Scheduling Fellows to Achieve Adequate Training on Procedures with Random Occurrences

CHEPS Center for Healthcare Engineering & Patient Safety
MICHIGAN ENGINEERING

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BACKGROUND

Claim Projected shortage of cardiothoracic (CT) transplant surgeons over the next 10 years

Evidence Heart and lung surgeons constitute the oldest group of surgeons (average age of 55)

Motivation Certification for CT transplant surgery is experience-based
Transplant opportunities are not scheduled but occur randomly in time
Fellows rotate on a fixed call schedule for acquiring these experiences

Problem Inherent conflict exists between the daily call schedule and the unpredictable arrival of transplants → *There is no guarantee that fellows will receive adequate training for certification by the end of the fellowship.*

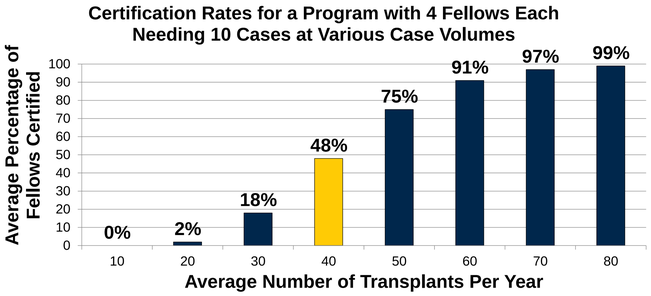
Approach Collaboration between engineering and medicine has led to the development of simulation software that illuminates the effects of randomness in transplant opportunities on a fellowship program's ability to train transplant surgeons

KEY QUESTION

If a program has 4 fellows (rotating call daily) and receives an average of 40 transplants per year, what is the likelihood that each fellow receives 10 within 1 year?

0% – 20%	21% – 40%	41% – 60%	61% – 80%	81% – 100%

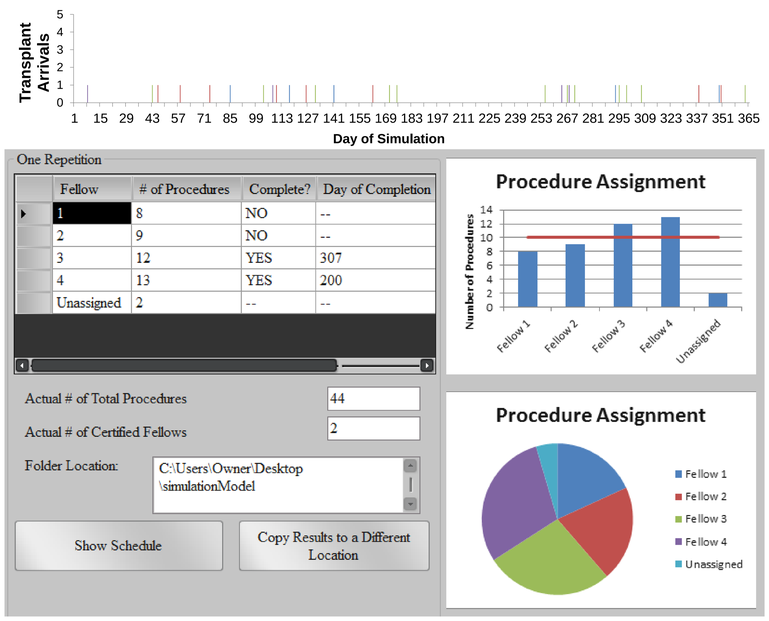
LINKING CASE VOLUME TO OUTCOMES



The sensitivity analysis tool illustrates the minimum average number of procedures per year required to enable certification of a certain percentage of the fellows.

For example, an average of at least 50 transplants per year is needed to provide confidence that 3 of the 4 fellows in a program will be certified in a typical year if each is required to achieve at least 10 transplants.

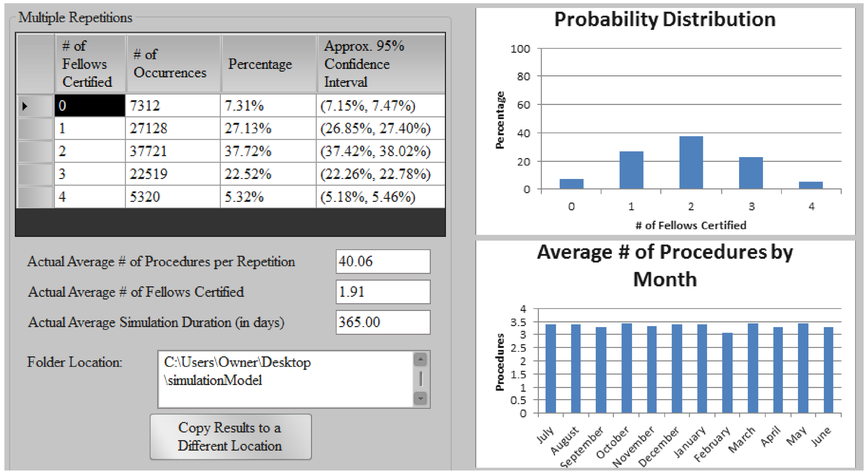
SIMULATOR OUTPUTS



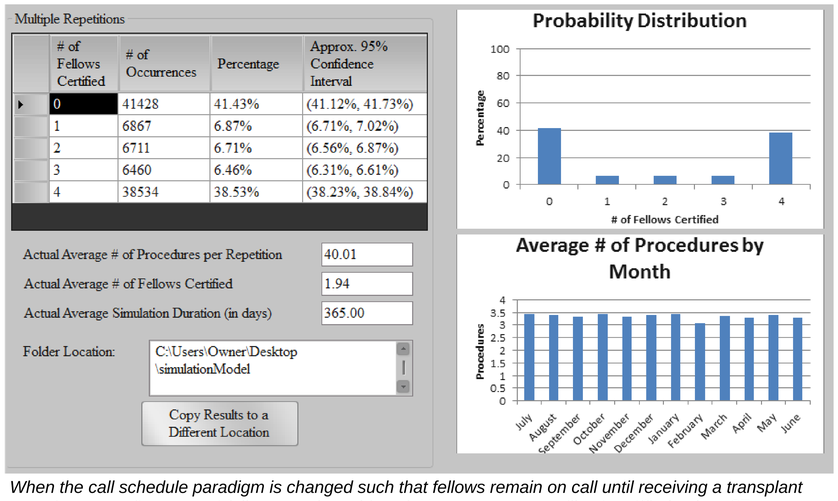
Allocation of transplants to 4 fellows over 1 year using a Q4 call schedule with 40 cases expected

Development Principles

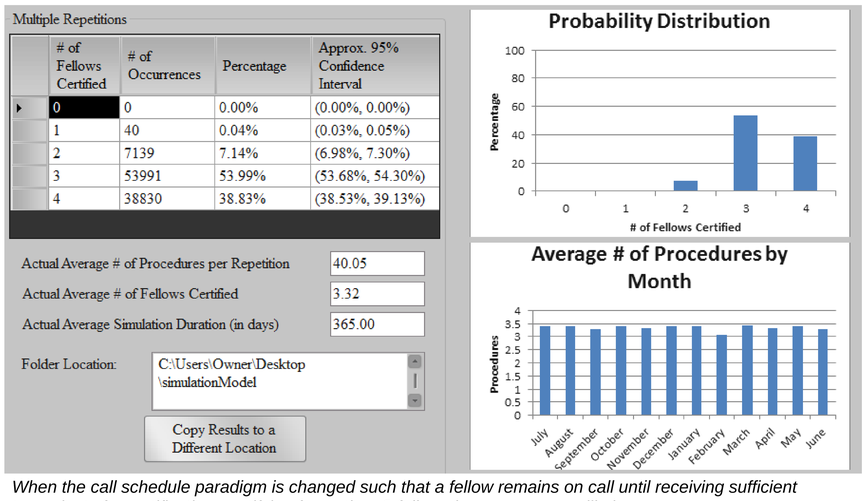
- Coded an easy-to-use tool to simulate transplant arrivals and fellow assignment in the Visual Basic programming language using the Visual Studio environment
- Quickly generates results for single repetition, multiple repetition, and sensitivity analyses



Aggregate statistics over 100,000 simulations of a 1-year period with respect to number of fellows certified using a Q4 call schedule with 40 cases expected



When the call schedule paradigm is changed such that fellows remain on call until receiving a transplant experience, equity amongst fellows can be achieved. However, no one will get certified unless 37 or more transplants arrive.



When the call schedule paradigm is changed such that a fellow remains on call until receiving sufficient transplants for certification, certifying fewer than 2 fellows becomes very unlikely.

CONCLUSIONS

Due to randomness in occurrence, a large number of transplant opportunities are needed to ensure that all fellows can be certified when using a fixed rotating schedule. In the example above, the probability is only ~5% even though the average number of transplants appears to be sufficient.

This could be addressed by reducing the size of the residency program, increasing the program's duration to allow extra time, or increasing the case volume. All of these are problematic, however.

In the long term, changes in UNOS certification requirements, as well as the development of surgical simulators to supplement live training experiences, might facilitate timely training of transplant surgeons.

But new scheduling paradigms (possibly in conjunction with supporting changes in ACGME work hour rules) may be the best way in the short term to ensure greater success in allowing fellows to achieve certification within the confines of the current program structure. Engineering techniques can be used to develop, simulate, and analyze these new approaches to scheduling fellows.

FUTURE WORK

- Identify and implement more call schedule paradigms into simulator
- Incorporate 80-hour work week regulations into simulator
- Work with UMHS program directors to assess their residency/fellowship structures
- Evaluate other CT transplant programs across the country to compare to UMHS

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