# Effects of Physician Assistant Hiring Trends on Outpatient Clinic Efficiency: A Simulation Analysis Case Study

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***Abstract*—The physician assistant profession is a fast growing field that offers flexibility in medicine. It also offers hospitals and physicians a way to increase the efficiency of a multitude of practices. This report is a case study of an out-patient surgery clinic and analyzes the effects of hiring PAs on the clinic's efficiency. Efficiency is measured by instantaneous utilization, the amount of time a patient is waiting, and how long a patient spends in the clinic. The ARENA simulation language is used to create the simulation. The results suggest that there is a maximum level of efficiency to which the PAs can help the clinic obtain.**

***Index Terms*—simulation, systems engineering, industrial engineering, ARENA Simulation, hospital design, physician assistants**

## I. Introduction

With an increase of patient demand in both emergency and specialty departments, the goal with the influx of Physician Assistants (PAs) is to increase the efficiency of clinics. In particular, surgery departments look to PAs to face the bulk of the clinical work, freeing up the surgeon to perform surgeries. This allows higher quality of care for the patients, and more revenue generated for the hospital. However there are a myriad of risk factors that are incurred by this more complex process. Constraints on the liberties of PAs as well as non-uniform and unpredictable time allotments of the surgeons can result in a severely handicapped clinic. This situation would result in longer hours for the staffers, unreasonable wait times for patients, and strain on surgeons. All of the these factors could readily result in burn-out, employee turnover, and patient loss.

## II. Background

### A. Physician Assistants

The Physician Assistant (PA) profession was born out of the men and women who had received extensive medical training during the their time in the armed forces. They possessed considerable knowledge of the medical field, but lacked in the formal training of licensed physicians.

Dr. Eugene A. Stead Jr., MD, found that there was an opportunity to fill a need for primary care physicians with these individuals. At Duke University in North Carolina the first PA class graduated in 1967. [1]

The PA field has evolved into a deep and widespread practice in every specialty. Depending on the state and type of medical practice, PAs have almost as many liberties as their supervising physicians. (eg. prescription writing) There are even some localities that PAs are able to open their own practice. [1]

In the environments where PAs and physicians (MD/DO) continue to work in tandem, the PAs continue to fill a crucial role. With many demands on the physicians' time, especially surgical procedures, PAs serve to interface with them and provide important information on patient history, status, and complaints. With respect to patients, the PA's help bridge the gap between the patient understanding and the the Physicians report. PAs engage in patient education quite often, which naturally makes the patient more at ease with his or her medical diagnosis.

### B. Hospital Organization

Many, if not most, hospitals leverage PAs to help in operating both in-patient and out-patient services. Most often, it will be the case, at least in practice, that a single physician will have multiple PAs as direct supervisees. This allows the clinic/floor to operate more efficiently with the doctor able to perform their duties of formal diagnosis, patient exams, and prescription writing, while the PAs can handle the history gathering process, patient education, and more in-depth examinations.

*1) Case Study Organization:* For the case study here the Cranial Team of University of Pittsburgh Medical Center Presbyterian Hospital's (Pittsburgh, PA 15213) Department of Neurosurgery will be examined. This is out-patient surgery clinic what has 3 surgeons, and 3 PAs. (For the sake of this report, their names will be removed, and we will discuss in terms of Dr. A, Dr. B, Dr. C, along with PA A, PA B, PA C.) Each Physician has a "dedicated" PA (we will say that Dr. A's dedicated PA is PA A). The term 'dedicated' is used loosely here, but is important.

*2) Case Study Operations:* In each standard 5-work week, there are 3 'clinic days' and 2 'admin' days. On the clinic days, exactly one of each surgeon is present and sees their specific patients. (Each surgeon has a set of patients, the sets do not overlap.) On these days, all of the three PAs work under the supervision of this surgeon collecting information and performing exams as outlined previously. There is a set of appoints that the clinic has with patients for the day. The

admin days are days where the PAs have dedicated time to chart patients and make any calls to patients that are needed. A single clinic day will be simulated.

*3) Appointment Types:* On clinic days, there are multiple types of appointments:

- New Patient Intakes: These appoints are for patients seeking consultation on whether they are candidates for surgery. They are seen by PAs and then by the physician (of the day).
- Return Patients: Patients who have been seen before but have developed complications or require imaging come in for these appointments and are seen by the PAs and the surgeon.
- Return Patients Stable: These appoints are for those who are returning without complications and have had surgery in the distant (at least a year prior) past. These appoints can be seen by the physician OR the physician's dedicated PA in order to be considered 'seen'. It is possible that another of the PA's may see the patient prior.
- Pre-Operational: These appointments are for patients who are about to have surgery and must be seen by the PA and the surgeon.
- Post-Operational: Patients who have recently had surgery can see any PA but only see the surgeon if there is a complication/issue.

## III. Description of the Problem

Given the structure of the clinic in question described in the previous section, the problem can be described with the following goals:

1 Efficiently Capture the current operation of the clinic. This can be done with surveys with clinic members and validation of initial simulation results.
2 Once the clinic if correctly simulated, determine the marginal effect that differentiating the number of PAs have. This allows us to gain numerical insight into the level of efficiency that PAs give to the clinic operations.

### A. Applications Area

The applications area for a study like this is comfortably inside the realm of hospital administration. The insights found here would be helpful for any organization that is trying to determine the effect of PA hiring on clinic functions. Indeed, the clinic need not be set up in the same exact way as described here for this simulation analysis to have an impact on the decision in increase or decrease the number of PAs. This analysis will serve to add numerical simulation based evidence to any discussion of this matter. Workforce and patient satisfaction are of course other useful areas of application.

## IV. Methodology

### A. Modeling Approach

To conduct this simulation analysis, a model will be created in the ARENA simulation language. This is a natural choice due to its ability to conduct high-level simulation and do fine adjustments, which, as discussed in the problem description will be critical to answering the central questions.

To build the model, we will consider the surgeon as a single resource, the PAs as a set of resources, with the PA at index 1 to be the dedicated PA. (In each trial, there will be a dedicated PA). The PAs will be selected based on which has the smallest number of patients that they are currently seeing. This is congruent with how the PA in the interview described the process.

To measure the effects of hiring differentiating number of PAs, 3 performance metrics will be analyzed:

1 Patient Wait Time: Assuredly, the patient will want to spend as little time waiting as possible. This is a useful metric because it can reflect to the hospital, the efficiency at which the clinic is moving. With more efficient use of resources, the lower the waiting time is expected to be.
2 Total Patient Time in System: Similar to the previous, this metric will allow us to evaluate how fast patients are leaving the clinic. Naturally for more profit and a better care experience for patients, efficiency would cause this number to diminish. (Though it should be noted that different patients require differing amounts of time to be seen.)
3 Instantaneous Utilization: This provides insight into what percentage of the time the doctor or PAs are used as soon as they are available. It a helpful measure to understand how efficiently the clinic is running.

In order to improve insight these metrics were broken down by patient type.

### B. Data Collection

The data for this project was obtained from interviews with a PA from the clinic. This PA provided the data (in consultation with the other two) for the distribution of several key modeling quantities, such as patient arrival and length of time different procedures in the clinic take place. A comprehensive list of the distributions and how they were modeled are provided in the appendix. For processes in the clinic (eg. Patient Interview) a triangular distribution was used. This distribution captures the nature that some appointments take a longer time, some a shorter time, but there is a 'most common time' as well. This was how the interview was conducted; the the PAs were asked for 'shortest', 'longest', and 'most common' time for each procedure.

The interview to collect the data revealed that the following was the flow of the patient through the system and the actions/processes taken by the various providers:

1 PA Interviews patient for past medical history and current status. Mental Exam is also included here, as the PA determines cognitive function.
2 PA conducts a physical exam of the patient.
3 PA presents findings to physician on the patient.
4 Dr and PA construct a plan for the patient.
5 Dr interview patient.
6 Dr and patient discuss proposed plan.

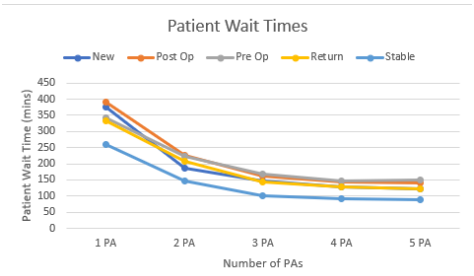


Fig. 1. There appears to be a decrease in the marginal effect of adding a PA.

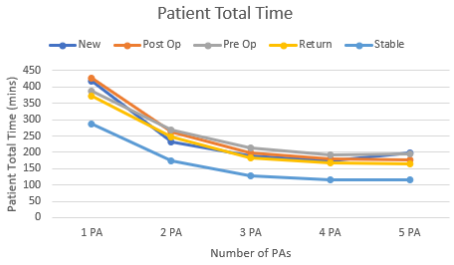


Fig. 2. The patients' average total time in the clinic appears to follow the same trend as the wait times.

8 PA sees the patient out and relays any other information.

(Data on the length of time of appointments are not available from the hospital in question so an interview with the PAs was the best way to collect this data. For more discussion on the improvements to the data collection see the "Improvement" section.)

## V. Main Findings

### A. Elementary Data Analysis

After the interview with the PA, it appears the the triangular distributions will be and appropriate tool as that is how they described the times that different processes take (small, most, largest). It appears that there will be about 60 minutes of patients interacting with the staff. This will serve as a useful point of reference based off of the metrics of efficiency we are going to utilize.

Also note that some process take different amounts of time to conduct based on the type of patient. This is reasonable because of the different topics that need to be discussed with different kinds of patients, depending on where they are in the medical procedures. The interviewee did not report that there was a pattern to the schedule, only a rough percentage of each type, so we will assume that there is no pattern of patient type.

### B. Output Analysis

Appendix B Contains the raw data that was output from ARENA. Twenty-five replications were used. (Ideally more would happen but computational power was limited.) The basic number of the output (of the current system with 3 PAs) was validated and verified with a PA from the clinic. The metrics reportedly coincided with the average expectations of a clinic day.

Fig 1. Suggests that there is a decreasing benefit to hiring PAs. We see that the simulation suggests that patients' average wait time will not be less than about two hours, depending on the patient type. Naturally the stable return patients, who need only see the dedicated PA have a less than average return time.

Fig. 2 confirms the same suggestion as in Fig. 1: there is a diminishing return of hiring the PAs. There appears to be a set amount of time that the patients will have to wait for regardless of the number of PAs.

Fig 3 relates the instantaneous utilization of the resources. It appears that the hiring of additional PAs does not balance

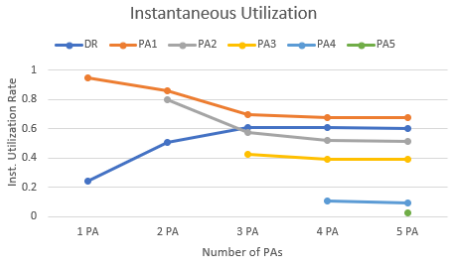


Fig. 3. The increase of the number of PAs in the system does not appear to alter the instantaneous utilization.

out the instantaneous utilization, and that there is less of a need for the additional PAs. All rooms had a constant average utilization rate of about 0.4 through all of the experiments.

These outputs along with the statistical analysis provided in the next section will be discussed in section IV.

### C. Experimental Results

To establish statistical significance of the simulation analysis, consider the following tables of t-statistics against $t_crit = 1.711$ with $\alpha = 0.05, N = 25$:

Comparison of means of average patient wait time. (The column and row head refer to the experiments that are being compared)

| | 1 PA | 2 PA | 3 PA | 4 PA | 5 PA | |
|---|---|---|---|---|---|---|
| 1 PA | 0 | 11.1 | 13.5 | 14.4 | 14.8 | New |
| 2 PA | | 0 | 3.9 | 4.9 | 5.1 | Post Op |
| 3 PA | | | 0 | 1.2 | 1.2 | Pre Op |
| 4 PA | | | | 0 | 0.3 | Return |
| 5 PA | | | | | 0 | Stable |

Similarly, consider the same for total patient wait times:

| | 1 PA | 2 PA | 3 PA | 4 PA | 5 PA | |
|---|---|---|---|---|---|---|
| 1 PA | 0 | 11.1 | 13.5 | 14.4 | 13.0 | New |
| 2 PA | | 0 | 3.9 | 4.9 | 5.1 | Post Op |
| 3 PA | | | 0 | 1.2 | 1.2 | Pre Op |
| 4 PA | | | | 0 | 0.3 | Return |
| 5 PA | | | | | 0 | Stable |

Both of these statistical analyses suggest that there is significant change in the wait times of the patients when hiring a second and a third PA. However, as suggested by the plots in the previous subsection, there does not appear to be any

statistical advantage to decrease the wait times by adding a fourth or fifth PA.

## VI. Conclusions

### A. Discussion

The results presented in the previous section suggest that the clinic is currently running at an efficient level and that hiring of another PA would not significantly increase efficiency. There are a variety of reasons that this could be. The first is suggested by Fig. 3. Notice that the instantaneous utilization of the doctor does not appear to vary much after the third PA. This suggests a bottleneck: the patients will always have to wait for the doctor. This conclusion is also supported by the indication that the patients who do not need to see the doctor (Stable) have the lowest waiting time. Indeed, it appears that the doctor is limiting factor in this clinic.

Another insight surrounds the number of rooms. There are only 8 rooms involved in the clinic and the instantaneous utilization remained at about 0.4 regardless of the number of PAs. This suggests that maximum efficiency is achieved, as no room is being used less than others. Now, the rooming process is a little outside of the purview of PAs. Medical assistants are the ones who take the patients back, and the patients do arrive at scheduled times, so this result is to be expected.

Based on the metrics selected it appears that this clinic is running at near-optimal efficiency, and it would be less effective for the hospital administration to hire another PA. This suggests that any stakeholder interested in maximizing the efficiency of the clinic in question may wish to pursue other options, as the addition of a PA may be more costly (salary and benefits) than other possible changes.

It should be noted that the simulation had a 16 hour time limit. After 3 PAs approximately 15 hours was used. This is of course a long day, even for healthcare workers. Doing this three times a week can increase employee burn out and spread discontent. Also, patients may be less inclined to select these wait times if other options are available.

### B. Limitations and Extensions

Perhaps it was natural to find that the current way that the clinic was running was the most efficient; the numbers provided by the PA must work, because they do. There is still insight to be gained, but as with any case study, it would help to look at other clinics in the same and different hospitals to determine how hiring PAs would effect clinic output. It appears that there would be some abstract maximum throughput that can be achieved, and that a hospital would have a great interest in achieving it.

With respect to the modeling approach, it is the case that more replication would always be appropriate. Also, considering different selection strategies for the PAs may be helpful. Allowing the PAs access to information ahead of time to choose the patients that the see may decrease the wait times of the patient. There would still be the question of the surgeon however.

A specific experiment that would helpful would be to limit, by some administrative effort, the amount of time that the doctors spent with the patients. This would certainly increase throughput, but could also affect how adding in the number of PAs would help the efficiency of the clinic. (It appears that it would increase the marginal benefit of adding PAs.)

A batching strategy would also be insightful to test. If the physician would be able to be presented multiple patients at once, and then see them, there would be an increase in efficiency. However, both of these suggestions may cause concern for the decrease in patient care which is the mission of the clinic.

## Acknowledgment

I would like to thank the PA at the clinic for offering insight and providing the numbers for this experiment. They have asked to remain unnamed.

## References

[1] AAPA.org
[2] PSPA.net

## APPENDIX

### C. Collected Data

*1) Resources:* There are 8 non-distinct rooms in which patients can be seen. There is a single surgeon supervising on a day. There is one 'dedicated' PA and two other non-distinct PAs.

*2) Patient Arrival:* Patient appointments are scheduled every 15 minutes from 7 am to 4 pm. Beginning at 11 am and continuing until the close of the clinic, 2 addition patients are scheduled on the hour and the half-hour slots.

*3) Patient Types:* For each patient type, the following percentage of that type are seen:

30% New Patient
15% Pre - Operational
25% Post - Operational
10% Return Patient
20% Return Patient - Stable

*4) Process Times:* Patient types head the columns and the three numbers correspond respectively to the arguments for a triangular distribution:

| Process | New | Pre-Op | Post-Op | Ret. | Ret. Stbl |
|---|---|---|---|---|---|
| PA Int | 10,15,20 | 10,15,25 | 5,7,10 | 5,10,20 | 10,10,15 |
| Ph Ex | 10,15,20 | 10,15,20 | 10,15,20 | 10,15,20 | 10,15,20 |
| PA Pres | 3,4,5 | 3,4,5 | 3,4,5 | 3,4,5 | 3,4,5 |
| Plan | 1,5,10 | 1,5,10 | 1,5,10 | 1,5,10 | 1,5,10 |
| Dr Int | 3,5,8 | 3,5,8 | 3,5,8 | 3,5,8 | NA |
| Dr. Rev | 3,4,5 | 3,4,5 | 3,4,5 | 3,4,5 | 3,4,5 |
| PA Ord | 3,4,5 | 3,4,5 | 3,4,5 | 3,4,5 | 3,4,5 |
| Exit | 3,4,5 | 3,4,5 | 3,4,5 | 3,4,5 | 3,4,5 |

*5) Output:* The output from the simulation is below (N=25, time in minutes):

| PAs | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Avg. Patients Seen | 24 | 47 | 54 | 54 | 54 |
| Patient Wait Times | | | | | |
| New | 375 | 186 | 146 | 130 | 124 |
| Post Op | 392 | 227 | 161 | 144 | 140 |
| Pre Op | 343 | 224 | 169 | 148 | 149 |
| Return | 333 | 208 | 143 | 129 | 123 |
| Stable | 260 | 148 | 100 | 91 | 88 |
| Total Time in System | | | | | |
| New | 419 | 230 | 190 | 173 | 197 |
| Pre Op | 427 | 262 | 197 | 180 | 175 |
| Post Op | 388 | 269 | 214 | 193 | 194 |
| Return | 371 | 248 | 183 | 169 | 163 |
| Stable | 287 | 175 | 127 | 117 | 114 |
| Instantaneous Utilization | | | | | |
| DR | 0.24 | 0.5 | 0.61 | 0.61 | 0.60 |
| PA1 | 0.95 | 0.86 | 0.70 | 0.68 | 0.68 |
| PA2 | - | 0.80 | 0.58 | 0.53 | 0.52 |
| PA3 | - | - | 0.43 | 0.39 | 0.39 |
| PA4 | - | - | - | 0.11 | 0.09 |
| PA5 | - | - | - | - | 0.03 |