid and uninsured patients
- One in 7 direct admissions had a recent ED visit
- Controlling for medical conditions, the acuity of ED patients is generally equal to or greater than that of direct admissions

Clinical outcomes of "internal ICU diversions" (Hospital in Australia)

Number of cases

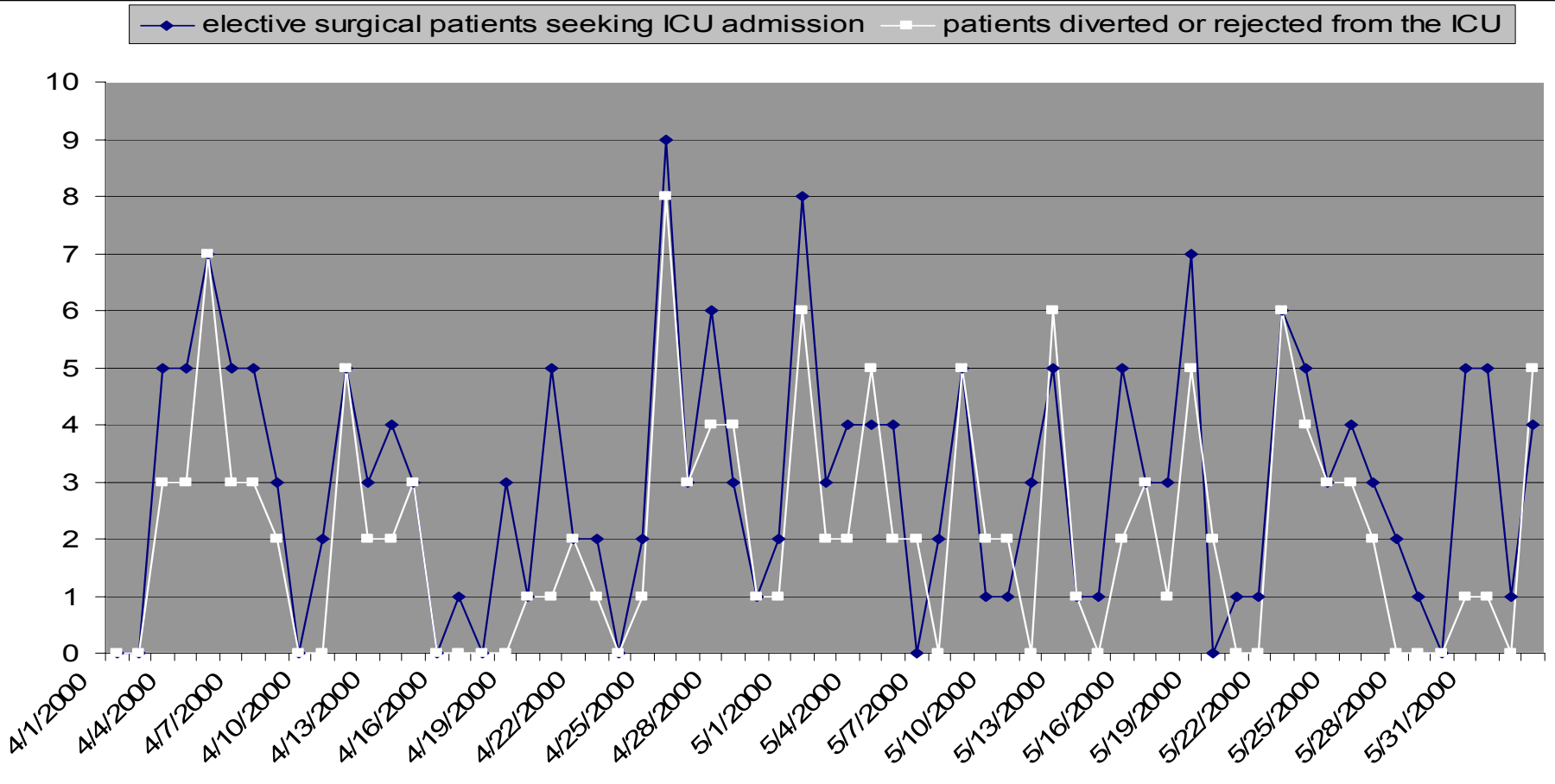


*Root Cause Analysis of Emergency Department Crowding and
Ambulance Diversion in Massachusetts,*
Boston University, 2002: ED diversions study under
Department of Public Health grant

http://www.state.ma.us/dph/dhcq/pdfs/Final_Report_Exec_Summary.pdf

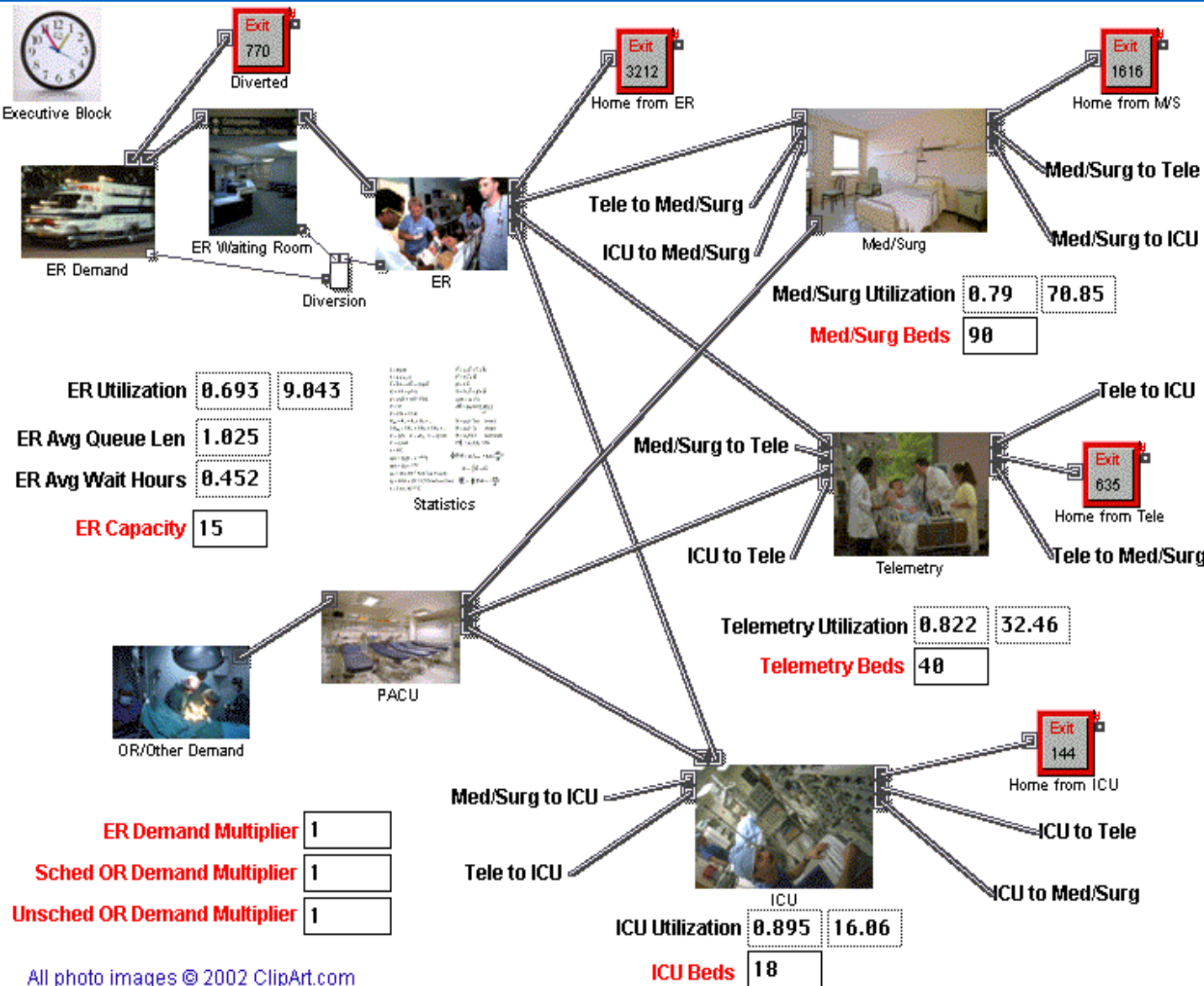
**When the scheduled demand is significant, there
was much stronger correlation between scheduled
admissions and diversions than between ED
demand and diversions**

Elective Surgical Requests vs Total Refusals



Michael L. McManus, M.D., M.P.H.; Michael C. Long, M.D.; Abbot Cooper; James Mandell, M.D.; Donald M. Berwick, MD; Marcello Pagano, Ph.D.; Eugene Litvak, Ph.D. **Impact of Variability in Surgical Caseload on Access to Intensive Care Services**, *Anesthesiology* 2003; 98: 1491-1496.

How many beds does a hospital need?



ER Queue to Med/Surg	
Ave. length:	0.004
Ave. wait:	0.014
Max. length:	2
Max. wait:	5.238

ER Queue to Telemetry	
Ave. length:	0.261
Ave. wait:	1.413
Max. length:	6
Max. wait:	25.72

ER Queue to ICU	
Ave. length:	1.084
Ave. wait:	8.277
Max. length:	6
Max. wait:	45.79

Smoothing Elective Case Load: Benefits

Better utilization of resources

- Reduced hours of ED diversions
- Staff and patient satisfaction
- More staffing resources: better tolerating peak loads
- Reduced mortality and medical errors
- Reduced length of stay
- Increased hospital throughput
- **Increased surgical throughput**

Problems that we have encountered

- Lack of Operations Management educational efforts
- Hospital IT systems have not been oriented on collecting data on patient flow

Success stories

Capping Admissions: Luther Midelfort Mayo Health System Study

300 beds community hospital

(March-December, 2001)

- increased patient throughput increased patient throughput through better utilization of hospital capacities (the opportunity that was previously lost) resulted in the increased revenue of about **\$200,000/month.**
- increased percent of patients put into bed within 1 hour from **23% to 40%**
- Emergency Department diversions have been reduced from **12% to 1-2%**
- **overall** number of open nursing positions decreased from about **10% to 1%**

“Recognition of variability and
smoothing artificial variability [is] the
only answer”

Roger Resar, MD, leading author of the Mayo
study

Smoothing scheduled surgical case
volume through separation of scheduled
and unscheduled Operating Rooms
(IHI Patient Flow)

Christy Dempsey, Kenneth Larson. *Improving
Flow Through perioperative services. A Practical
Application of Theory*. White paper. St. John's
Regional Health Center, Springfield, MO 65804

Action:

- **Eliminated block times in one out of 22 Operating Rooms (4.5%) and made it unscheduled**

Results:

- **Surgical throughput/revenue increased by 5.1%**
- **Waiting times for unscheduled patients reduced by 45%**
- **Reduction in overtime and improved nursing satisfaction**
- **Surgeons are not routinely working late into the evening on add-on cases**
- **The surgeons involved realized a greater than 4.6% increase in revenue over this time period. This is a very conservative estimate.**

Boston Medical Center

Urgent Matters (RWJF)

Daily volume of elective SICU related vascular surgeries has been capped at the average plus level – 2/day

Results:

Nurse hours per patient in the corresponding unit dropped by 6% resulting in significant saving from this initiative alone

- Daily variability in nursing staffing as well as overtime hours have been reduced
- Stress to the OR staff, floor nurses, bed schedulers, patients, and surgeons has been reduced
- A higher than average number of vascular surgeries have been performed without canceling a single case for lack of beds

Smoothing the cardiac surgery schedule by changing block time distribution

- There was a problem with peak elective scheduling on Wednesday because the two large volume surgeons were both scheduling elective cases that day. One surgeon's block time has been moved from Wednesday to Friday. He had to move his clinic from Friday to Wednesday (almost a unique event in surgical practice)

Results:

- The crunch for SICU beds on Wednesdays has been eased
- SICU, which was the main bottleneck in patient flow is no longer a bottleneck and can admit more patients
- The number of PCU census peaks and valleys has been reduced by 44% (!)
- Hospital throughput increased by almost 5%

Block scheduling from one of the two Operating Room sets has been eliminated, and one room for urgent cases has been separated from the remainder of the OR

- Two ORs have been designated for to orthopedic surgery because it uses that much capacity and the other 4 rooms have been released to “open” scheduling. This should increase OR efficiency and reduce surgical backlog that exists in the face of a 50% utilization rate due to the block scheduling
- Quantitative results are not available yet – the data are being processed

Three alternatives:

- Provide the resources (e.g., staffing) sufficient to meet current patient peaks in demand - historical scenario
- Staff below the peaks and tolerate ED diversions, nursing overloading and medical errors - current scenario
- Smooth artificial variability and provide the resources to meet patient (vs. schedule) driven peaks in demand. Variability methodology can quantify and justify such additional resources