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# Nurse-Physician Ratio in an Internal Medicine Residency Clinic

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**Abstract** The Veterans Health Administration recently transformed its primary care system into a team-based care model in which all Veterans are assigned to Patient Aligned Care Teams (PACTs). These PACTS are constructed with standard ratios of medical staff to patients. However, these ratios may not be appropriate for trainee clinics, where the volume and complexity of patients and trainee needs are quite variable. In this paper, we describe our efforts in partnering with the Durham VA Medical Center to develop a discrete event simulation model of a trainee PACT clinic called PRIME. The objective of this analysis was to develop a tool that identified areas contributing to bottlenecks in the daily functioning of PRIME Clinic to assess means to combat variable demands from variable patient volume. A related component of this analysis was to access if a higher ratio of nurses were needed in trainee clinics compared to traditional PACT models.

***Keywords: Discrete Event Simulation, Patient Flow, Primary care, Resource Utilization***

## I. Introduction

In 2010, the Veterans Health Administration transformed its primary care system into a team-based care model in which all Veterans were assigned to Patient Aligned Care Teams (PACTs). The goal of the PACT model is to provide continuous and comprehensive care with emphasis on high performing team-based, personalized, patient-driven care. In the traditional PACT model, the team consists of 1200 patients, 1 attending physician, 1 registered nurse (RN), 1 licensed practical nurse (LPN) and 1 medical support assistant (MSA). This size is based, in part, on the goal of assuring continuity of care for patients among the medical team. In 2013, the PRIME Clinic which is one of three resident continuity clinics within the Duke University Medical Center Internal Medicine Residency Program extensively reorganized the clinic to fully implement the PACT model.

The PRIME Resident PACT consist of 800-900 patients among residents with 3 PACTs in total. There are multiple challenges to implementing the PACT model in a resident clinic. With variable patient volumes, there is variable demand on all staff but particularly on LPNs. During high volume days, LPNs check-in and check-out more patients than would be typical in the traditional PACT model. With increased demands, clinical reminders may not be completed, shorter check-in assessments may be sacrificed and thereby longer check-out assessments are needed, residents may be more poorly utilized and ultimately continuity and integrated care may suffer.

The objective of this analysis was to develop a tool that identified areas contributing to bottlenecks in the daily functioning of PRIME Clinic to assess means to combat variable demands from variable patient volume. A related component of this analysis was to access if a higher ratio of LPNs were needed in resident clinics compared to traditional PACT models, especially on maximum volume days.

## II. Literature Review

### A. *The Rising Demand for Primary Care*

Since 2002, at least 33 states including North Carolina have identified shortages in physician workforce needs (American Association of Medical Colleges Center for

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Workforce Studies 2012). Multiple other studies and projections have predicted physician and, especially primary care shortages, in the coming decade. With the PACT model, the Veterans Health Administration continues to emphasize primary care and continuity of care. Indeed, improved care coordination and continuity has been shown to decrease hospital readmission rates in academic and community primary care practices (White et al. 2014), improve disease specific outcomes (Honeyford et al. 2013), and identified as an important aspect of care to patients (Walker et al. 2013) especially among patients with chronic illness (Waibel et al. 2012).

### *B. The Importance of Primary Care in Internal Medicine Residency Curriculum*

Guidelines towards design of PACTs at Academic teaching facilities have contained broad conceptual formulations (Bowen and Schectman 2013). Current regulations for Graduate Medical Education in Internal Medicine from the Accreditation Council for Graduate Medical Education (ACGME) stipulate a minimum of 130 distinct half-day outpatient sessions extending over a minimum of a 30-month period in a longitudinal care experience (2013). Maximizing the efficiency of this time is vital as the demand to primary care providers continue to grow. The PRIME Resident PACT consist of 800-900 patients. There are 3 PACTs with 3 RNs, 2 LPNs and soon to be hired third LPN and 3 MSAs. Prior to PACT, both RNs and LPN were responsible for patient check in and check out. Since initiation of PACT, RNs function as care managers leaving fewer LPNs to complete check in and out process. This workload can be variable and especially considerable when 6 providers are scheduled for each half-day.

### *C. Variable Restraints and Needs Based on Year of Residency*

PRIME clinic is composed of 54 residents: 9 combined Internal Medicine-Psychiatry (Med-Psych) residents and 45 categorical Internal Medicine residents. There are 8 half-days of clinic per week with different resident and attending physicians each half-day. The compliment of residents varies and thereby the number of patients seen on any given day varies. First-year residents (PGY1), second-year residents (PGY2) and third-year residents (PGY3), all rotate through the clinic. The ACMGE encourages increasing levels of autonomy and decreasing direct observation throughout residency. In the first six months of residency, interns are required to have an attending evaluate every patient that he/she sees in clinic. This direct evaluation may take varying forms and include focused history, physical exam or overview of plan. Upper level residents are not time restrained by the need for direct attending observation. This, thereby, impacts residents' efficiency during ambulatory care settings.

### *D. Clinical Reminders*

Clinical reminders prompt providers at all levels from LPNs to MDs to assess quality-of-care metrics. They represent one strategy for improving implementation of guideline-based therapies and have been shown in randomized controlled trials to improve adherence to therapy (Gupta et al. 2014). These reminders are typically integrated in the electronic medical record. However, implementation is variable even across different Veterans Health Administrations facilities (Fung et al. 2004).

### *E. Application of simulation to improve efficiency of clinic flow*

Discrete event simulation (DES) has been well established and validated as a business intelligence tool in the manufacturing sector and has been shown to be effective in a number of healthcare settings (Hamrock et al. 2013) because it has the key advantage that it can guide quality improvement activities without disrupting the clinical care of patients (Rutberg et al. 2013). This characteristic is particular well suited to busy ambulatory care practices.

A number of studies have utilized simulation to improve clinic flow in primary care. Many of these studies have focused on optimization of appointment scheduling. None have specifically focused on the ratio of nurses to physicians. For example, Parks et al. (2011) utilized DES within a large, tertiary care, academic medical center adult medicine clinic to identify system bottlenecks. These were identified in the medication administration and check-out steps. This simulation predicted a reduction in patients' mean wait time from 124.3 (SD +/- 65.7) minutes to 87.0 (SD +/- 36.4) minutes when matching resources to excessive demand. An earlier DES of an academic ambulatory care clinic sought to identify optimal attending to resident (preceptor to trainee) ratios for efficiency with minimization of flow and waiting time while maximizing revenue. This occurred with resident to attending ratios of 3 to 7 residents to 1 attending. More recently, Balasubramanian et al used simulation to redesign physician panels in a primary care group practice of 39 physicians (2010).

## III. SIMULATION MODEL

### *A. Data Analysis*

We used a data collection form to gather timestamps for three clinic days. For two days, patients were asked to carry their data collection form with them as they followed the care delivery process. The staff was instructed to write the beginning and the end times of each activity on the form. Not all patients agreed to support our data collection campaigns and not all staff completed the forms. Consequently there was missing data. To improve our data

collection, for the third day, we provided a list of patients to each staff and asked them to time their own activities. The list of timestamps are displayed in Table 1.

Table 1: Timestamps activities and resources

| Process Step | Resource |
|---|---|
| Check in | MSA |
| Intake | LPN |
| Examination | Resident |
| Patient Presentation | Resident |
| Wrap up | Resident |
| Exit Interview | LPN |
| Check out | MSA |

In three days (six half day clinics), there were 116 appointments with twelve "No Shows" and four "Add Ons" resulting in a net impact of 6.9% "missed opportunities". Patients have a choice of checking in with the MSA or use a check in kiosk; 42% used the kiosk to check in. Patients are instructed to arrive 30 minutes prior to their appointments. Figure 1 depicts the distribution of patient arrivals; 94.6% of patients arrive prior to their appointment time. 34.2% of patients arrive 30 minutes or more prior to their appointment time.

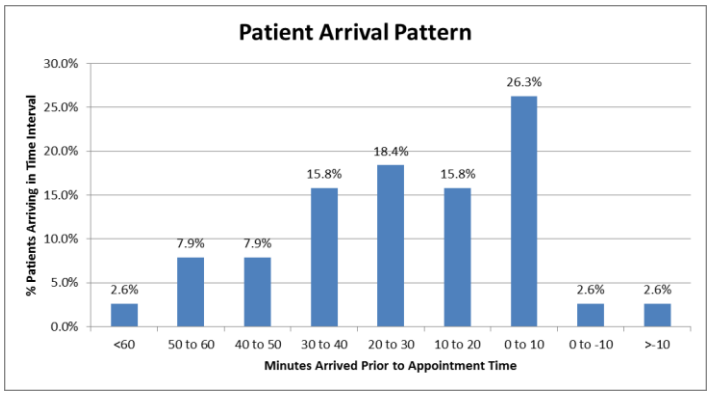


Figure 1: Patient Arrival Pattern

The 116 appointments were assigned to 18 different residents, including 24% to PGY1, 41% to PGY2 and 35% to PGY3. Figure 2 depicts the length of time residents spend with their patient as well as average number of appointments per shift/seniority level. Notice that second year residents do not spend as much time with their patients as first year and third year do. Also, first year residents are assigned fewer appointments per clinic than the second and third year residents.

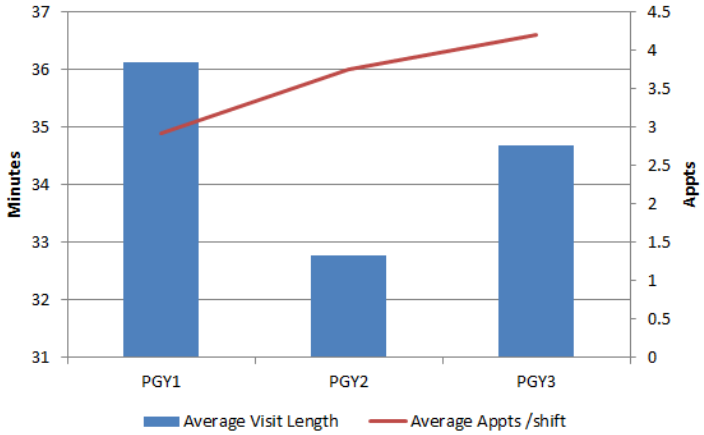


Figure 2: Average Length of Visit and Number of Appointments/Shift

Finally, not all patients have a second encounter with the LPN. In our data set, 13% of patients went directly to checkout with the MSA after they were seen by physician resident instead of having an exit interview with the LPN.

### *B. The Baseline Model*

A discrete event simulation model of patient flow in the PRIME clinic at the Durham VA medical center for a typical morning shift was developed using Simio (Kelton et al, 2013). The flow of patients was organized by the following five major steps: check in, intake, examination, exit interview, and check out. Figure 3 depicts a conceptual model of the patient flow.

Patients have two options for check in: the first option is to use a kiosk in much the same manner as seen at airports; alternatively, the second option is for a patient to check in with one of three MSAs. In either case, patient arrival is denoted and paperwork is printed. Our observation of the check in process supports that there are enough check -in kiosks that we can model the use of a check-in kiosk as a simple delay. Once a patient is checked in, he/she is instructed to wait in waiting area which is a few steps away from the check-in counters. The waiting area is modeled as a process to *dispatch* patients; patients are waiting to seize four possible resources, a licensed practical nurse (LPN) for in-take, their resident physician for examination, an LPN for exit interview, and a clerk to check out.

There are three nurses available and the first available nurse picks up the paperwork off the printer and calls in the patient into one of available nurse rooms. The nurse obtains vital signs, point-of-care labs, and completes reminders as applicable. The nurse then directs the patient back to the waiting room.

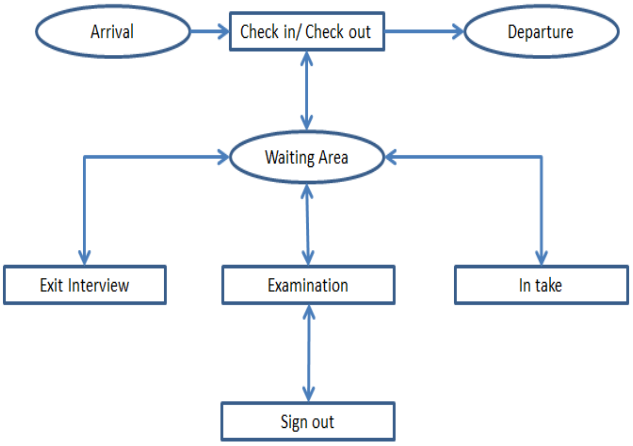


Figure 3: Conceptual model of patient flow

Next, the patient is called in by one of six resident physicians with whom the patient has an appointment. The visit includes addressing acute health problems, chronic medical conditions and health maintenance as indicated. Following the resident physician's evaluation, the patient remains in the exam room while the resident goes to the attending conference room to *sign out* with one of two available supervising attending physicians, preferentially signing out with his/her assigned attending. The resident provides situation and background on the patient and reviews pertinent components from the history, exam and plan. The attending physician asks additional questions and/or offers further items of consideration or suggests alteration of plan. The attending or resident may request a face to face review of particular aspects of the history or examination with the patient, prompting the attending returning to the exam room with the resident to speak with the patient. However, in the baseline model, we assume the attending physicians do not travel to the examination rooms. If a direct observation is not necessary, the resident physician returns to the patient room after sign out. He/she reviews pertinent aspects of the plan including alterations from what may have been previously discussed. Orders are completed. The patient is then escorted back to the waiting area. The resident places the patient's paperwork in a bin for exit interview with the LPN.

The LPN then obtains the patient's paperwork in order from check out bins. The patient is called back from the waiting room into one of available nurse rooms. The patient does not need to see the same nurse who he/she had the intake with. In this step, the nurse reviews all clinical reminders to ensure patient health maintenance is up-to-date. Any new orders, requests for blood draw or imaging test are also reviewed with the patient. Any follow-up vaccinations or educational material that is requested by the resident is given to the patient. If the check-in process was expedited then on exit interview further reminders are completed. The LPN then directs the patient to check-out with the MSA. Figure 4 depicts a snapshot of the animation of a simulation run.

To verify and validate the baseline model, in addition to using Simio's animation features, we used the actual appointments and the associated actual length of times of the activities for one of the observed morning shift with 21 appointments to compare the actual patient discharge time with the simulated discharge time. We calibrated the model by varying the travel time between the input and output nodes – a constant 42 seconds for all segments. All patients were discharged at reasonable comparable times.


Figure 4: A snapshot of the animation of a simulation run

## IV. Analysis of Clinic Capacity and Appointment Template

To analyze the PRIME clinic capacity and appointment templates, we first started with a full template of 29 appointments to establish an upper bound for clinic capacity. We found that this "full" appointment template is not acceptable as it violates the clinic's constraints, namely that residents are able to complete their duties prior to 12:00 PM and patients were staying beyond scheduled times for clinic. We thus compare four other "acceptable" scenarios with appointment templates with fewer patients.

### A. *The Experimentation and Key Performance Measures*

In the experimentation phase, for the duration of the activities, we used the dataset discussed earlier and Arena Input Analyzer [Kelton et al, 2013] to estimate the probability distribution for all the pertinent activities, as depicted in Tables 2 and 3.

Table 2: Probability Distributions for Support Staff (minutes)

| Activity | Probability Distribution |
|---|---|
| Check in | Triangular(0.00, 1.04,4.5) |
| Intake | 4.0 + Lognormal(1.68,0.677) |
| Exit Interview | 4.0+Lognormal(1.48, 0.813) |
| Check out | PearsonVI(33.246,5.768,.4242) |

Table 3: Probability Distributions for Residents (minutes)

| Activity | Probability Distribution | | |
|---|---|---|---|
| | PGY1 | PGY2 | PGY3 |
| Examination | 8.66+Lognormal(2.52, 0.773) | 9.0+Lognormal(2.21, 0.697) | Triangular(6.0, 13.8, 38.5) |
| Patient Presentation | 1.47+Lognormal(1.59, 1.02) | Lognormal(1.74, 0.542) | Lognormal(1.92, 0.486) |
| Wrap up | Triangular(1., 2.05, 6.76) | Lognormal(1.51, 0.713) | Lognormal(1.76, 0.535) |

In addition to the above parameters, we included a few other probabilistic parameters, including: a distribution for patient tardiness, Norm(5,1); a 13% probability for patients who do not see the LPN for exit check out; a 5% "No Show" in some of the scenarios; and in 39% of cases, the PGY1 residents, combine the patient presentation with wrap up.

The medical center is interested in the efficiency of the clinic in providing care to patients as well as an opportunity for trainees to learn. With this in mind, we were interested in measuring the interval of check in and check out, length of stay (LOS), the value added time (VAT), and resource utilization. VAT includes the time spent to check in with an MSA, the time spent in intake and check out with an LPN, and the entire time a resident is spending with patient or discussing the patient's case with a preceptor. The clinic is also obligated to ensure the residents have seen all their patients by noon, and so we capture the time that each resident is finished with their last patient. Likewise, the clinic is interested in the discharge of the last patient from clinic to minimize the overtime for staff staying after clinic hours. Finally, the resident and LPN utilization are captured to measure the efficiency of the resource utilization during the clinic hours.

For all experiments the model was run for 50 replications of a single morning shift with a specified appointment template.

### *B. The Full Template*

To establish an upper bound for clinic capacity, we began our analysis with a full morning shift with 29 patients, scheduled every 30 minutes, starting at 9:00 AM; one PGY1 with four appointments, three PGY2 each with five appointments, and two PGY3 each with five appointments. Table 4 depicts the key performance metrics results from running the model for 50 replications for the full template. Note that there is significant probability that the completion of clinic visit by the residents' last patient exceeds the 12:00 PM threshold which is not an acceptable scenario for the clinic. Furthermore, the last patient leaves 30 to 40 minutes after 12:00 PM and the ratio of VAT/LOS is around 40%. In other words, patients are spending too much of their time waiting for services.

Table 4: Key Performance Measures for the Full Template Scenario

| | PGY1 | | | PGY2 | | | PGY3 | | |
|---|---|---|---|---|---|---|---|---|---|
| | Average | 95% LCL | 95% UCL | Average | 95% LCL | 95% UCL | Average | 95% LCL | 95% UCL |
| LOS | 147.1 | 137.3 | 157.0 | 129.4 | 122.3 | 136.5 | 128.5 | 122.3 | 134.7 |
| VAT | 58.3 | 57.5 | 59.1 | 57.6 | 56.6 | 58.6 | 58.3 | 57.0 | 59.6 |
| Resident Last Pt | 11:55:47 AM | 11:46:22 AM | 12:05:13 PM | 12:21:10 PM | 12:14:44 PM | 12:27:37 PM | 12:21:11 PM | 12:16:11 PM | 12:26:11 PM |
| Clinic Last Pt | 12:32:47 PM | 12:25:29 PM | 12:40:05 PM | 12:44:24 PM | 12:37:19 PM | 12:51:28 PM | 12:43:26 PM | 12:37:16 PM | 12:49:37 PM |

Table 4 also depicts the average resource utilizations for residents. LPN utilization was similar to PGY3 (79%, 78%-81%). All of these resources are highly utilized, although comparative data from similar clinics is not available. In fact, published benchmarks of utilization rates for physician and nurse staff would be very beneficial.

### *C. The Feasible Scenarios*

The full template is not an acceptable template as evidenced by the fact that the average visit lengths are longer than 30 minutes, To accommodate longer visit lengths, we reduced one appointment from each resident's schedule from the end of the shift. We then compare the following four scenarios that are feasible/acceptable against each other. The motivation is to provide an insight on the sensitivity key performance measures with respect to the implementation of such scenarios.

1. **Zero "No Shows" -** In this scenario we assume all patients checked in. This case provides the performance measures for days that clinic will have all their patients that are scheduled, again as an upper bound if a 23 patient appointment template is implemented.
2. **5% "No Shows"** – in this scenario we examine the results if on average the clinic experiences 5% "No Shows".
3. **5% "No Shows" with a Proposed Template** - The proposed template uses 40 minute slots for PGY2 and PGY3 (patients are scheduled for 9:00, 9:40, 10:20, and 11:00) and 60 minute slots for PGY1 (patients are scheduled for 9:00, 10:00, and 11:00).
4. **5% "No Shows" with a Proposed Template with Two LPNs** – in this scenario, we examine the impact of staffing the clinic with just two LPNs.

### *D. Scenarios Analysis and Discussion*

Tables 5, 6, and 7 depict the LOS, the time that residents are expected to finish with their last assigned patient, and the expected time that the last patient of the morning clinic is leaving the clinic. Table 8 depicts the expected resource utilization for each of the four scenarios.

Considering the expected value added time for all scenarios remain the same, the LOS statistics adequately compare the quality of each scenario from the patients' point of view. Comparing the first two scenarios, when the "No Show" is around 5%, the LOS stay is expected to drop for a few minutes for each of resident type. Furthermore, the residents are finished with their last patients before the 12:00 PM conference start time. The resource utilization when compared with the same parameters as the 29 patients template demonstrated a significant reduction.

The proposed template scenario demonstrates that residents can still complete their duty prior to the 12:00 PM conference time and the last patient can still depart the clinic before 12:30 PM, but the LOS can be substantially reduced. The reduction in LPN utilization in the first three scenarios generated a question: "What if we reduce the number of LPNs to two?" The results demonstrate that a reduction to LPN staff could jeopardize the operational performance of the clinic because it significantly increases LOS, extends the departure of the last patient, and causes the residents to miss their 12:00 PM conference.

Table 5: Length of Stay in Minutes

| Scenario | Seniority | Average | 95% LCL | 95% UCL |
|---|---|---|---|---|
| Zero "No Shows" | PGY1 | 117.5 | 108.4 | 126.6 |
| 5% "No Shows" | | 113.7 | 105.4 | 122.1 |
| 5% "No Shows" - Proposed Template | | 92.6 | 82.9 | 102.3 |
| 5% "No Shows" - Proposed Template with 2 LPNs | | 141.2 | 130.7 | 151.8 |
| Zero "No Shows" | PGY2 | 110.4 | 104.0 | 116.9 |
| 5% "No Shows" | | 108.9 | 102.2 | 115.6 |
| 5% "No Shows" - Proposed Template | | 92.5 | 86.6 | 98.4 |
| 5% "No Shows" - Proposed Template with 2 LPNs | | 134.6 | 126.5 | 142.7 |
| Zero "No Shows" | PGY3 | 109.3 | 104.1 | 114.5 |
| 5% "No Shows" | | 107.3 | 101.5 | 113.1 |
| 5% "No Shows" - Proposed Template | | 89.9 | 85.0 | 94.9 |
| 5% "No Shows" - Proposed Template with 2 LPNs | | 134.5 | 126.9 | 142.1 |

Table 6: Completion of Clinic Visit for Residents' Last Patient

| Scenario | Seniority | Average | 95% LCL | 95% UCL |
|---|---|---|---|---|
| Zero "No Shows" | PGY1 | 11:12:38 AM | 11:02:37 AM | 11:22:38 AM |
| 5% "No Shows" | | 11:08:04 AM | 10:59:06 AM | 11:17:02 AM |
| 5% "No Shows" - Proposed Template | | 11:51:08 AM | 11:40:47 AM | 12:01:30 PM |
| 5% "No Shows" - Proposed Template with 2 LPNs | | 12:33:36 PM | 12:22:28 PM | 12:44:43 PM |
| Zero "No Shows" | PGY2 | 11:40:21 AM | 11:34:29 AM | 11:46:12 AM |
| 5% "No Shows" | | 11:40:03 AM | 11:33:14 AM | 11:46:51 AM |
| 5% "No Shows" - Proposed Template | | 11:50:19 AM | 11:44:55 AM | 11:55:44 AM |
| 5% "No Shows" - Proposed Template with 2 LPNs | | 12:21:35 PM | 12:14:46 PM | 12:28:24 PM |
| Zero "No Shows" | PGY3 | 11:38:12 AM | 11:33:54 AM | 11:42:30 AM |
| 5% "No Shows" | | 11:38:08 AM | 11:32:40 AM | 11:43:35 AM |
| 5% "No Shows" - Proposed Template | | 11:46:01 AM | 11:41:17 AM | 11:50:46 AM |
| 5% "No Shows" - Proposed Template with 2 LPNs | | 12:23:16 PM | 12:17:34 PM | 12:28:59 PM |

Table 7: Departure of Clinic's Last Patient

| Scenario | Seniority | Average | 95% LCL | 95% UCL |
|---|---|---|---|---|
| Zero "No Shows" | PGY1 | 11:41:23 AM | 11:32:51 AM | 11:49:56 AM |
| 5% "No Shows" | | 11:37:31 AM | 11:28:44 AM | 11:46:18 AM |
| 5% "No Shows" - Proposed Template | | 12:08:41 PM | 11:57:19 AM | 12:20:02 PM |
| 5% "No Shows" - Proposed Template with 2 LPNs | | 1:10:36 PM | 12:59:46 PM | 1:21:26 PM |
| Zero "No Shows" | PGY2 | 11:58:47 AM | 11:52:42 AM | 12:04:52 PM |
| 5% "No Shows" | | 11:58:04 AM | 11:51:21 AM | 12:04:46 PM |
| 5% "No Shows" - Proposed Template | | 12:06:49 PM | 12:00:56 PM | 12:12:42 PM |
| 5% "No Shows" - Proposed Template with 2 LPNs | | 1:01:12 PM | 12:53:07 PM | 1:09:17 PM |
| Zero "No Shows" | PGY3 | 11:56:34 AM | 11:51:25 AM | 12:01:43 PM |
| 5% "No Shows" | | 11:56:52 AM | 11:51:28 AM | 12:02:15 PM |
| 5% "No Shows" - Proposed Template | | 12:02:55 PM | 11:57:14 AM | 12:08:36 PM |
| 5% "No Shows" - Proposed Template with 2 LPNs | | 1:02:43 PM | 12:54:48 PM | 1:10:37 PM |

Table 8: Resource Utilization

| Scenario | Seniority | Average | 95% LCL | 95% UCL |
|---|---|---|---|---|
| Zero "No Shows" | PGY1 | 54% | 49% | 59% |
| 5% "No Shows" | | 50% | 45% | 55% |
| 5% "No Shows" - Proposed Template | | 53% | 47% | 60% |
| 5% "No Shows" - Proposed Template with 2 LPNs | | 51% | 47% | 56% |
| Zero "No Shows" | PGY2 | 64% | 63% | 66% |
| 5% "No Shows" | | 62% | 60% | 64% |
| 5% "No Shows" - Proposed Template | | 62% | 60% | 64% |
| 5% "No Shows" - Proposed Template with 2 LPNs | | 60% | 58% | 62% |
| Zero "No Shows" | PGY3 | 63% | 62% | 65% |
| 5% "No Shows" | | 61% | 59% | 64% |
| 5% "No Shows" - Proposed Template | | 59% | 57% | 62% |
| 5% "No Shows" - Proposed Template with 2 LPNs | | 60% | 58% | 62% |
| Zero "No Shows" | LPN | 67% | 66% | 69% |
| 5% "No Shows" | | 65% | 63% | 67% |
| 5% "No Shows" - Proposed Template | | 64% | 62% | 66% |
| 5% "No Shows" - Proposed Template with 2 LPNs | | 94% | 92% | 96% |

## V. CONCLUSIONS

This paper describes a partnership with the Durham VA Medical Center to model a trainee clinic to make recommendations regarding appointment time template design as well as optimal staffing of LPNs for the intake and exit interview process. The model found that the clinic's current appointment template does not meet the goals of physician training and is not efficient as evident by the LOS being over 2 hours, the resident finishing with the patient after 12 noon and the last patient leaving the clinic area close to an hour after the clinic session has ended.

The 4 feasible scenarios examined in this analysis decrease the total number of patients seen by each PGY level by one. So PGY1 are scheduled 3 patients and PGY2 and PGY3 are scheduled 4 patients. Adding in a clinic no show rate of 5% resulted in several favorable changes: first, a decreased LOS; second, completing clinic with the resident finishing before 12 noon; and third, the last patient leaving before the start of the afternoon clinic session. The third scenario with the 40 minute appointment template dramatically decreased the length of stay for all patients regardless of PGY level. While this would require reformatting of appointment templates, this would be most beneficial regarding limiting length of stay and still completing clinic in a timely manner. The final scenario decreasing the number of LPNs from 3 to 2 showed the impact of how decreasing staff slowed the efficiency of the clinic. This study has shown that optimal LPN staff is of paramount importance to keeping length of stay reasonable and having trainees and patients leave clinic at acceptable times.

The findings of this study have been shared with clinic leadership and are being used to support redesign of the trainee clinic.

### A. *Copyright Form*

An IEEE copyright form should accompany your final submission. You can get a .pdf, .html, or .doc version at http://www.ieee.org/copyright. Authors are responsible for obtaining any security clearances.

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