![AAIM — Alliance for Academic Internal Medicine]

AAIM Perspectives

AAIM is the largest academically focused specialty organization representing departments of internal medicine at medical schools and teaching hospitals in the United States and Canada. As a consortium of five organizations, AAIM represents department chairs and chiefs; clerkship, residency, and fellowship program directors; division chiefs; and academic and business administrators as well as other faculty and staff in departments of internal medicine and their divisions.

Medical Students and the Electronic Health Record: 'An Epic Use of Time'

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Abraham Verghese, MD has dubbed the electronic health record (EHR) as the "iPatient."[1] In that provocative piece, he observed that learners spend a significant amount of time evaluating patients via the electronic record, often before meeting the actual patient and at the expense of a bedside diagnostic examination. Although the concerns about bedside medicine being shortchanged predate EHR,[2,3] others also have suggested that EHR, in pulling learners away from the patient, may be further harming the medical education enterprise.[4]

Features in EHRs may encourage learners to make medical decisions or deliver medical care without having to interact directly with patients or other providers. Historical information on a patient awaiting admission to the hospital can be gathered from a distant work room or even away from the hospital.[5] Without proper training and guidance, EHR can undermine the student's development of patient-centered care practices.[6,7]

Adoption of EHR is becoming more common in teaching hospitals, but few studies have evaluated its effect on medical education.[8-10] Prior investigation has revealed that internal medicine learners spend a significant proportion of their day on clinical documentation and at computer workstations[11,12]; 2 recent direct observation studies have determined that internal medicine residents spend approximately 40% of their time engaged in computer use, mostly occupied by documentation, orders, and chart review.[13-15]

Despite these concerns, a recent survey examining attitudes of medical school education deans about medical student EHR use found that most leaders were supportive of access and documentation in the EHR. Student EHR use can enhance education through development of communication skills, promote student roles on a patient care team, and facilitate assessment of student competencies.[16] In the face of these controversies, we sought to examine medical student EHR use at our institution, using a novel method that avoids the potential pitfalls of self-report. Our study aimed to quantify the amount of medical student time spent on EHR use and to examine the potential benefits of student EHR use on education outcomes.

METHODS

Sample

Audit data on EHR use was collected during the medical student academic instruction period between September 27, 2011 and May 5, 2012. The initial sample was

composed of EHR audit data from 119 third- and fourth-year medical students enrolled at Stanford School of Medicine for a minimum of 10 workdays on at least one of the following required clerkship rotations: Internal Medicine, Family Medicine, Ambulatory Medicine, Surgery, Obstetrics/Gynecology, Psychiatry, and Intensive Care.

Student Guidelines

Clinical documentation, data review, and physician order entry at our institution is performed using the Epic electronic health record product (Epic Corporation, Madison, WI). Students receive a minimal amount of Epic training; it consists of required online modules before obtaining login access. Medical students are permitted full view and write access to the medical record. Although no formal EHR student guidelines were in place at the time of this study, students were asked generally to perform traditional paper chart tasks, including daily documentation of patient care and review of other notes, labs, and imaging. Hospital policies discouraging the use of "copy and paste" functions by physicians also applied to medical students. Medical students were permitted to enter orders, which could be "pended" and activated after physician review. They were also permitted, but not expected, to contribute to or correct other more permanent components of a patient's standing record, including problem lists, medication reconciliation, or history. Similarly, students were allowed to document with or without the use of templates. To our knowledge, no other formal EHR training was provided during individual rotations; variation in EHR use likely occurred depending on the expectations of the supervising attendings and residents.

Electronic Audit

Using Epic Clarity Reporting provided by our hospital informatics support team, we generated an audit report for the 119 students in the original sample. This report provided a description of individual EHR logins by each student during the study period. Of note, Epic EHR at the institution is set to automatically log off after 20 minutes of inactivity. In total, we captured 58,300 logins over 6252 student workdays; these days were matched to a student scheduling database, allowing us to sort login data based on rotation specialty. To

exclude remote access from home on nonstandard workdays, such as days off, we censored data from days that did not feature more than one login. Similarly, logins of <1 minute, which likely represented either computer crashes or login difficulties, were excluded. After excluding these data, the final data set included 53,602 logins over 5422 student workdays.

PERSPECTIVES VIEWPOINTS

- Medical student electronic health record (EHR) use and the effects on medical education have not been well described.

- Medical student EHR activity at an academic center was obtained and studied. For a subset of students assigned to the Internal Medicine rotation, EHR use was correlated with performance measures.

- Medical students are exposed to large amounts of screen time during clerkship years. EHR usage does not correlate with performance.

- Medical students do not accurately estimate EHR use.

Internal Medicine Rotation

To better understand student use of EHR, the Internal Medicine rotation was selected for further analysis because it was associated with the heaviest EHR use. Students on the Internal Medicine rotation were assigned to 1 of 5 medicine ward teams over 4 weeks, accepting new patients on every first and fourth day of a 5-day cycle. Students were expected to arrive by 7:00 AM each morning and leave by 9:00 PM on call days, matching the intern work schedule. We conservatively estimated that students arrived at 7:00 AM and left work by 6:00 PM on noncall days. After accounting for 1 day off per week, we estimated that students averaged 297.6 hours per 4-week rotation over 11.2 call days and 16.8 noncall days.

Third-year medical students rotating on the Internal Medicine clerkship at Stanford are required to take the Medicine Subject ("shelf") Examination administered by the National Board of Medical Examiners. In addition to examination scores, students on the Internal Medicine rotation receive evaluations in patient care based on the reporter-interpreter-manager-educator framework.[17] Students are scored on a 1 to 3 scale for each competency (Figure 1) by supervising interns, residents, and attendings. The evaluations are collated subsequently by a medicine core clerkship committee and students are given a composite score.

We distributed an electronic survey to 48 medical students enrolled in the Internal Medicine clerkship using Qualtrics Online Survey Software (Provo, UT); 45 students (94%) responded. The survey asked students to estimate their average daily EHR use during their Internal Medicine clerkship. We also obtained student evaluation data from attending physicians and housestaff as well as shelf examination scores.

This study was granted exempt status by the Stanford Administrative Panels for the Protection of Human Subjects (institutional review board) as an educational study.

REPORTER:	Consistently True	Sometimes True	Rarely or Never True	Unable to Assess
Obtains an accurate, complete and detailed H&P.	○	○	○	○
Presents patient data clearly and logically, following a standard format, with good command of medical terminology.	○	○	○	○

INTERPRETER:	Consistently True	Sometimes True	Rarely or Never True	Unable to Assess
Gathers data efficiently. Focuses H&P and adapts presentation to the situation/reason for visit or hospitalization.	○	○	○	○
Selectively presents pertinent information.	○	○	○	○
Synthesizes and concisely summarizes data.	○	○	○	○
Interprets clinical findings to independently offer an accurate working diagnosis and prioritized differential diagnosis and/or problem list.	○	○	○	○
Describes the pathophysiology or rationale underlying each possible diagnosis when relevant to patient care	○	○	○	○

MANAGER/EDUCATOR:	Consistently True	Sometimes True	Rarely or Never True	Unable to Assess
Offers a reasonable plan for testing and/or treatment, including needs beyond the immediate hospitalization or clinic visit.	○	○	○	○
Incorporates patients' work and home situations, values and preferences in treatment planning recommendations.	○	○	○	○
Discusses the risks, benefits, and costs of tests and treatments and of alternative choices. Demonstrates awareness of the sensitivity and specificity of lab tests and imaging modalities.	○	○	○	○
Incorporates information from reference resources and clinical studies in developing evaluation and treatment plans.	○	○	○	○
Serves as a primary provider in patient care. Trusted by the preceptor/team to manage tasks, e.g. calling consults, speaking with outside physicians, arranging discharges, following up labs and studies. Contributes substantially to patient management.	○	○	○	○

Figure 1   Reporter, Interpreter, Manager, Educator (RIME)-based medical student patient care evaluation.

Data Analysis

A 2-sample paired t test and a Pearson correlation analysis were used to compare students' self-reported time on EHR and their audited EHR time. In all further comparisons, students' audited EHR was used as a measure of EHR usage. We used a Pearson correlation analysis to evaluate the association between EHR use and objective performance measures. Student shelf examination scores were used as an objective measure of performance. A 1-way analysis of variance (with Bonferroni posttest) was used to test for associations between EHR use and different clerkship groups. All statistical analyses were performed using Stata MP, version 10 (StataCorp LP, College Station, TX).

RESULTS

Electronic Health Record Use

For the 119 students enrolled in 274 rotation blocks in the 9 rotation groups, students on the Internal Medicine rotation logged significantly more hours per day on the EHR than students in other clerkships (6.19 vs 3.25 hours per day, $P < .001$). Low EHR use was systemic in certain specialty rotations, such as Obstetrics/Gynecology (2.74 hours per day), Neurology (2.83 hours per day), and General Surgery (2.90 hours per day) (Figure 2). Based on an average estimate of 297.6 hours per Internal Medicine rotation over 24 workdays (4 weeks with 4 days off), 6.19 hours of EHR activity
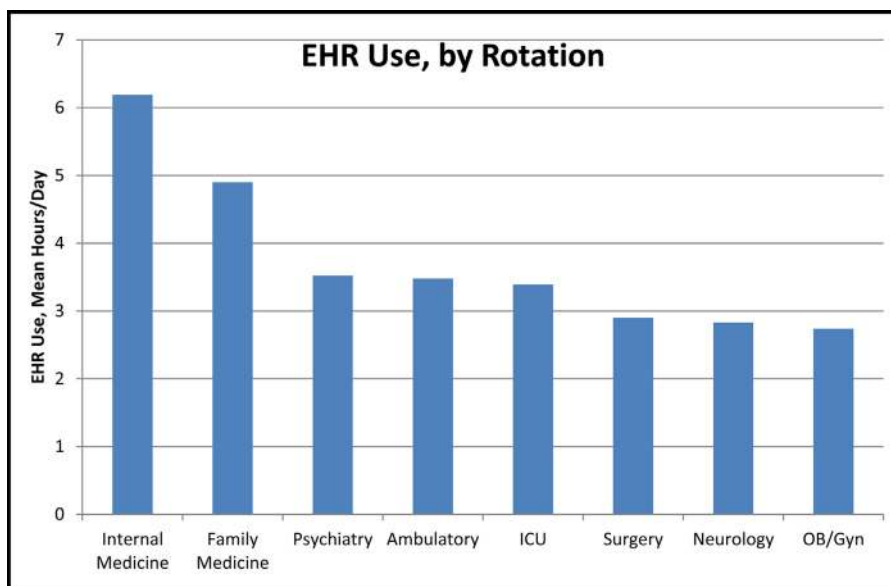
Figure 2   Electronic health record (EHR) use by rotation assignment. ICU = intensive care unit; OB/Gyn = Obstetrics/Gynecology.

per day corresponded to approximately 49.9% of an average student workday.

In total, we received 45 survey responses from the 48 students assigned to the Internal Medicine core clerkship site during the study period (94%). Students estimated their average daily EHR use at 4.9 hours per day, which was less than their electronic audit ($P < .001$). Interestingly, there was no association between self-reported EHR use and observed EHR use ($r = -0.05$).

Audited student EHR use was matched with examination scores and evaluations. Shelf examination scores ranged from 61 to 95, with an average of 77.7. Our study showed no significant correlation between daily (audited) EHR use and standardized examination scores ($r = 0.01$, $P = .96$). There was also no correlation between EHR use and patient care based on the reporter-interpreter-manager-educator evaluation ($r = 0.07$, $P = .64$).

DISCUSSION

Our study shows that medical students are not immune to the effects of the EHR, and similar to more experienced learners, they spend a substantial amount of time at the computer. While it may not be surprising that procedure-based clerkships such as surgery were associated with less computer time, EHR use on the internal medicine rotation far exceeded most other specialties.

In general, medical student notes receive more attention than the notes of house officers, and EHR documentation promotes feedback[18,19] that may drive computer usage. However, today's medical note promotes the use of copied content,[20] including labs that have been automatically imported but not reviewed, reports of imaging studies that have not been seen, and unverified historical patient information. Paradoxically, a very comprehensive medical student note can include very little original thought, simply reflecting facility with the EHR software. This emerging form of medical practice has potential duty hour and educational concerns, previously raised by others,[21] and has prompted a call for uniformity and guidelines for student EHR use and curriculum development.[22,23] Student EHR use also may be influenced by circumstances beyond their control and actually reflect the practice of supervising physicians. Some junior faculty trained in the EHR era themselves and may prefer to discuss patients in a workroom in the presence of EHR. Others prefer a more traditional approach by bringing learners to the bedside without distractions from the computer.[1]

Because no correlation between EHR use and clerkship performance was shown, we were not able to make strong inferences about the educational benefit. Shelf examination scores may reflect traditional study preparation, while subjective evaluations are likely multifactorial, incorporating interactions outside of EHR use. Some types of EHR use may be more instructive, while others yield diminishing returns. There also may be other educational benefits that we did not specifically measure. It is worth noting that pre-EHR era time studies dating as far back as 1981 found that Internal Medicine students spent only a fraction of their time on direct patient care.[3] Residents in 1997 were found to perform up to 5 hours per day of documentation and chart review and only 12% of their time speaking with and examining patients on call days.[2] However, these studies predate at least 2 different sets of duty hour regulation changes and also occurred at different institutions, which make it difficult to interpret as a frame of reference for our study.

Limitations

The sample size and duration of our study are important strengths, but several limitations should be taken into account. Learner schedules, patient census, workflow, and team structures are likely to differ among institutions and may limit the generalizability of our findings. Although Epic EHR at our institution is set to automatically log off after 20 minutes of inactivity, time spent engaged in other activity, such as e-mail or other Internet use, was likely included if EHR activity was resumed before the automatic logout. With multiple logins per day, this other activity could partially account for the discrepancy between self-reported average daily use and data obtained by our electronic audit. However, medical students both underestimated and overestimated their usage without any correlation between perceived and audited time spent, which suggests that students were not able to accurately estimate their EHR usage. Our audit was also limited to time audits and unable to provide more granular data to differentiate between time spent on different activities such as documentation or lab review.

We did not directly observe the amount of direct patient contact by students and can only infer that excess EHR use comes at the expense of direct patient care, after accounting for other required clerkship activities such as teaching conferences, didactics, and increasing mandates limiting duty hours. Lastly, our study predates the growing focus on EHR curriculum that has developed in recent years. Students and faculty were therefore unable to benefit from EHR use guidelines such as those proposed by the Alliance for Clinical Education,[23] which likely increased some variability in expectations of student EHR use, even within rotations.

CONCLUSION

Among medical students rotating through clerkships at our medical school, most EHR time was spent while rotating through the Internal Medicine inpatient clerkship, which mirrors recent observational studies of Internal Medicine interns.[13-15] Despite the potential impact of the EHR on educational outcomes, no correlation could be identified between EHR use and clerkship performance. These findings suggest that EHR use habits may be learned early in medical training and certain specialties are more prone to increased screen time. More attention should be directed towards the interface between medical students and the EHR. Their experiences with the EHR during these earlier stages of training are likely to influence attitudes and habits later on as physicians.

ACKNOWLEDGMENTS

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