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The impact of medical students on work after clinic for neurology preceptors**Abstract**

Objective: To determine whether medical students significantly impact preceptor physicians' clinic volume and work after clinic (WAC), we compared the time to note completion and the number of patients seen per hour (PPH) for outpatient neurologists with and without students present in their clinic.

Methods: Outpatient neurologists (n=47) involved in the Johns Hopkins Neurology Clerkship from 2015-2017 were included. WAC for each patient encounter was calculated as the interval between the date and time of a scheduled patient appointment and the time of clinic note completion. The number of patient encounters per scheduled clinic hour (PPH) was also calculated for each preceptor. Measurements were compared for each preceptor, serving as their own control, to account for variability in efficiency between preceptors.

Results: There was no statistically significant difference in WAC or PPH for individual preceptors with and without students (WAC p-value = 0.837; PPH p-value=0.139). Preceptors did see significantly more patients per day with students than without (6.28 with students, 5.07 without students, p-value <0.001).

Conclusions: In this study, assigning a student to an outpatient ambulatory clinic did not significantly increase work after clinic. In addition, students did not significantly alter the number of patients faculty saw per hour.

Public Interest Summary

Both medical students and educators have highlighted the importance of greater student involvement in clinic in providing a valuable outpatient educational experience, but it is often difficult for academic programs to recruit physician preceptors willing to teach and actively involve students in outpatient clinics. This study shows that medical student presence in clinic does not delay physician preceptors' note completion and is not associated with less patients seen. To further optimize the outpatient educational and efficiency model, it is important for future investigations to evaluate training programs that enhance the efficacy of a student in clinic, particularly for students

with less outpatient experience. This could encourage more preceptors to involve medical students in their clinic, potentially increasing student competence and interest in outpatient medicine.

Introduction

While the evidence is mixed about whether the inpatient or the outpatient setting provides medical students with a better educational experience, medical students perceive the outpatient setting to be an enriching educational environment (1–4). Outpatient clinical experience has been gaining a greater role in undergraduate medical education with 80% of all neurology clerkship rotations including an outpatient component (5). Both medical students and educators have highlighted the importance of student involvement in clinic to provide a valuable outpatient educational experience, particularly emphasizing the importance of students seeing patients independently (6–9). However, it is often difficult for academic programs to recruit faculty members willing to teach and actively involve students in ambulatory clinics. A major contributing factor is likely the prevailing attitude that students negatively impact clinical productivity.

An observational study in our neurology department demonstrated that when students were present in clinic, preceptors generated on average 42% more relative value units (RVUs), 35% more invoices, and 39% more charges per clinic session compared to their clinics without students (10). Additionally, giving students active responsibilities in clinic was associated with both greater perceived learning for students, as well as greater preceptor productivity in RVU, charge, and invoice generation. Preceptors who were highly rated teachers were invited to engage in the Osler Attending Preceptor in Neurology Program (OAP), which encouraged preceptors to allow students to see patients independently (10,13). Two recent studies showed similar findings of increased RVU generation with students (11,12), though one of these was not statistically significant (12).

While these results are promising in suggesting medical students may improve preceptor clinic productivity, it remains unclear whether preceptors take longer to complete clinic notes when students are present, thus potentially offsetting the rise in clinical productivity with more "work after clinic" (WAC) for preceptors. The primary objective for this study was to evaluate whether physician work after clinic (WAC) differed when a student was present in clinic, and whether there were any observed differences between the OAP cohort and other faculty members.

Secondary objectives were to determine whether the number of patients seen per day and the number of patients seen per scheduled clinic hour differed when a student was present in clinic.

Methods:

Overview

This retrospective study evaluated the length of time needed for preceptors to complete clinic notes when students were and were not assigned to their outpatient clinics at the Johns Hopkins University School of Medicine.

Standard protocol approvals, registrations, and patient consents

This study was approved by the Johns Hopkins University institutional review board (IRB00055745). Written consent was provided by the Department of Neurology to retrospectively evaluate productivity measures of providers.

Data availability

Anonymized data from this study can be provided upon request.

Preceptor productivity and work after clinic (WAC)

Clinic preceptors (n=47) were university faculty members in neurology at Johns Hopkins. Of these preceptors, 17 were part of the OAP, selected for their excellent student reviews and their consistent devotion to teaching medical students. All OAP preceptors were encouraged to allow students to see patients independently. At a minimum, the student would take a full patient history while the preceptor either saw another patient or completed other clinic work. Students were encouraged to perform the exam, although some preceptors reported they preferred to do the neurological exam with the student so that the patient did not have to do the exam twice. The medical student would present the patient to the preceptor (commonly outside the exam room), and then the student and preceptor would see the patient together where the preceptor would confirm the data the student gathered.

Both OAP and non-OAP preceptors could request an extra room when a student was present in clinic. Only one student was assigned to each preceptor, and all preceptors were notified in advance if they would have a student with them in clinic. Each preceptor clinic had a mix of new and follow-up patients that the student could see, and the preceptor determined which patient the student should evaluate (there were no instructions provided to preceptors for whether to assign students to new or to follow-up patients).

Neurology clerkship students consisted of second, third, and fourth-year medical students who had the ability to document in the Electronic Health Record (EHR). The neurology clerkship is four weeks, where each student participates in outpatient neurology clinics for at least one week and spends the remainder of their clerkship in the inpatient setting. All clerkship students received training on taking a patient history and doing a neurologic exam before the clerkship as part of their first-year medical school curriculum, and they received additional training in completing a full neurological examination at the beginning of the clerkship. Students were invited to fill out an optional survey during the study period which included how many rotations they had completed prior to the neurology clerkship as an indicator for their level of clinical experience.

Preceptor productivity was assessed using the average number of patients seen per scheduled clinic hour (patients per hour/PPH), number of patients seen per clinic day, and WAC per patient encounter. WAC was measured as the time elapsed (in days) from the scheduled appointment time until the clinic note was completed for each patient encounter. PPH was calculated by the number of patients seen that day divided by scheduled clinic hours, with scheduled clinic hours measured as the difference between the last appointment time and the first appointment time for each unique faculty-student-day combination. Clinic days with only one appointment were excluded as it could not be determined how much time was given to that patient and students were rarely present for these appointments; therefore, it was not a legitimate comparison to clinic days when students were present. The raw data used to create these metrics were collected from the EHR at our institution. Clerkship attendance records were retrospectively used to identify dates that students were present or not present in each preceptor's clinic from August 2015 to March 2017. The majority of the preceptors in this study were in the Tanner et.al. 2017 study referenced above, excluding those who were no longer practicing at the clinic.

The primary outcome was median WAC time for each preceptor with versus without students present. The secondary outcomes were number of patients seen per scheduled clinic hour (PPH) and number seen per clinic date.

Statistical approach

R statistical programming version 3.5.1 was used for all statistical analyses. Calculations were compared with versus without students for each preceptor independently so that preceptors served as their own controls to account for other potential causes of variability between preceptors (e.g., subspecialty, use of dictation, amount of time spent with patients, etc.).

As the WAC data were non-parametric, a paired Wilcoxon signed rank test was used to compare median WAC for individual preceptors with versus without students. The minimum WAC value is negative due to some notes being completed before the scheduled appointment time (when a patient is seen early). A paired t-test was used to compare PPH for individual preceptors with versus without students. Calculations were made for all preceptors and then preceptors stratified by whether they were in the OAP.

Results:

Clinic and preceptor characteristics

Data for 47 preceptors were included. Results were calculated from 5,187 unique preceptor-day combinations included in our dataset, of which 722 (16.2%) dates involved a student. There were 33,351 patient encounters included, of which 6,156 (22.6%) were spent with a student (Table 1).

Student experience

43 of 113 students (38%) during the 2016-2017 academic year answered the optional survey discussed above. The median number of prior rotations completed was 2 (interquartile range 0-4). The neurology clerkship was the first rotation for 30% of students, while 34% of students had completed ≥ 4 prior rotations and 5% completed 7 rotations.

Work after clinic results

Descriptive statistics of all WAC data is displayed in Table 2. Overall, there was no statistically significant change in WAC time comparing individual faculty performance with versus without students (p-value = 0.8365, 95% CI [-0.629, 0.328]). This remains true when faculty are grouped by those in the OAP (p-value = 0.660, 95% CI [-0.910, 1.399]) and those not in the OAP (p-value = 0.577, 95% CI [-1.035, 0.240]). There is also no statistically significant difference in patients seen per scheduled clinic hour by individual faculty with and without students (1.5 PPH with students, 1.55 without students, p-value = 0.139, 95% CI [-0.100, 0.014]). This remains true whether faculty are grouped by those in the OAP (1.56 PPH with students, 1.62 PPH without, p-value = 0.187, 95% CI [-0.145, 0.031]) and those not in the OAP (1.48 PPH with students, 1.51 PPH without, p-value = 0.350, 95% CI [-0.113, 0.041]). However, faculty see significantly more patients per day with students versus without students (6.28 patients with students, 5.07 patients without students, p-value <0.001, 95% CI [0.767, 1.636]). Figure 1 shows the median WAC for each of the individual 47 faculty members with and without students.

Discussion:

In this study of over 33,000 patient encounters during a 2-year interval, we found that student presence in clinic did not seem to affect the amount of work after clinic (measured in days). Although faculty see more patients per day with students present than without, there is no significant difference in the number of patients seen per hour. This may be due to students being scheduled to join preceptors on busier clinic days. Our results demonstrate that working with a medical student does not appear to reduce provider efficiency in completing clinic documentation. This held true even on subgroup analysis for preceptors in the OAP teaching program, where students are not simply shadowing, but gaining a rich educational experience through direct involvement in patient care. It should be noted that providers served as their own controls in this study, so variability in provider style (e.g., use of dictation, efficiency with notes, subspecialty) should not affect these results.

Our analysis builds on the findings of Tanner et al. (2017), which evaluated RVU generation, student perception of each clinic session's educational value, and patient encounters per clinic session with and without students for many of the same faculty preceptors in our data set. They found preceptors who provided a more valuable educational experience for students through greater clinic involvement increased student satisfaction, completed more patient

invoices, and had higher RVU generation for clinic sessions with a student when compared to clinic sessions without a student. This study extends those results by suggesting the increased clinical productivity was not due to an increase in WAC for preceptors. Given our findings that there was no significant difference in PPH with and without students, it is possible that the increase in invoices and RVU generation previously identified was due to medical students working with preceptors when more patients are scheduled, such as during full-day rather than half-day clinics. However, it is also possible preceptors purposefully added patients to their schedule for clinic dates with a student as preceptors knew in advance whether they would have a student in clinic. Anecdotally, some faculty members have admitted to overbooking patients if a student is able to see another patient at the same time. Regardless, our results suggest that preceptors can provide an engaging educational experience in the ambulatory setting and see the same number of patients per hour without having a significant increase in WAC. This implies that it is possible to achieve a clinical workflow that actively engages students without sacrificing productivity or efficiency. Additionally, it provides support against the pervasive notion in many academic centers that teaching medical students in outpatient clinics leads to less productivity. Of note, the model discussed in this paper did not require any training; however, when time and resources allow for a modest level of training, a recent study found that students can decrease preceptor documentation time if students and preceptors are trained on a workflow model that efficiently integrates students into the EHR documentation process (14).

Past studies have found that a model encouraging pre-learning and parallel patient booking, with the student and preceptor seeing separate patients simultaneously, increases clinical efficiency (13). Faculty at our institution have also commented on the difference “star students” can make with their productivity as these students can see patients effectively and efficiently with little guidance needed from the preceptor. From our own experience, pre-rotation learning, particularly when targeted to a specific clinic, contributes to student learning and provider efficiency, although this has not been formally evaluated.

There are several limitations to our study. The data was gathered from a single neurology department in one medical system; thus, the generalizability to other institutions may be limited. We used a surrogate measure (time to note completion) to measure WAC for preceptors and used the appointment time as the start time for WAC. We did not have access to more direct measures of time spent in the chart (e.g., number of hours spent in the chart), and there

may be additional time spent by preceptors that is not accounted for in this measurement (e.g., faculty who started the note before the appointment). We hoped to limit the variability in time to note completion from affecting our interpretation by including a high number of clinic dates and patient encounters. As patients per hour (PPH) was calculated as number of patients seen that day divided by number of scheduled clinic hours, it is possible the actual number of patient visits completed per hour is different, and it could not be determined based on our data whether physicians fell behind schedule. In addition, we only measured clinical efficiency, and did not have corresponding RVU data to capture financial productivity, so it remains unclear if providers were indeed generating higher RVUs with students, despite seeing the same PPH as when working alone (e.g., if they were able to bill at a higher level when working with students, or complete other RVU-generating work while the student was seeing patients). Our data on medical students present in each encounter did not include their year in medical school, and our data on medical students' level of experience in this neurology clerkship comes from an optional survey, which may over represent students earlier in training. While the OAP preceptors were encouraged to provide students with pre-clinic learning, integration into clinic activities, and post-clinic feedback, we did not record how each preceptor incorporated medical students into clinic visits or student documentation, which may affect WAC and generalizability. In future studies, we hope to better understand the impact that a medical student in clinic may have on flowtime and satisfaction for patients.

In summary, engaging and teaching students in outpatient neurology clinic can be accomplished without increased WAC or decreasing the number of patients seen per hour for preceptors. To further optimize the outpatient educational and efficiency model, it is important for future investigations to evaluate training programs that enhance the efficacy of a student in clinic, particularly for students with less outpatient experience.

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