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

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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

→ Expected CT surgeon shortage by 2020

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.

Complexity of Fellowship

Stochastic Arrival Rates and Procedure Times + ***Fixed Call Schedule for Unplanned Surgeries*** + ***ACGME Work-Hour Limits*** + ***ABS/UNOS Experience Requirements*** = ***Certification Assessment*** (*Patient Care and Surgical Competency Metrics*)

Q4 Call Schedule

July

Sun	Mon	Tue	Wed	Thu	Fri	Sat
	1 Chen	2 Jones	3 Smith	4 Reddy	5 Chen	6 Jones
7 Smith	8 Reddy	9 Chen	10 Jones	11 Smith	12 Reddy	13 Chen
14 Jones	15 Smith	16 Reddy	17 Chen	18 Jones	19 Smith	20 Reddy
21 Chen	22 Jones	23 Smith	24 Reddy	25 Chen	26 Jones	27 Smith
28 Reddy	29 Chen	30 Jones	31 Smith			

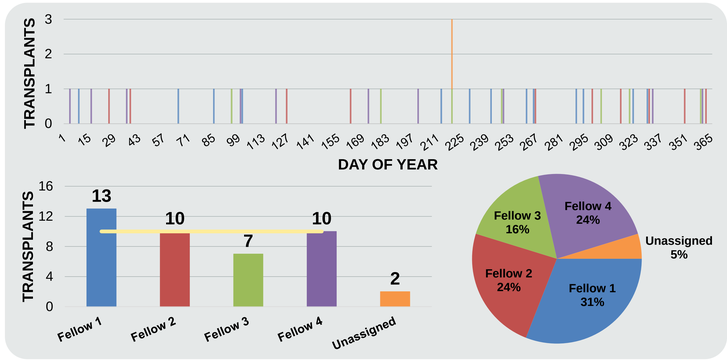
Solution Approach

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

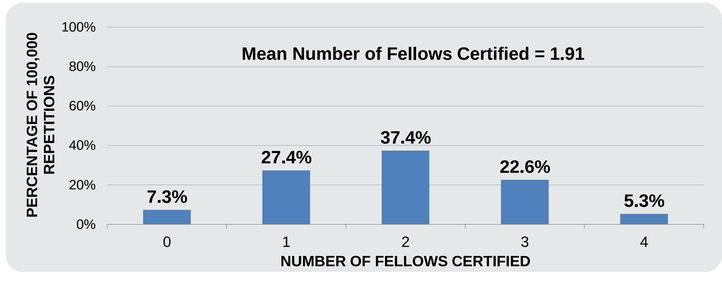
1. Simulate arrival of transplant opportunities
2. Match transplant opportunities to on-call fellows
3. Evaluate transplant certification rates

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

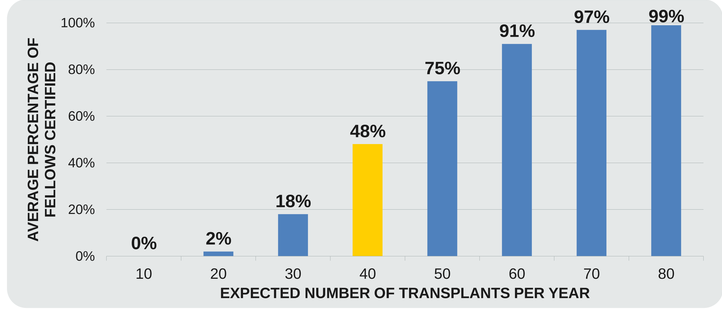
Sample Single-Repetition Simulation Results



Sample Multi-Repetition Simulation Results



Sample Sensitivity Analysis Results



Conclusions

UMHS should expect to certify all of its fellows for transplants about 5% of the time in the allotted fellowship duration.

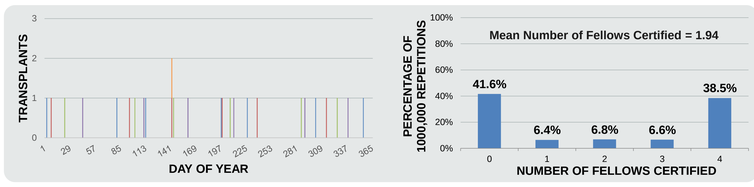
These results imply potential system changes, including:

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

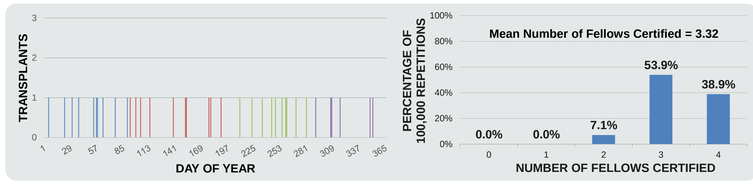
The simulator is capable of assessing any of these changes.

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.

On Call Until Transplant



On Call Until Certified



The simulator may also be applied to other operations involving random arrivals and fixed physician schedules.

Acknowledgements

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