Challenges in Training Cardio Thoracic Transplant Surgeons

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Key Question

- How can we prepare a well-trained, sufficiently large pool of cardio thoracic transplant surgeons while maintaining compliance with ACGME work rules and satisfying UNOS certification requirements?
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Background

- Cardio thoracic surgeons perform several thousand heart and lung transplants annually in the U.S.
  - 2300+ hearts in 2011, 1800 lungs
- These numbers are increasing annually
- More than 50% of practicing cardio thoracic surgeons are age 55 or older
- 70 CT training programs (not all do transplants)
- 70-80 graduates per year
- Shortage predicted by 2020
Training Process

• 4 years of medical school
• 5 years of residency in general surgery
• 2 – 3 years of CT fellowship
• Optional fellowship afterwards
• CT training averages to 9.3 years of training post-med school
• Average age of completion is 39
Life of a CT Resident/Fellow

- Weekdays, 6am to 6pm surgery, clinic, etc.
- Primary calls
- Backup calls
- Weekend calls
- Where do transplants fit in?
Sources of Conflict

- ACGME restricts work hours
- UNOS dictates training requirements
- Transplants are lengthy processes
- Opportunities arrive stochastically and with little advance warning
Scope of Our Project

• Model the dynamics of this process
  – Integration of scheduled activities (shifts) and unscheduled activities (transplants)
• Analyze the capacity of the system to certify transplant surgeons
• Identify alternative scheduling paradigms to increase this capacity
• Provide tools for policy makers to better understand the impact of policy changes
First Phase of Analysis

• Emphasis on ACGME compliance:
  – IF transplants arrive according to a random (exponential) distribution
  – IF fellows are assigned according to the call schedule
    • Will they be ACGME-compliant?
    • Will they be UNOS-certified?
Results of First Phase of Analysis

• Short answer:
  – NOT compliant with ACGME rules in many cases
  – NOT able to achieve UNOS certification in many cases

• Which begs the question...
  – Even without ACGME restrictions, can UNOS certification be achieved?
Motivation for Computer Simulation

• Cardio thoracic surgeons don’t always think about probability the way engineers do
• Policy makers limiting work hours don’t always think about probability the way engineers do
• Policy makers setting training certification levels don’t always think about probability the way engineers do
Motivation for Computer Simulation

• Motivating question:
  – If you have, on average, 40 transplants per year...
  – If you have four residents...
  – If each resident is on call every fourth night...
  – What is the probability that each resident gets 10 transplants over the course of the year?
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  – Hint: It’s not 1!
Description of Computer Simulation

- A way to demonstrate these probabilistic issues to people not used to thinking about probability
- A way to analyze policy questions
- A way to evaluate alternative scheduling paradigms
Demo of Computer Simulation