A Simulation-Based Tool to Improve Matching of Fellows to Surgical Training Opportunities

Amy Cohn Ph.D.\(^1\), Rishindra Reddy M.D.\(^2\), F. Jacob Seagull Ph.D.\(^3\), Mark Daskin Ph.D.\(^4\), Andrea Obi M.D.\(^2\), William Pozehl B.S.E.\(^1\), Ryan Chen\(^1\), Asher Perlmutter\(^4\)

1: Industrial and Operations Engineering, University of Michigan  
2: Department of Surgery, University of Michigan  
3: Department of Medical Education, University of Michigan  
4: Computer Science and Engineering, University of Michigan

**Problem Statement**

Heart disease is the \#1 leading cause of death in the United States  
Lung disease is the \#3 leading cause of death in the United States

Clinical Intervention: Cardiothoracic (CT) surgeons perform transplants for patients with end-stage heart & lung diseases.

1. Majority of CT surgeons nearing retirement  
2. Increasingly complex requirements for training new CT surgeons  
3. Medicare population expected to double by 2030

Operational Goal: Prevent the expected shortage through efficacious training of new CT surgeons.

Training pathway for a CT surgeon

- Medical School 4 years  
- Residency 3 – 7 years  
- Fellowship 2 – 3 years  
- Independent Practice

* Majority of transplant training received during fellowship. When a transplant opportunity arrives, the on-call fellow from the call schedule performs the operation.

**Solution Approach**

We analyzed heart & lung transplant data from the University of Michigan Health System (UMHS), then built a simulator in Visual Basic to:

- Simulate arrival of transplant opportunities  
- Match transplant opportunities to on-call fellows  
- Evaluate transplant certification rates

The simulator has single-repetition, multi-repetition, and sensitivity analysis capabilities.

**Conclusions**

UMHS should expect to certify all of its fellows for transplants about 5% of the time in the allotted fellowship duration. These results imply potential system changes, including:

1. Program size reduction  
2. Case volume expansion  
3. Certification policy alterations  
4. Call schedule modifications

The simulator is capable of assessing any of these changes. Identifying a call schedule that enables efficient CT surgeon training may be the most useful intervention. We illustrate results for two alternative call schedule paradigms.

**Acknowledgements**

We gratefully thank the Center for Healthcare Engineering and Patient Safety, The Seth Bonder Foundation, The Doctors Company Foundation, University of Michigan Summer Undergraduate Research Opportunity, and the UMHS Department of Surgery for supporting this work.

Those interested in assessing their own training programs or seeking more information may contact Professor Amy Cohn at amycohn@med.umich.edu