

**Applying Operations Research in Improving Quality of Inpatient Surgical Care**



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**Organizations Involved**

- University of Toronto
  - The Health Care Resource Modelling Lab
- Hamilton Health Sciences Centre (HHS)
  - Perioperative Services
  - Clinical Appropriateness and Efficiency Program (CARE)
- Institute of Clinical Evaluative Sciences




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**Primary Team Members**

- University of Toronto
  - Jean Yong – MASc candidate
  - Michael Carter – Director, Healthcare Resource Lab
  - Carolyn Busby – Doctoral Candidate & Modeller
- Hamilton Health Sciences
  - Kelly Campbell – Director of Perioperative Services
  - Steve Metham – CARE Facilitator
  - Dr. Kevin Teoh – Head of Cardiac Surgery
- ICES
  - Dr. Jack Tu – Senior Scientist

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## Background

- **Background:**
  - Expansion of cardiac operating room activity
  - Determine new surgical booking policy
- **Objective:**
  - Facilitate strategic planning of cardiac surgical resource allocation
    - Determine OR schedule
    - Determine number of beds required in ICU and ward

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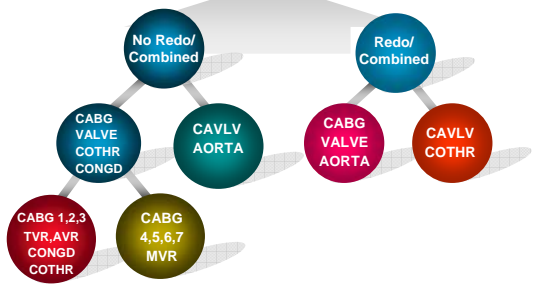
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## Surgery Grouping

Cardiac Surgery 2002-2005  
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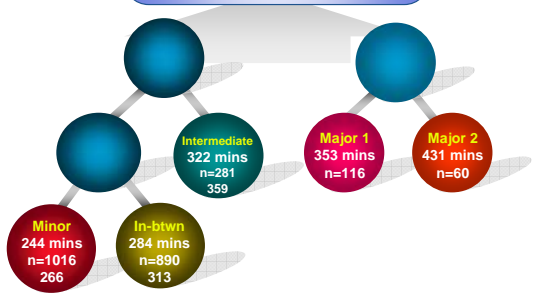
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## Surgery Grouping

Cardiac Surgery 2002-2004




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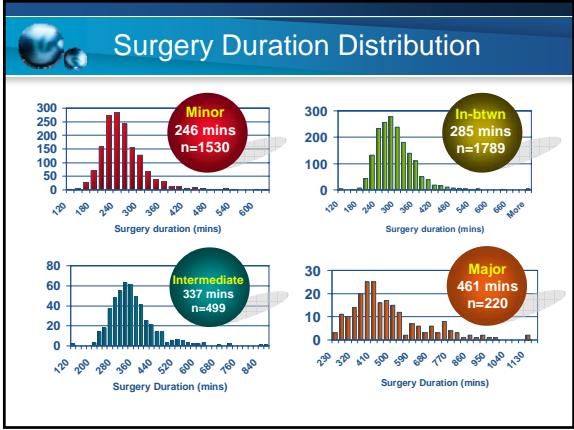
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- ### Discrete-Event Simulation
- Able to capture impact of variability in system
    - Capture extreme cases in the distribution, measure overtime
  - Able to assign individual attributes to patients, which affect the pathway of patients in the flow
    - Acuity of patients: Emergent, Urgent, Elective
    - OR procedure time
    - Length of Stay (ICU & ward)
  - Allow stakeholders to ask what-if questions

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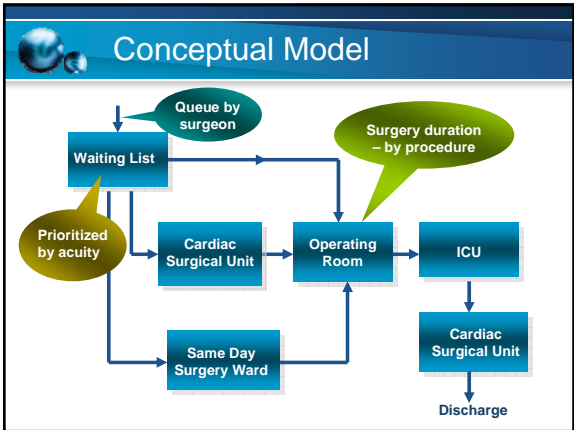
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## Performance Indicators

- Number of cases completed/year
- Cancellation rates
  - Lack of ICU/ ward bed
  - Out of scheduled time
  - More urgent case took precedent
- Operating room utilization
  - Under-utilization (hours/week)
  - Overtime (hours/week)
- Ward bed utilization (ICU & CSU)

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## Model Verification

- 50 replications of each year
- Imitate current scheduling rules
- Run the model with 2002 - 2005 data
- Compare output from the 4 models with historical data
- Experts' opinions
  - Meeting with clinicians

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## Results

2004	Historical	Model Avg	Std. Deviation
No. of cases/ year	1355	1275	33.5
Cancellations due to more urgent replacement /year	77	62	28.7
Cancellation due to lack of ICU beds /year	58	35	28.3
Cancellation due to out-of-time /year	48	73	11.2
Average overtime Hour/week	6.1	5.3	0.443
Average undertime Hour/week	16.6	30.6	1.84

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### Development Process

- Regular review with modeling results/scenarios and core team members from HHS
- Director of Perioperative Services, CARE facilitator, OR Manager, Chief Perfusionist, Chief of Cardiac Surgery, Director of Cardiac and Vascular Program

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### Applications

Can we meet provincial target with 4 ORs varying room length

Do we have enough ICU/ward capacity?

What if we pool all the surgeons' urgent slots together?

- Simulated what-if scenarios for 4 operating rooms to answer stakeholders' questions
- Encouraged clinicians to propose new ideas of how the system could be run differently for higher efficiency
- Tested over 10 scenarios

Can we book surgery differently?

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### Key issues from surgery

- Ability to achieve priority funded volumes
- Organization of block time – length and placement
- Available beds – ICU/ward
- Minimizing cancellation rate
- Development of booking rules
- Pooling of referrals
- System for urgent/emergent cases

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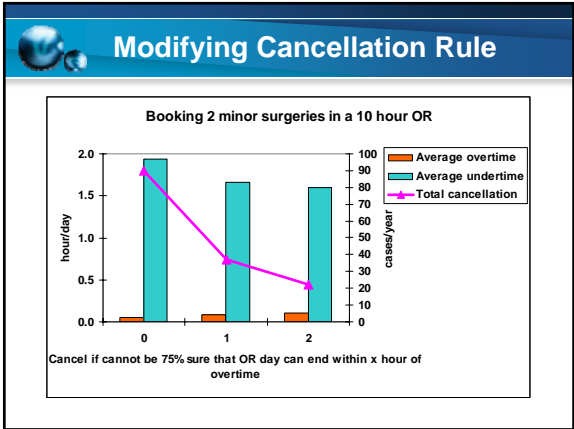
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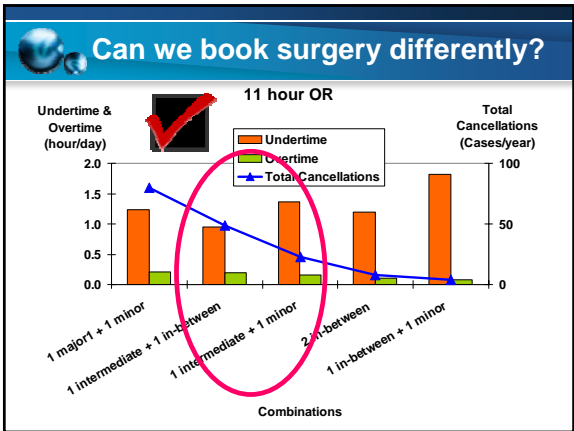
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### Scenarios – OR schedule

- Scenario A
- Scenario B

	OR1	OR2	OR3	OR4		OR1	OR2	OR3	OR4
Mon	12	10	10	9	Mon	12	10	10	10
Tues	12	10	10	9	Tues	12	10	10	10
Wed	11	9	9	9	Wed	11	11	9	9
Thu	N/A	12	10	10	Thu	N/A	12	10	9
Fri	N/A	12	10	10	Fri	N/A	12	10	9

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### Model Results

		A	B
Seen / year		1430 ±25	1487 ±26
Cancellations /year	Total	188 ±42	221 ±47
	More Urgent	83 ±22	102 ±24
	ICU/ ward	32 ±22	41 ±27
	Overtime	72 ±9	78 ±10
Overtime (hour/week)		5.6 ±0.6	6.0 ±0.7
Undertime (hour/week)		26.7 ±1.3	25.3 ±1.3

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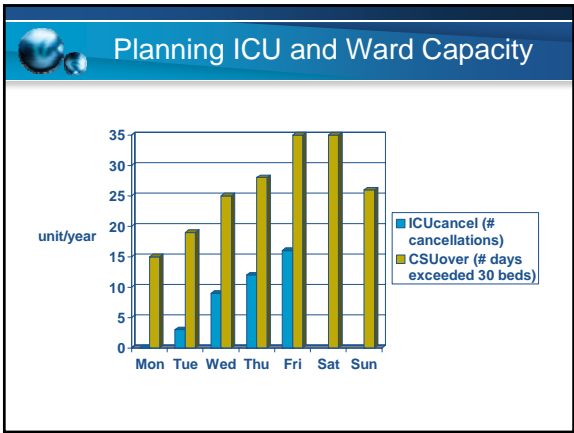
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- ### Next Steps
- New initiative focusing on bed capacity – ICU and ward
  - LOS data analysis of CIHI data Apr – Nov 2006 (2% of patients accounted for 25% of ICU bed days)
  - Created an in-house simulation model in Excel to test OR and LOS scenarios
  - Retrospective chart review of long stay patients against a predictive scoring tool to see if we could have predicted long stay

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**Next steps – computer simulation model**

- Currently working with Dr. Carter from U of T, HHS, St. Mike's, Mt. Sinai and CIHR grant funding to develop a computer simulation model for the entire operating room block schedule (multiple surgical services)
- Future plans for a commercial software product that hospitals could purchase to assist with queuing and smoothing of the OR block schedule

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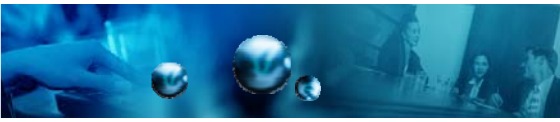
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**Questions?**



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