Bed Capacity Planning and Smoothing Using Computer Simulation on the OR Master Schedule

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Outline

• Brief introduction
• Hospital bed capacity planning
• Operating room Master Surgery Scheduling
The Importance of Health Care

- Health care is North America’s largest single industry.
- Estimated total spending in Canada was $219 billion (CN) in 2015. ($2.9 trillion in the US)
- In Canada, in 2013, $4,569 US per person was spent on health care compared to $9,086 in US
• Providers are private.
• Gov’t pays for services (like US Medicare)
• Covered if:
  – “Medically necessary”
  – Done in a hospital
  – Done by a doctor
• 1990 – Internationally recognized leader
• 2000 – We had slipped significantly
• 2008 – Major funding increases – improving
• 2012 – Major funding challenges!
## Commonwealth Report 2014

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Notes: * Includes ties. ** Expenditures shown in $US PPP (purchasing power parity); Australian $ data are from 2010.

Background

- Master Surgical Schedule
- Revised every 6-12 months
- Block booking OR time
- Major driver of resource utilization downstream (PACU, ICU, beds) and upstream (wait lists).
- How can you manage the volumes?
- I will discuss two applications.
Hospital Bed Capacity Planning

Tian Mu Liu and Michael Carter
Model Objective – To estimate the number of beds a hospital needs during a typical week in order to provide a given level of service

- We constructed a prototype:
  - In-patient groups are categorized by: admission category, provider service, bed group
  - A typical week includes 21 shifts (seven days a week and three shifts a day)
Model Overview

- Use one year of historical data
- Model surgical patients based on a “typical” full week OR schedule
- Model medical/emergent/urgent patients based on random historical arrivals
- We do not consider ward capacity; we tell you how many beds you need in each service
- We simulate several weeks, and find a range (confidence intervals)
- Separate LOS: ED (admitted), ICU, ward, ALC
• Admitted patients – “Bed Blockers”: 10-17
• Bed demand peaks on weekday evenings (3-4 more)
• Number of required SCU beds range: 55-63
• Bed demand is relatively consistent throughout a week
Ward Bed Demand

- Ward beds range: 344-370
- Bed demand peaks on Thursday evening
Average Demand by Service

Average Number of Beds Required

- **1 Infants**
- **2 Pregnancy & Childbirth**
- **3 Pediatrics**
- **4 Mental Health**
- **5 Surgical**
- **6 Medical**
Balancing Demand

• By swapping blocks for a few surgeons, we can dramatically reduce the peaks in bed demand

• Tian has created an automated procedure

• Surgeons can be “fixed” in place
Surgical Ward and ICU beds
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<th>Tuesday</th>
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Revised ICU & Surgical Bed Demand

- Sunday:
  - Night: 38
  - Day: 41
  - Evening: 31

- Monday:
  - Night: 35
  - Day: 50
  - Evening: 33

- Tuesday:
  - Night: 44
  - Day: 53
  - Evening: 41

- Wednesday:
  - Night: 44
  - Day: 53
  - Evening: 41

- Thursday:
  - Night: 45
  - Day: 53
  - Evening: 42

- Friday:
  - Night: 45
  - Day: 43
  - Evening: 41

- Saturday:
  - Night: 39
  - Day: 41
  - Evening: 33

Average number of beds required
Successes and Challenges of Implementing OR Master Scheduling Model at Twelve Hospitals

Daphne Sniekers
Carolyn Busby
Mike Carter
University of Toronto
Goal:
To develop a single model that can be used by any hospital to simulate each hospital’s unique perioperative process

Tools:
Simul8 to simulate the process
Excel to house inputs variables to define each hospital
Model Objectives

1. Provide decision support through quantitative analysis of complex systems.
2. Develop a model that can answer tactical, mid- to long-term decisions for resource requirements and process flow.
3. The model is easily implemented and able to answer “what-if” scenarios.
Model Background

Patient Flow:

- Wait List Arrival
- Wait List
- Schedule to OR block
- OR LOS
- Inpatient LOS
Inputs/Outputs

- Hospital Structure
- Schedule Info
- Patient Info and Flow

Model

- Volumes
- Cancellation rates
- Bed Occupancy
- Utilization
Model Background

Scenario Testing Examples

• Changes in booking policies: i.e. short cases first, etc
• Changes in block schedule
  – Longer OR days
  – Change in service/surgeon assignments
• Increase in resources - PACU, ICU or ward beds
• Decreased ALC LOS times
• Reduced variability between surgeons, between booked time and actual time
Implementation
Saskatchewan Wait Times: (in 2011)

• “No wait longer than 3 months by 2014”
• Victoria Hospital in Prince Albert, SK.
  – Ortho wait times avg. 8 months; 90th % 18 months
  – Wanted a new Ortho surgeon plus OR time plus $2M
  – Used surgical model: average weekly throughput
  – Used current wait list and predicted arrivals
  – Ortho will be fine in 2014!
  – But, Gen. Surg. wait will grow!
  – And, serious bed capacity issues (they knew that)
Ring-fencing surgical beds

- High degree of medical off-serving in surgical beds
- Ring-fence surgical beds
- In exchange give some surgical beds to medical
- Result: Reduced cancellations & medical off-servicing (win-win!)
- Implemented in hospital based on recommendation
- Results matched model prediction
Implementation Examples

How can hospital increase throughput without adding additional ORs?

• Explored weekend and 2\textsuperscript{nd} shifts
• Determined how many additional beds would be needed
• Smoothing throughout week would be an asset
Validation: Do the model volumes match reality?

- OR does not actually start at 8:00 AM
- Some docs only using part of their allocation
- Reduced summer schedule that did not reduce as much as planned
- Particular service picking up majority of extra time available
- Urgent time being used for elective patients
- OR days running longer than planned
Challenges

• Data
• Validation
• Communication
• Politics
• Training/On-going use
• Impact assessment
Challenges

• Data
  • We need real patient level surgical, LOS, transfer data
  • Transfer from hospital – timelines, accuracy, multiple databases
  • Process into 35 Excel Input sheets – manual, lacking data checks (for now)
  • Timing – only available a few months later, stable time period, changing processes
  • Quality – often doesn’t add up!
Challenges

Validation

• Rules are made to be broken...
• Things often aren’t what they seem
• Some more eager to validate than others!
Challenges

Communication

• Different meanings e.g. “urgent”, “inpatient”, “cancellation”, “off-service”/”bed-spaced”
• Political impact “underutilization”, “not enough OR time”, “validation”
• Clarity on what model can and can’t do
Challenges

Politics

• Some stakeholders concerned outcome won’t favour their position
• Attempt to discredit from the start
• Mitigation: Neutral, Internal champion, validation, language, wide involvement in scenario generation
Challenges

Training/on-going use

• Varying degree of success: highly dependent on recipient
  • Leadership
  • Skilled Operator
• Not commercial product – not completely user friendly (yet!)
Challenges

Impact Assessment

• Often difficult to assess

• Model is one step, one piece of information
  • Quantitative “Decision Support”

• Impact/Implementation decision often made long after project is over
Conclusion

• Model has been successfully implement at 12 hospitals
• Wide variety of issues tackled
• On-going use in several hospitals
• Impact of Model is large due to it’s ability to be tailored to specific hospitals.
• Very important to have internal champion and awareness of internal politics
Thank you