

OR Applications in Healthcare: Opportunities & Challenges

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Int. Conf. in Honor of Prof. Ravi
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Overview

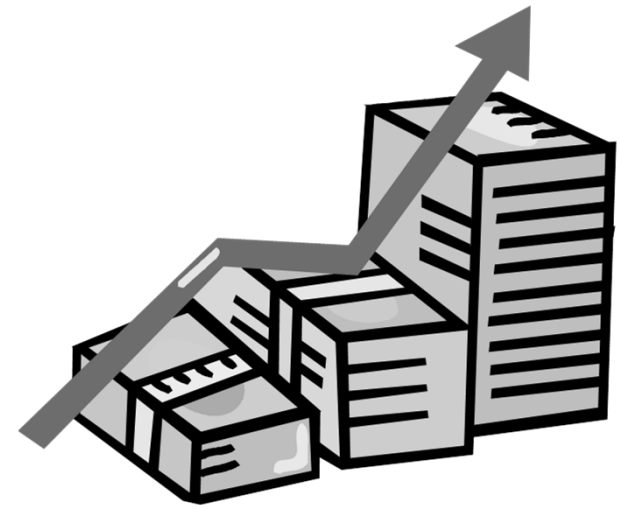
- Motivation
 - Focus on Hospitals Management
- Four / Five Problems in Healthcare Delivery
 - Traditional approach
 - Current issues / opportunities
 - Modeling & methodological challenges
- Concluding Remarks

Motivation

- ❑ Interest in healthcare delivery is universal – developed economies as well as developing countries
- ❑ Increasing focus on costs, efficiency and affordability
- ❑ Globalization
- ❑ Competition

Health care costs have been soaring high!

- In 2007, the U.S. spent about 16% of GDP or almost \$2.26 Trillion on Health Care (Ref: Wikipedia) or \$7,439 per person.
- Health care spending in U.S. is projected to reach 19.5% of GDP by 2017.
- Per capita health care cost in the United States surpasses that of most other developed countries.
- Situation in India
 - Spending is low 4.1% of GDP (public + private)
 - Public spending is abysmal – 1.1% of GDP
 - Health indicators very low, even in comparison with poor countries, e.g. Bangladesh, Pakistan etc.
 - Desire / commitment to achieve WHO / UN norms



Future does not look bright!

- Health care costs are projected to increase further due to
 - Rapid ageing of the population
 - Increasing number of chronic health care conditions
 - Soaring drug costs
 - Costs of new technologies
 - Inefficient internal processes
 - (Ref: Porter and Teisberg, 2006, Frist, 2005)
 - Focus on application of management principles to improve efficiencies & costs without compromising quality
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Growing Interest in Academia

- "ICU Admission Control: An Empirical Study of Capacity Allocation and Implications for Patient Outcomes," Song-Hee Kim et al., *Management Science*, Jan. 2015.
- "Waiting Patiently: An Empirical Study of Queue Abandonment in an Emergency Department," Batt & Terwiesch, *Management Science*, Jan. 2015.

P1: Rostering / Staff Scheduling

□ Planning Problem

- Staff hiring
- Scheduling

□ Traditional approach

- Deterministic
- Math programming / scheduling
- Cyclic schedules
- Week-end constraints
- Heuristics

Rostering / Staff Scheduling

Current Issues

- Uncertainty in requirements
- Flexibility
 - Multi-skilled, cross training
 - Full time, part time staff
 - Contract / Temp.
- Mix of full time, part time & temp hires
- Detailed schedules
- Role of flexibility

Rostering / Staff Scheduling

- Possible approaches
 - Stochastic models with embedded scheduling problems
 - Hierarchical planning
 - First stage – Hiring mix
 - Second stage – Detailed schedule
 - Simulation
- Challenges
 - Modeling of flexibility
 - Modeling / impact of uncertainty

P2: Resource Allocation Problems

- Sharing of common resources (operating theatres) between specialties & / or different services (emergencies vs electives)
 - Number of sessions (& session duration) to be allocated to various specialties for elective and emergency services
- Traditional approach
 - Dedicated facilities
 - Underutilization of resources & higher costs

Managing OTs: Some Contemporary Issues

- Multi-specialty, public / Private hospitals
- Emergency services & elective procedures
- Budget constraints
- Resource constraints
- Limited operational flexibility
- Expectations on service / performance

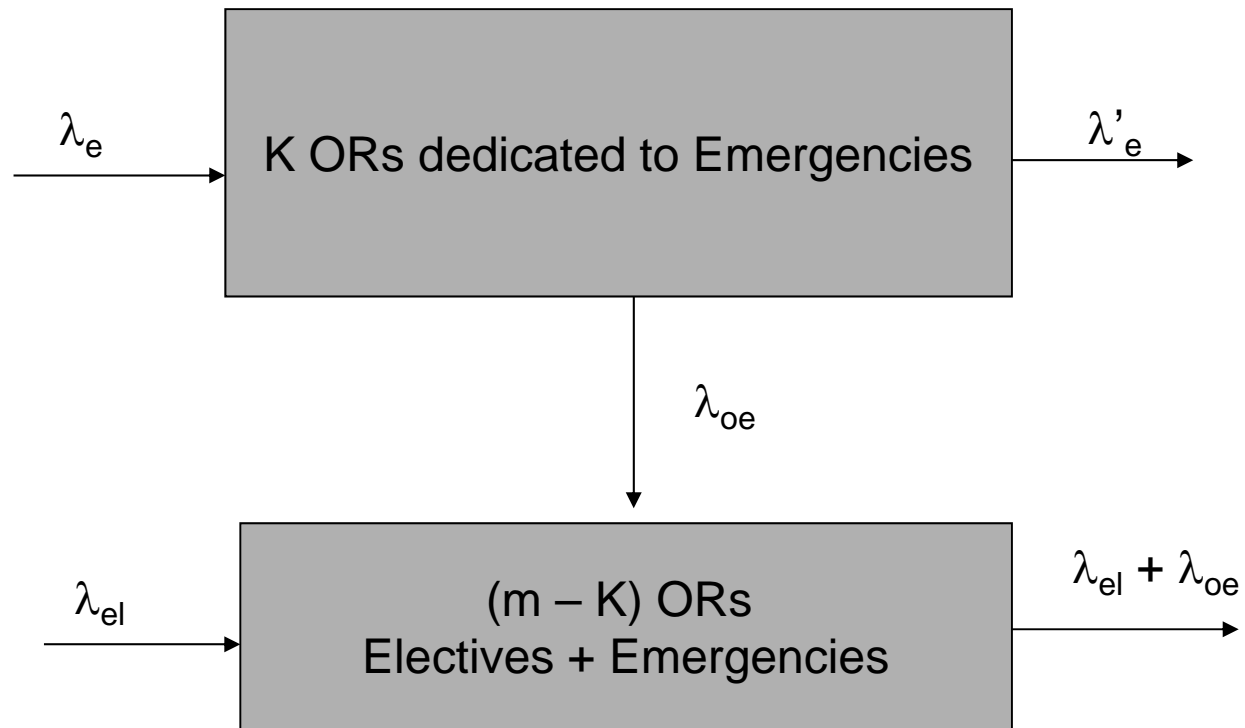
Managing OTs - Issues

- How to use the OTs effectively?
 - Implications for revenues
 - More electives mean more revenues
 - Hospital initiated postponements (HIPs) result in financial penalties
 - Well specified thresholds on waits for emergencies
 - Utilization of OTs

Managing OTs - Issues

- Should ORs be dedicated to emergencies? If yes, how many?
- Should emergencies be given priority over scheduled procedures?
- How many electives should be scheduled for a session?
- How should the hospital plan for OT?

Managing OTs - Model



Managing OTs - Results

- ❑ Completely dedicating ORs to emergencies and electives is not a good idea
- ❑ Dedicating some ORs for emergencies and permitting interruption of elective sessions for emergencies is a better approach
- ❑ Targeted interruption – designating certain specialties is more effective than use first available OR policy

P3: Product / Service Mix Problem

- Choice of service mix (with variants within each specialty)
- Traditional Approach
 - Tactical
 - Resources constrained
 - Multiple resources
 - Math Programming models (similar to those in manufacturing / production context)

Product / Service Mix Problem

□ Contemporary Issues

- Problem at strategic and tactical level
- Distinct market segments with demand dependency between segments
- Price and quality sensitive customers
- Ability to create variants of product based on quality and additional service
- Economies of scope and scale
- Learning effects
- Competition

Product / Service Mix Problem

□ Research Issues

- Modeling of heterogeneity, consumer choice and demand
- Modeling of costs
- Decision model for determining number of product variants, positioning and prices.
- Static and dynamic problems
- Modeling competition
- Impact of marketing decisions

P4: Quality of Healthcare Delivery

Scenario 1

- *All patients having surgeries in the morning session at a well known private hospital were instructed to arrive between 6.45 and 7 am. There were between 30 and 50 patients attempting to access the reception desk at this time. They were required to hand over any test results or medical notes that they brought and complete the necessary paperwork regarding private health insurance. The patients were seen on a first-come, first-serve basis. After registration, the patients were required to complete their pre-operative assessments by their respective anaesthetists before being transferred to OR.*
- *Both anaesthetists and nurses were observed to be searching for their patients, trying to ensure that the first patient on the surgeons' lists is ready to enter OR on time. There was chaos everywhere and everyone in the system appeared to be highly stressed.*

Scenario 2

- *A very valued surgeon, in a local, private hospital, is known to bring a lot of revenue into the hospital through his surgical patients. However, he is also known to modify his list in the last minute and he even modifies his list a day prior to the day of surgery. His secretary typically sends a tentative list about two weeks prior to the day of surgery to the hospital admission staff and sends a finalized list only a day prior to the surgery date.*
- *Due to the lack of confirmed data, the admission staff do not share the available information on the session with other departments. The nurse coordinator planned for a 5 o' clock finish on a particular Thursday evening based on a normal load of 6 patients in a session. Surgeon X had initially sent a list with 8 patients and had inserted one additional case on the last minute. The session on Thursday ended at 11 pm resulting in substantial overtime for nursing and technical staff.*

Quality of Healthcare Delivery

- Collaboration and coordination between the various stake holders providing service
 - Hospital
 - Medical specialists / professionals
 - Supporting staff
 - Equipment and supplies providers
 - Diagnostic labs & other service providers

Quality of Healthcare Delivery

- Practices / Lessons / Tools from Operations Management & Supply Chain Management
 - Process analysis
 - Systems
 - Lean philosophy
 - TQM

P5: Providing Affordable Healthcare

- ❑ Target population: Poor and below the poverty line (BPL) communities
- ❑ Assure basic healthcare
- ❑ Primary Responsibility with Government with implications for healthcare policy
- ❑ Recognition for need for partnership between public and private – non-profit and for profit entities

P5: Providing Affordable Healthcare: Issues

- Appropriate business models
- Innovations
 - Operational level – in processes to reduce costs, improve efficiencies
 - Improve access
 - Development of comprehensive approaches that include increasing awareness, education, training & prevention

Concluding Remarks

- Fertile area for applied work with potential for making an impact
- Wide range of problems / methodologies
- Data is available
- Potential for publication in medical & management journals
- Need to involve medical professionals

Thank you

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