

Using Computerized Simulation to Improve the Assigning of Surgical Residents to Training Opportunities

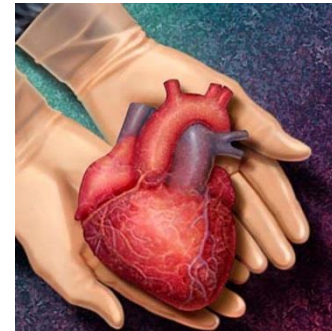
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Transplant Surgery at UMHS

- 2-year Fellowship in Section of Thoracic Surgery
- 2 junior + 2 senior fellows each year
- Q4 call schedule
- UNOS Certification Requirements:
 - 20 heart transplants
 - 15 lung transplants



If a program has **4 fellows** on a Q4 call schedule and expects **40 transplants** per year, the probability that each fellow participates in at least **10 transplants** within a year (to be on track for 20 in 2 years) is...

~5%.



Motivation



- 3 of 10 deaths due to cardiovascular disease or COPD in the United States
- Medicare population expected to double by 2030
- Aging cardiothoracic (CT) surgeons
 - Mean age: 55 years old
 - 65% (lung) and 70% (heart) are 51+ years old
- Decreasing number of CT surgeons nationally
 - 2004-08: 26% decline in CT fellows
 - 2010: fewer applicants than positions (93/116)

Graduate Medical Education

Residency/Fellowship: graduate medical training required for certification to practice independently



Call Schedule: schedule of residents/fellows responsible for covering emergency operations

Sun	Mon	Tue	July 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			



Our Approach

- Analyze historical data (Jan. 2009 – May 2011)

$$IAT(\text{transplants}) \sim \text{Exponential}(\lambda=0.10)$$



$$\text{Transplants/year} \sim \text{Poisson}(\lambda=40)$$

- Simulate occurrences of transplants
- Match occurrences to call schedule
- Assess performance and generate graphical reports for medical personnel to inform decision-making

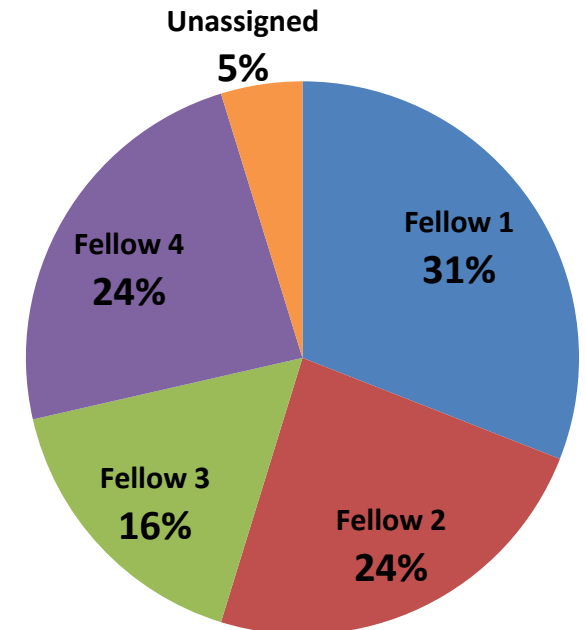
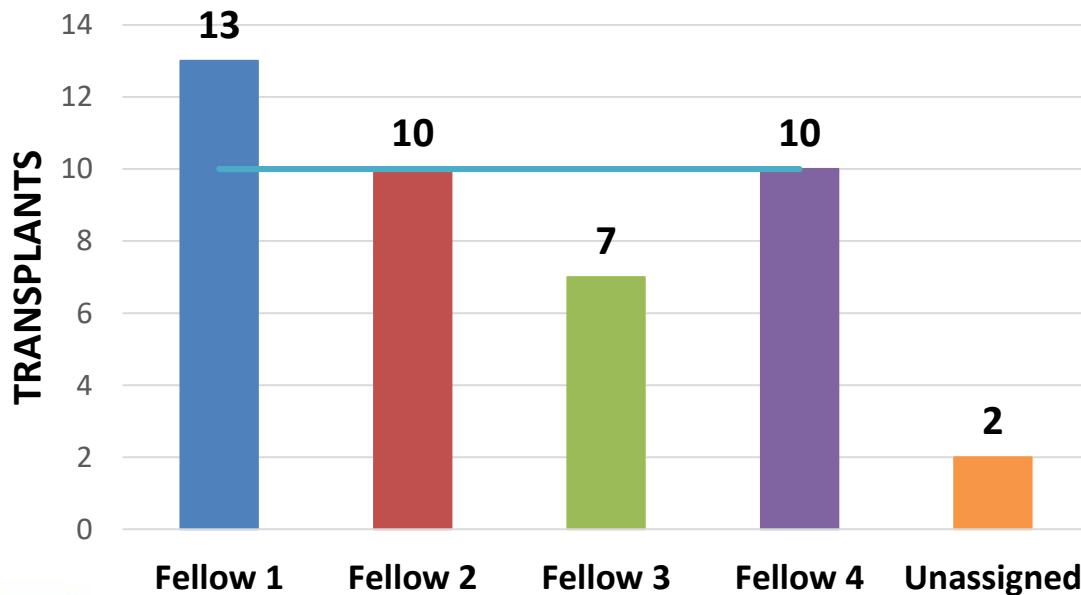
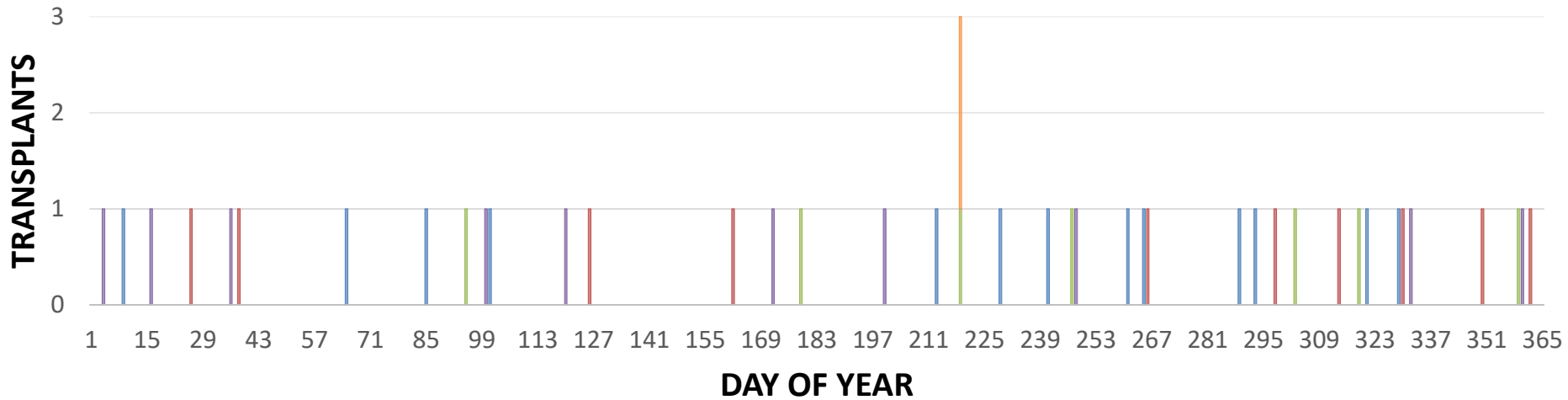
Simulator: User Inputs

- Number of fellows (4)
- Expected number of transplants per year (40)
- UNOS certification requirement (10)
- Duration of fellowship in days (365)
- Rotation method (Q4 call schedule)
- Number of repetitions (1 – 100,000)
- Advanced settings

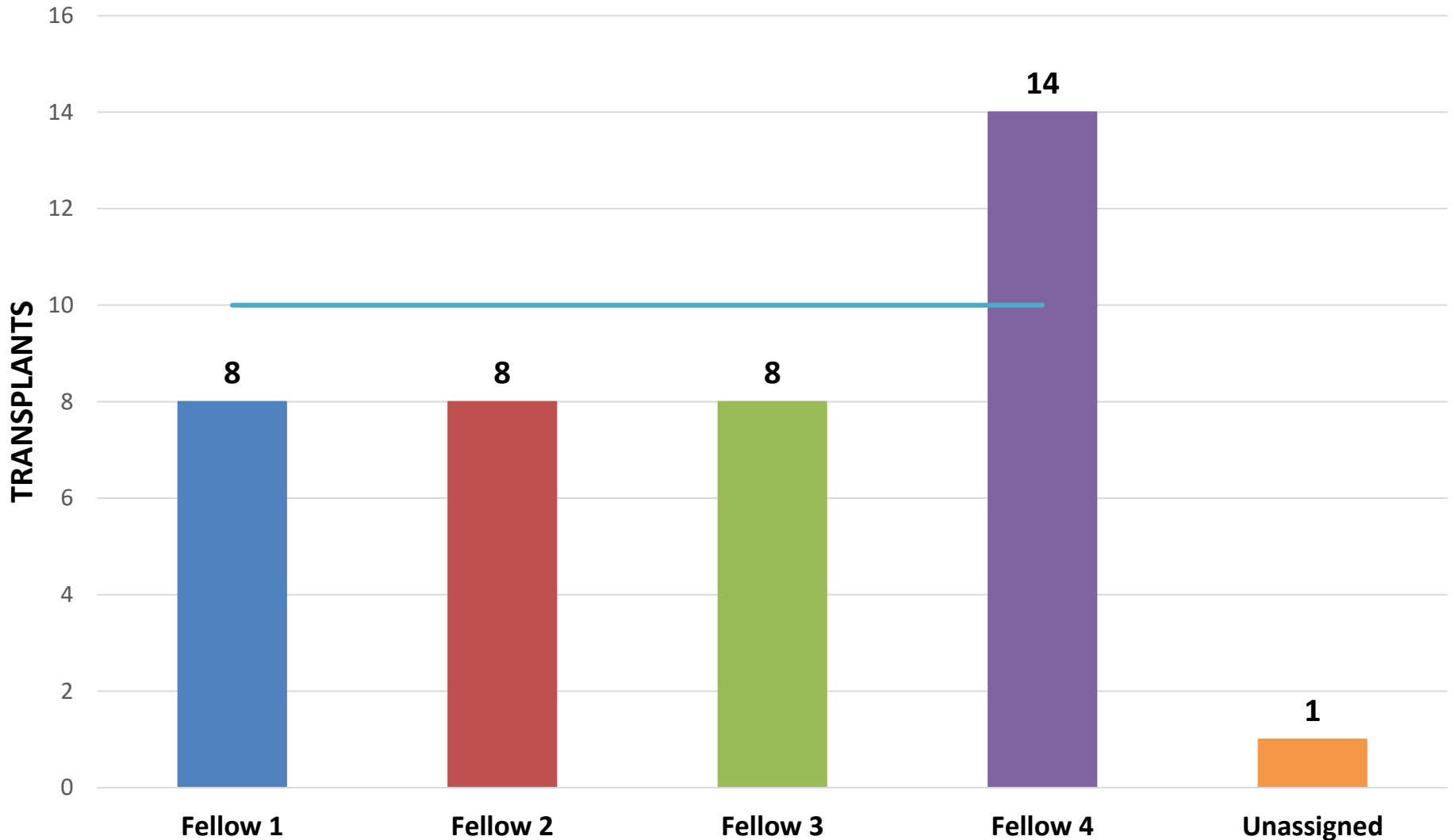
(default, canonical settings)



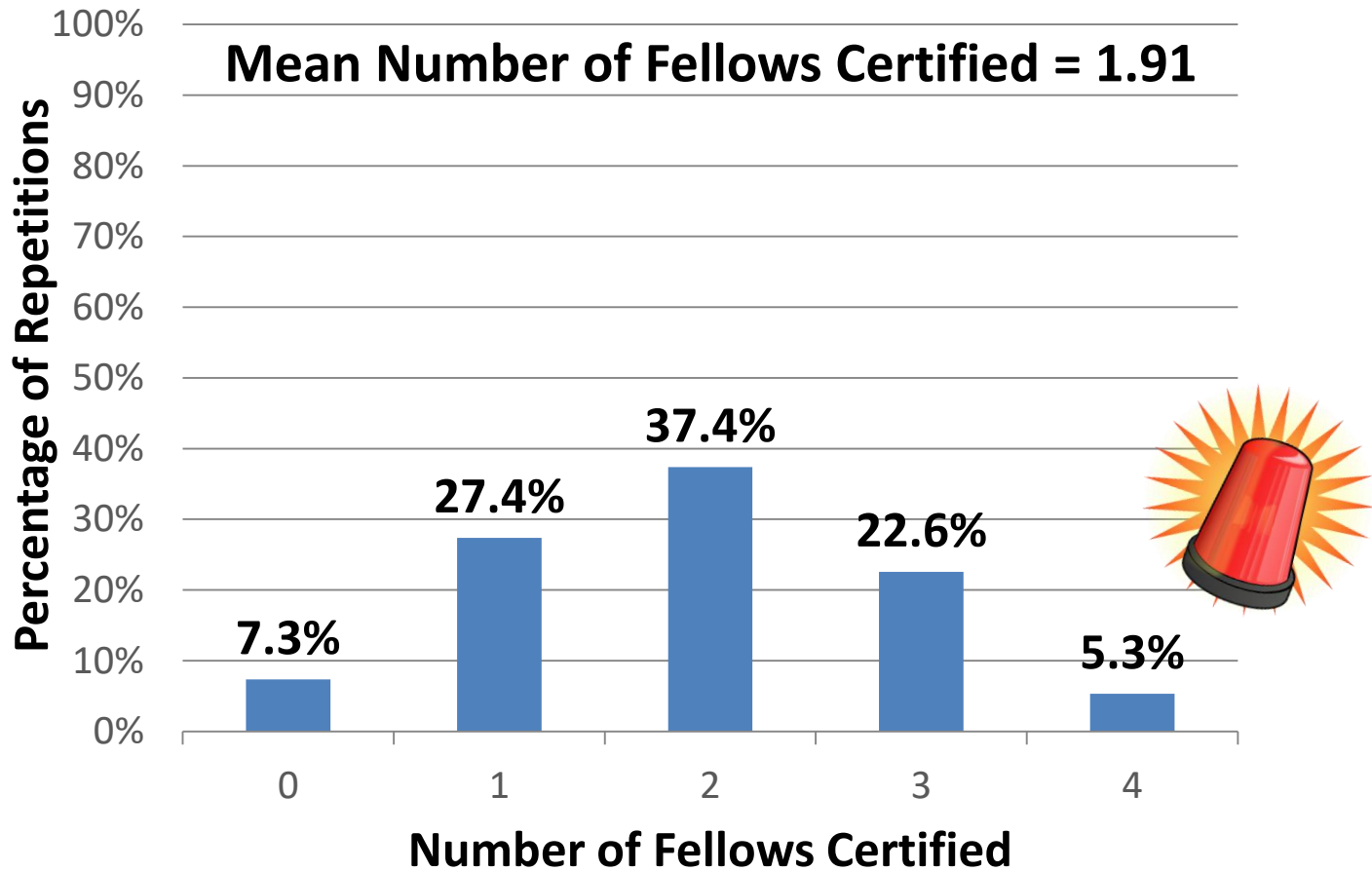
Graphical Outputs: One Repetition



Another Try



Graphical Outputs: 100,000 Repetitions

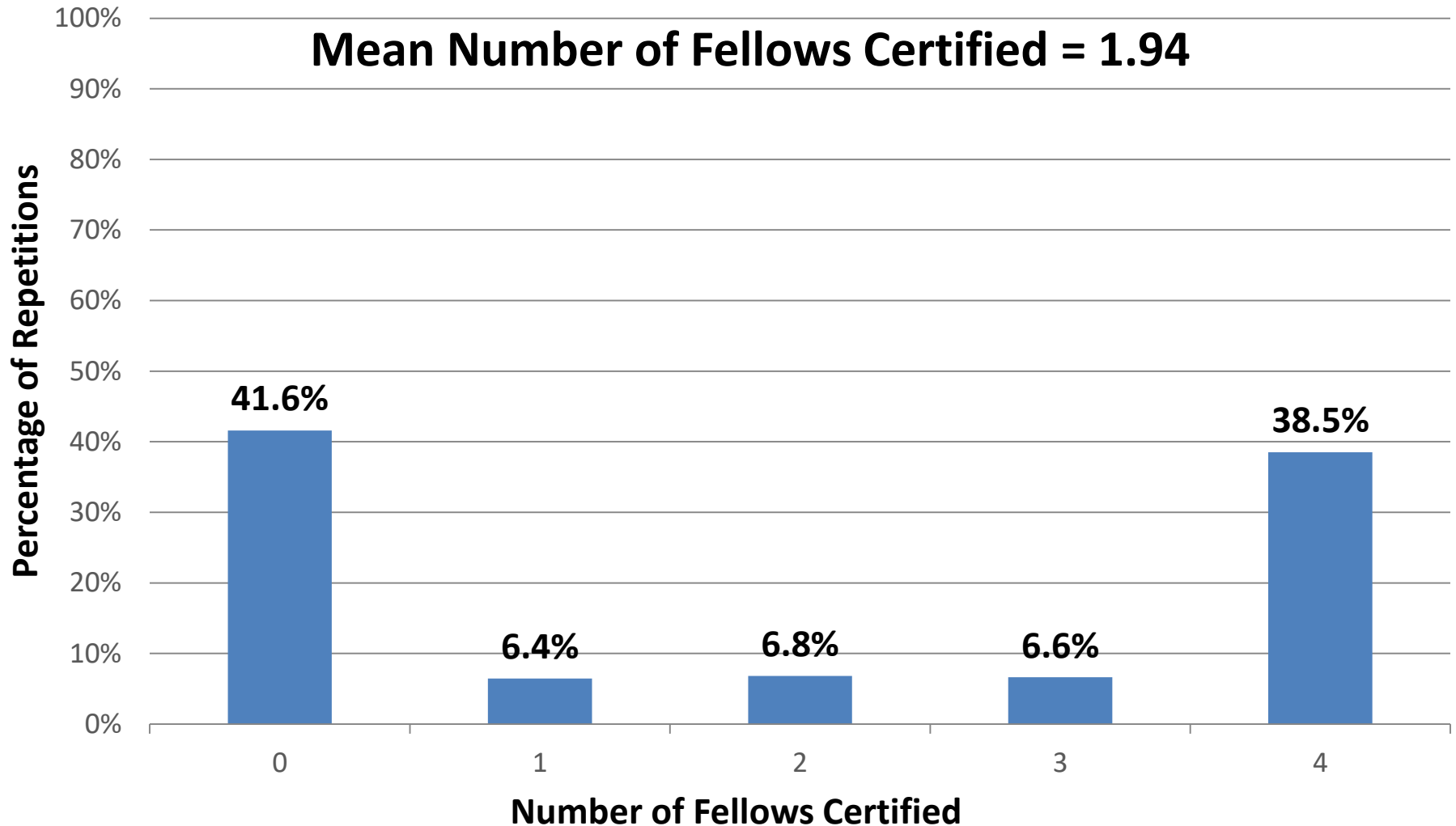


Implications: Potential System Changes

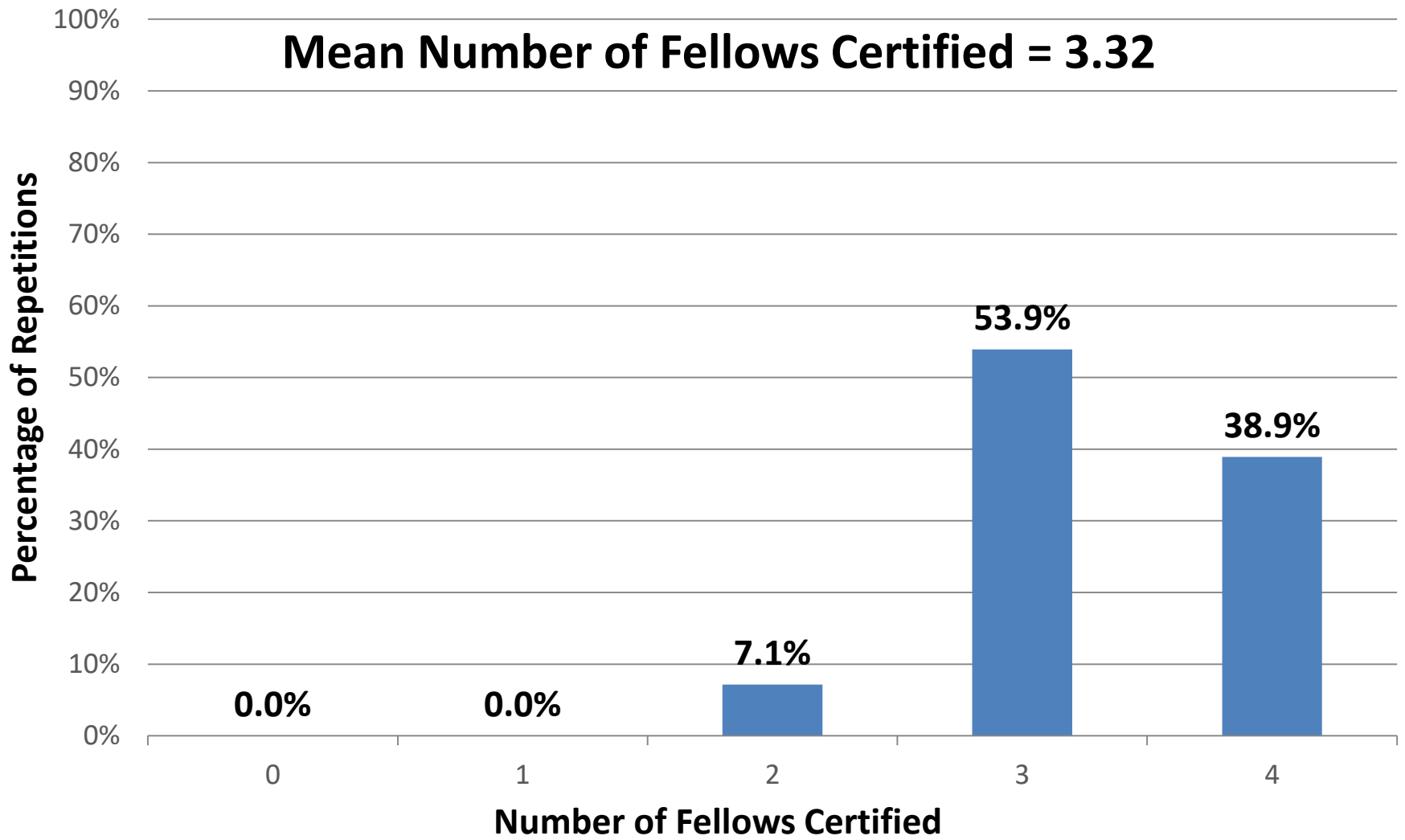
- Change certification policies
 - Surgical simulator certification
 - Proficiency-based certification
- Try alternative scheduling paradigms
 - On call until procedure
 - On call until certified



100,000 Repetitions: On Call Until Procedure



100,000 Repetitions: On Call Until Certified



Conclusions

- We can use simulation to assess program performance
- Alternative scheduling paradigms may increase the rate of certification for cardiothoracic transplants at UMHS, but feasibility is a concern
- UMHS should not expect to adequately train all fellows for cardiothoracic transplants in most years



Current Efforts and Future Work

- Redesign the simulator to incorporate:
 - Other procedure types (scheduled and unscheduled)
 - Other distributions to describe procedure arrivals
 - ACGME work-hour restrictions
 - Fellow characteristics (junior vs. senior, etc.)
 - More fellow-to-procedure matching paradigms
- Assess other residency/fellowship programs at UMHS and partner institutions
- Build optimization models



Collaborators

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Questions / Comments

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The simulator can be found at: transplantsimulator.herobo.com.

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