Inputs

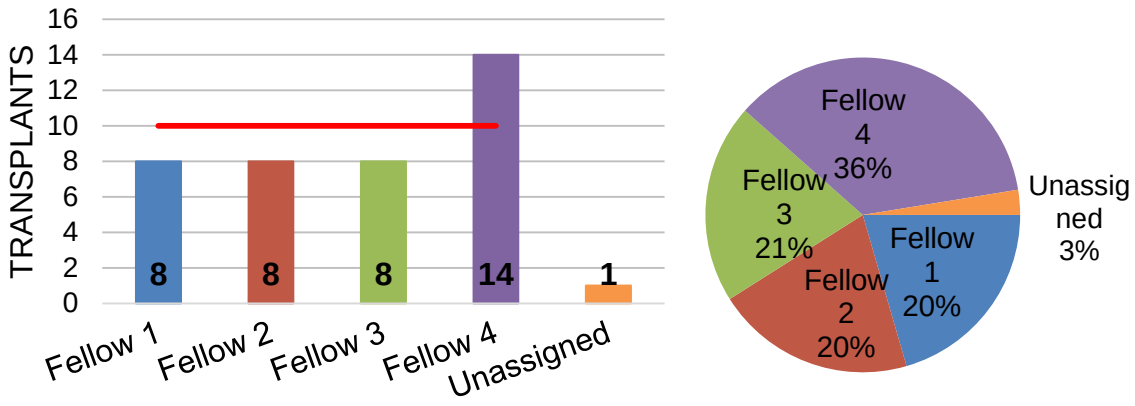
The simulator is easy to use with only a few inputs necessary to run meaningful experiments. These inputs include:

- Number of fellows
- Expected number of transplants per year
- Number of transplants needed for certification per fellow
- Planning horizon
- Number of repetitions
- Call schedule rotation method

In addition to these basic inputs, advanced users may conduct more customized simulations by incorporating seasonality, handling multiple transplants in a single day, or running a repetition until all fellows reach certification.

Single-Repetition Simulations

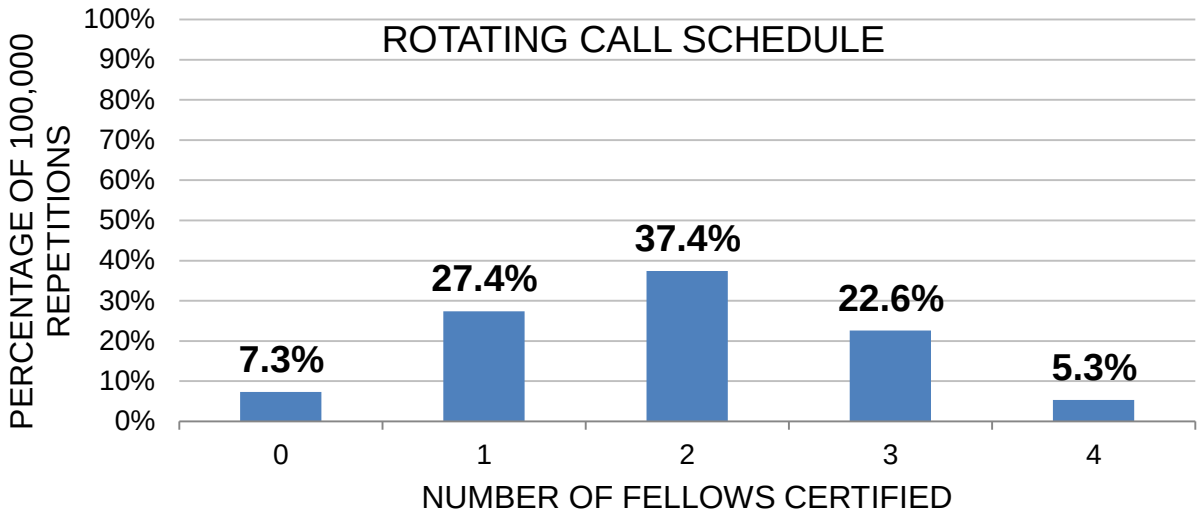
When running the "One Repetition" component, the simulator produces three graphical outputs: a timeline like the one shown previously, a bar graph, and a pie chart. The timeline shows not only the days on which transplant opportunities occurred but also the resident to which it was assigned indicated by the color of the bar. Because the timeline can be very busy, it is not shown by default but can be displayed by pressing the appropriate button. Instead, the bar graph and pie chart summarize how the procedures were distributed amongst the residents, as shown below. On the bar chart, the bars indicate how many procedures each resident performed while the red line indicates the required number for certification. Notice that although there were nearly a sufficient number of procedure opportunities to certify each resident in this example, they were distributed unevenly due to the random nature of transplant opportunities mixed with a fixed call schedule.



Multiple-Repetition Simulations

Because of the repetition-to-repetition variation that occurs, it is often necessary to conduct many repetitions to better understand the average performance of a program. Multiple repetitions on

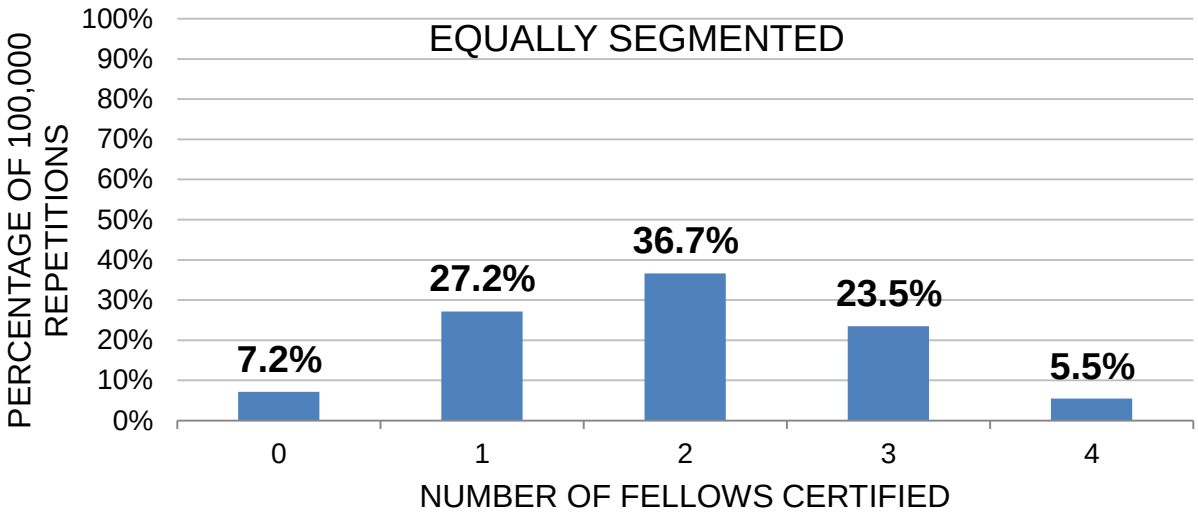
the same inputs can be quickly achieved by increasing the Number of Repetitions from the Inputs tab up to a maximum of 100,000. When running the "Multiple Repetitions" component, the simulator produces a probability distribution of the number of residents that meet or exceed the case requirement by aggregating over all the repetitions the summarized results that would have been depicted for a single repetition. A probability distribution generated from 100,000 repetitions of the canonical example is given below. In addition, the output displays the average number of transplants per repetition and the average number of fellows certified.

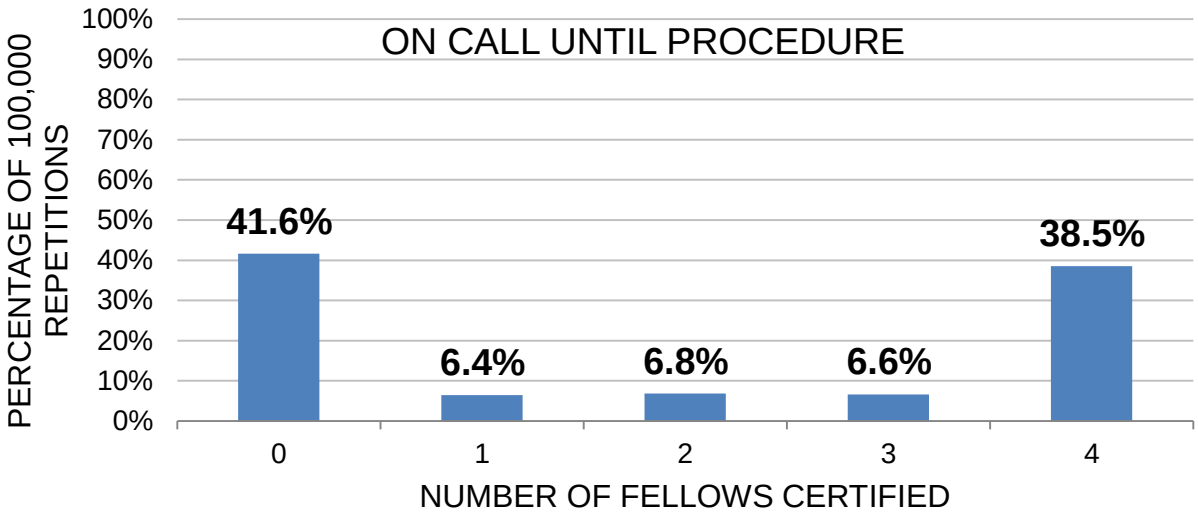


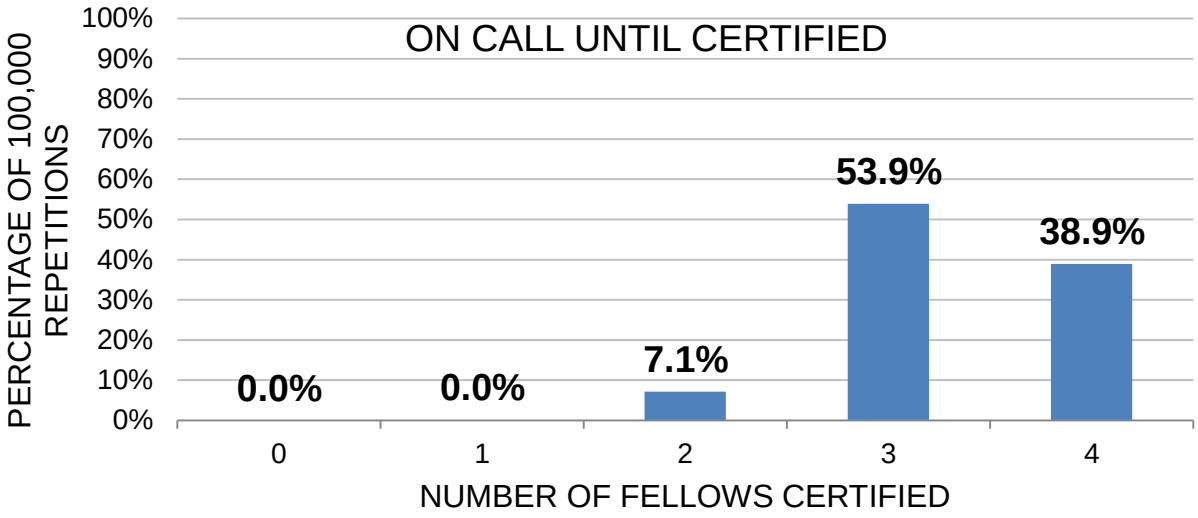
The distribution is also heavily influenced by the choice of call schedule rotation method. In addition to the traditional rotational call schedule, three hypothetical rotation methods are encoded in the simulator. These methods include:

1. Dividing the simulation time into segments of equal duration and assign a fellow to each
2. Keeping a fellow on call until they receive a procedure
3. Keeping a fellow on call until they receive certification

Keeping all the other inputs the same as the canonical example, changing the rotation method to each of these hypothetical methods produces the results below by the order given above.


EQUALLY SEGMENTED
PERCENTAGE OF 100,000 REPETITIONS
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
7.2%
27.2%
36.7%
23.5%
5.5%
0
1
2
3
4
NUMBER OF FELLOWS CERTIFIED

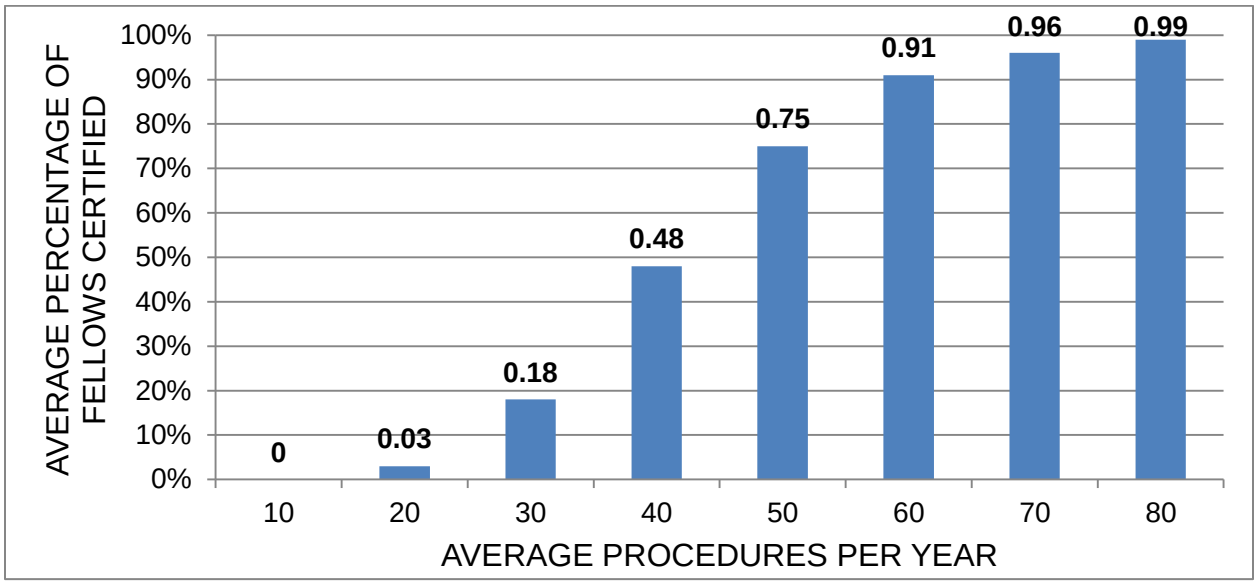

ON CALL UNTIL PROCEDURE
PERCENTAGE OF 100,000 REPETITIONS
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
41.6%
6.4%
6.8%
6.6%
38.5%
0
1
2
3
4
NUMBER OF FELLOWS CERTIFIED


ON CALL UNTIL CERTIFIED
PERCENTAGE OF 100,000 REPETITIONS
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0.0%
0.0%
7.1%
53.9%
38.9%
0
1
2
3
4
NUMBER OF FELLOWS CERTIFIED

The Multiple Repetition results reveal how unlikely current practices are to facilitate all residents receiving certification. Over many repetitions, the likelihood of each resident receiving certification is much lower than many would expect.

Percent Certified versus Number of Procedures Per Year

The final tool in the simulator provides an indication of how certification rate changes with the expected number of procedures. The simulator runs 10,000 repetitions for each expected number of procedures per year, starting at 10 and incrementing by 10 until reaching twice the entered expected number of procedures per year, as shown below for the canonical example with an entered expectation of 40 procedures per year.



Notice that only about 48% of residents will get certified at the canonical expected number of procedures per year. However, when the average procedures are doubled, every resident receives at least the minimum number of cases required in almost every repetition. Thus, the tool can be used to determine the effect of increasing or decreasing average procedures on certification rates.

The simulator has shown that resident case exposure using traditional call schedules is subject to great variability and unpredictability, suggesting that policy changes or alternative scheduling methods may be needed to improve equitable case exposure and to ensure that all residents achieve the minimum case exposure requirements prior to "graduating" from their residency.

Questions may be directed to cheps-contact@umich.edu.