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IMPACT OF ELECTRONIC HEALTH RECORD IMPLEMENTATION ON PATIENT VISIT VOLUME IN AN ACADEMIC OPHTHALMOLOGY CLINIC

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Abstract
Having electronic health records (EHRs) is now a standard part of healthcare delivery. We designed this study to measure the number of patients seen at the clinic before and after the introduction of EHR in the clinic. Our analysis involved going over patient visit numbers by session and checking the staff support given to established faculty ophthalmologists. In five sequential years, starting in the year prior to EHR introduction, data were gathered from July to October each year. Only eight of the surgeons reviewed satisfied our criteria. The number of patient visits was lower in every year after EHR adoption compared to the first year ($p \leq 0.027$). The number of patients treated per practitioner fell by 16.9% on average over the four years (the range was between 15.3% and 18.5%). For the group, the patient volume seen per session in the last year did not equal their pre-EHR numbers. The number of support staff did not change during the time frame of the study ($p > 0.2$). Changing to EHR was related to fewer patient visits per clinic session in an academic outpatient center with a constant number of support staff. In these types of clinics, needing more support staff may help maintain both the clinic's schedule and patients' ease of access.

Introduction

The adoption of electronic health records (EHRs) represents a major shift for healthcare providers. Legislation introduced in 2009 through the Health Information Technology for Economic and Clinical Health Act (HITECH) initially provided financial incentives for providers to implement certified EHR systems and demonstrate Meaningful Use between 2011 and 2016, followed by penalties for those who did not comply [1–4]. Compared with traditional paper-based records, EHRs offer advantages including electronic sharing of health information, improved patient safety and data protection, more efficient record management, and enhanced communication among healthcare professionals and patients [4–6]. Before penalties were applied, specialists in ophthalmology were observed to adopt EHRs more slowly than those in family medicine or general practice [7, 8]. According to a 2013 survey by a leading ophthalmology organization, 32% of ophthalmology practices had implemented EHRs, with an additional 15% in partial or ongoing stages of adoption [9]. In contrast, a 2012 survey of office-based physicians reported a 72% adoption rate of EHR

technology overall [10]. Key barriers to EHR implementation in ophthalmology and other outpatient settings include substantial initial costs, smaller practice sizes, time and resource demands for training, concerns about impact on clinical efficiency and productivity, difficulties in transferring existing records, challenges in customizing software for specialty-specific requirements such as ophthalmic illustrations and imaging storage, and concerns over changes in the physician-patient dynamic [9, 11–15]. Studies examining the effects of EHR adoption in ambulatory care have reported mixed outcomes regarding patient visit volumes [16–18]. There remains limited research specifically addressing how EHR adoption affects ophthalmology practice. The present study sought to evaluate the effect of EHR implementation on outpatient clinic visit volumes during the four years following adoption within an academic ophthalmology setting.

Methods

A formal review of the ethics of this study was not required. Information was obtained from ophthalmologists at our academic medical center, including subspecialists in the main branches of eye care. We included all approaches to teaching and learning in the department. A one-group pretest-posttest observational design was used in the research, following common research procedures [19]. At the time baseline data were obtained, each provider had three or more years of practice experience in the hospital's ophthalmology clinic. Because it was not possible to gather yearly data, a four-month period was examined for analysis. The study covered the same four-month period (July through October) for each of the years from 2008 to 2012. EHR systems were introduced in the ophthalmology clinic on May 5, 2009. Epic Systems' adoption of EpicCare Ambulatory in the ophthalmology clinic involved trimming physician templates by half for two weeks, then by 25% for the two following weeks, returning to before-EHR levels after that. Government regulations did not require providers to match their earlier patient volumes. During the two months after the EHR was put in place, paper charts could still be referenced and up to 26 months of scanned paper records were found in a different EHR system during the whole study period. For three months, staff from information technology were present on the premises and afterwards, clients could reach them by phone whenever they needed help. Looking back at clinic records allowed us to collect staffing and visit completion data. In our study, clinic sessions were set up for half a day and this was how we analyzed their utilization. We calculated the number of half-day clinics each provider led, not counting ones that took place away from their primary clinic or in specialty clinics for diseases such as glaucoma or retinal laser. Visit volume per half-day clinic was worked out by dividing the total number of visits by the number of half-day clinics. Operating room visits and procedure clinics did not contribute to the analysis being done. Each resident, fellow, nurse or technician was included as one supportive staff member in the count. Because their first four months of training meant limited patient evaluations, first-year residents were considered only 0.5 staff. After adopting EHR, staff and physicians were required to do the same tasks they had done before. Electronic prescribing was promoted but remained a choice for the first years. On July 7, 2009, the agency moved about four miles away to a new facility. For two weeks, physician templates were halved again so that the transition could be made and normal scheduling was restored after that. Rates of patients not showing up for each study period were studied to look for any impact resulting from the move. During the same time frames, we gathered patient numbers for two doctors in Internal Medicine who made a relocation from the original office to the new one in 2010 and continued practicing with paper records. Excel for Mac 2011 was used to manage the data in this study. All statistical procedures were done with SPSS 19 for Mac using paired t-tests and a repeated-measures ANOVA that used the Greenhouse-Geisser correction to handle non-spherical data.

Result

Table 1 summarizes patient visits and support staff per provider per half-day clinic session over a five-year period from 2008 to 2012. In 2008, the baseline year prior to electronic health record (EHR) adoption, providers saw an average of 119.2 patients per year per half-day clinic session,

with a range of 77 to 160.8 patients. Following the implementation of EHR in 2009, there was a consistent and statistically significant decline in patient volume each subsequent year. By 2009, patient visits decreased by 17.0% ($p = 0.002$), with similar declines noted in 2010 (-16.9%, $p = 0.001$), 2011 (-15.3%, $p = 0.003$), and 2012 (-18.5%, $p = 0.027$). These declines persisted despite the clinical environment remaining otherwise stable. Support staff per half-day clinic session showed less variability over the study period. Starting at 22.4 staff members in 2008, the number slightly decreased in 2009 and 2010 before rising in 2012 (+10.7%). However, these changes were not statistically significant across the years ($p > 0.2$), indicating relatively stable staffing levels despite fluctuations in patient volume. Table 2 presents individual faculty data for average patient visits per half-day clinic session. Across the eight physicians included, a general downward trend in patient volumes is evident following EHR adoption. Faculty 1, for example, saw a reduction from 25.3 patients in 2008 to 18.5 in 2009 and fluctuated between 17.6 and 20.9 visits in later years. Similar patterns were observed in other providers, with most experiencing reduced volumes in the years following EHR implementation. A few providers had missing data in later years due to personnel changes or other factors. Overall, these findings demonstrate a clear association between EHR adoption and decreased patient volume per half-day clinic session within this academic ophthalmology practice. The declines were consistent across providers and years and occurred despite stable staffing levels. This trend raises concerns about potential impacts on clinic capacity and access to care. Further research is warranted to explore underlying causes, such as workflow inefficiencies or increased documentation demands, and to identify strategies to mitigate these effects.

Table 1: Patient visits and support staff per provider (N) per half-day clinic session, by year

Year (N)	2008 (8)	2009 (8)	2010 (8)	2011 (7)	2012 (6)
Patients per year (range)	119.2 ± 32.0 (77 - 160.8)	96.0 ± 25.6 (62.4 - 124)	95.2 ± 24.8 (61.6 - 120)	100.8 ± 24.0 a (68 - 132)	96.8 ± 33.6 b (54.4 - 133.6)
Change from 2008 (%)	—	−17.0 ± 6.1	−16.9 ± 12.0	−15.3 ± 10.1	−18.5 ± 6.7
p value*	—	0.002	0.001	0.003	0.027
p value**	—	0.001	0.005	0.014	< 0.001
Support staff per year (range)	22.4 ± 4.8 (16 - 28)	20.8 ± 2.4 (16 - 24.8)	20.0 ± 2.4 (16.8 - 23.2)	21.6 ± 4.8 a (16 - 27.2)	24.8 ± 4.8 b (19.2 - 32.8)
Change from 2008 (%)	—	−7.1	−10.7	−3.6	+10.7
p value*	—	0.379	0.248	0.516	0.204
p value**	—	0.379	0.204	0.659	0.573

Table 2: Average number of patients seen per half day clinic for each faculty physician included in this study

Faculty	2008	2009	2010	2011	2012
1	25.3	18.5	17.7	17.6	20.9
2	24.5	19.5	18.9	19.7	20.9
3	21.9	17.9	18.6	20.8	16.5
4	19.8	18.6	14.3	13.5	—
5	18.4	14.1	18.5	15.8	14.2
6	14.6	10.2	9.9	—	—
7	13.5	12.1	12.3	12.4	9.9
8	12.1	9.8	9.7	10.7	8.6

Figure 1: Patient Visits and Support Staff Trends per Provider, Per half-day clinic session, by year (2008-2012)

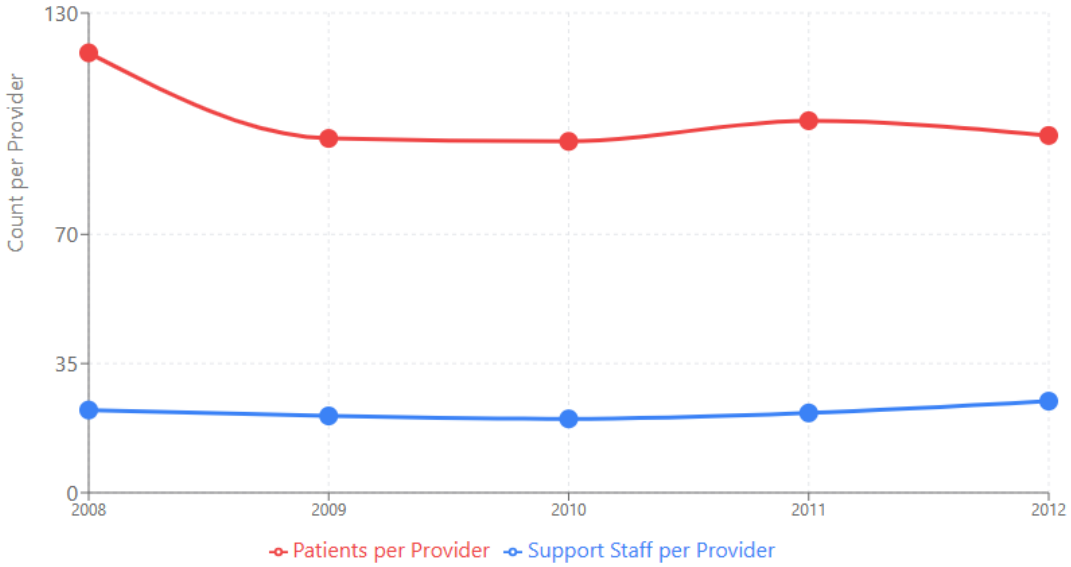
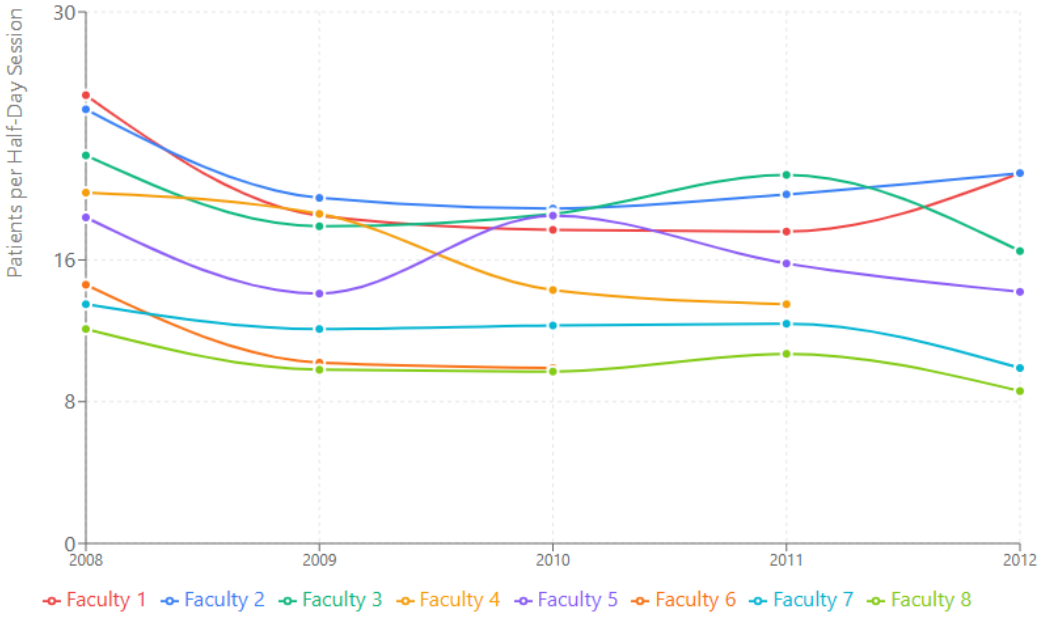


Figure 2: Individual Faculty Patient Loads Over Time, Average patients seen per half-day clinic session (2008-2012)



Discussion

After electronic health records (EHR) were introduced, there were ongoing and substantial decreases in the number of patients seen in academic outpatient ophthalmology for up to four years. Even though we have only looked at a small group, the drop we found is concerning. With an older population needing more visits to eye doctors due to aging and increasing demand [20], the extra time taken to use EHRs could leave the workforce short and this might currently be underestimated [20]. Adding medical scribes among the healthcare team to handle document entry has improved patient flow in many other areas, but it also brings unexpected EHR-related expenses. This study encounter s several issues. The analysis reviewed just a few providers associated with practice at one educational institution. Even with fewer participants in later years, the results remained the same and statistically reliable for every physician included. It was unusual for patient numbers to be affected by a clinic relocation when the factor was not a key one for our clinic. The providers used well-developed methods and appointment no-show rates were stable during the sampling period.

Experts do not anticipate that the move would change the number of patients seen years hence. We studied internists who changed clinics, still using paper record systems and whose patient load increased without them seeing more patients. For simplicity, we examined data collected during a four-month window in both the experimental and control groups, so their results weren't affected by yearly shifts in physicians or seasonal factors involved in regular overbooking. The number of patients treated rose steadily in the control group for four years, but remained stable in the study group during those years. During the study, there were no major changes to clinic policies, how things were done or clinical standards that could explain the results. Duration of each clinic session and the number of staff stayed the same with no statistical difference. No system changes were made to the workflow, but individual medical staff could have changed their scheduling and it's uncertain whether patient numbers would have returned to their previous levels had this been required. But things like needing to see more patients, filling staff positions based on estimate and doctor compensation by productivity pushed everyone to focus on seeing more people. Because of this, fewer appointments in scheduling templates are not likely to explain the sustained volume declines seen in all providers.

Only a quick optimization event in December 2011 took place in the form of time and motion analyses to enhance provider use of the EHR. It was found that on average, doctors and their patients spent around 19 minutes together, from coming into the exam room until closing the chart and more than 90% of doctors immediately finished their documentation after each encounter. Although the earlier timing data could not be accessed for a match, there was no change in the number of patients seen by clinics the next year, pointing to EHR being separate from the decline in average visits. Although we did not look at how physicians spend their time second by second, we believe added time with patients is mostly used for paperwork, in line with what other research has shown [16, 23, 24]. There were no difficulties described with the EHR interface, but no comparisons of its ease of use to those of other systems were found. We do not know how updates or changes to the user interface affected users during the course of the study. At big universities like ours, the EHR system is chosen for use across much of the hospital. This means our small department had limited input which was recognized as a likely hurdle in adopting the new system. Providers documented according to their own approaches, as long as the standards were met. No practices of over-documentation were uncovered through casual chart reviews, even though those actions could lead to much higher documentation times. There were no hired scribes or documentation assistants at any point, before or after we switched to EHR. Results from other clinics in academic ophthalmology about adopting EHR are varied [23–27]. A big research study found that using EMRs took 6.8 more minutes of documentation time per visit than it had on paper and notes a 3% drop in clinic visits a few years after implementation [23]. Although the volume in the pediatric ophthalmology subgroup decreased by 11% at three years, this was not statistically significant [25]. Other data revealed that patient volume changes were minor. At one glaucoma practice, faculty and fellows ended up spending more time with patients and on computers in the exam rooms even as the number of patients and staff stayed the same; this shift was explained by the ability to document at the same time as seeing patients [24]. In another department, EHR adoption did not seem to affect the patient volume managed by each provider, yet reports on staffing and how much work was handled did not include adjustments over the study period [26].

In another study of an academic department with 23 physicians, the patient load stayed the same, even though the glaucoma specialists performed much more work [27]. This department used significant funding and effort, with a special budget for improving workflows and temporary support help during the switch to electronic health records. Also, their area came last in adopting an EHR and enjoyed learning from the first groups to go through these changes. Meanwhile, our department started using EHR before any other specialties, but our patient volume did not change after the 2011 event focused just on our department and there were no records for the rest of the system at that time. Evidence of EHR influences in different specialties and kinds of practice is lacking. For instance, patient flow at one college pediatric clinic dropped by 10% immediately after introducing an EHR and two years on the average visit was taking longer [16]. Among this large

multispecialty group, doctors planned visits for patients increased a little six months following adoption, though there were new types of visits being tracked, including lab work, vaccinations and counseling [17]. It's difficult to compare EHR implementation studies because of differences in software, staff levels and how practices are organized. It is also hard to capture information about how physicians' actions affect how many patients they serve and how much time each patient visit takes. There are reports that demonstrate that using EHRs leads physicians to do more charting past regular working hours [23, 25]. Also, when we introduced electronic ordering at the same time as EHR, it took longer than writing a prescription by hand [28]. Importantly, this research adds new knowledge about EHR implementation and how it could impact ophthalmological practices, as this area has been little explored in the past. While there are some study limits, we found that using EHRs can help doctors see fewer patients over time. The investigation did not consider what leads to increased healthcare volume, how long patient examinations take, how good the care is or how satisfied everyone involved is with the results. More work is needed in different clinics to understand the full impact of using EHRs in ophthalmology.

Conclusion

The transition to EHRs in an educational outpatient ophthalmology setting reduced the number of patients seen by 26% after just one year and by 41% after four years. This result is especially significant because many different doctors experienced the same drop, despite the study's limited scope and sample size. With so many older people now needing eye care and the EHR time and effort putting a strain on overworked workers, this trend is concerning. Data from the study showed that patient volumes lowered by about 17% on average, without means being reduced for support staff, meaning the decrease was probably not caused by staff changes. No meaningful difference in no-shows along with no updated clinic policies, session lengths or staffing patterns back up the tie between EHR implementation and lower patient numbers. When we compare to internists who remained on paper charts after relocating, the observed declines seem to be influenced more by factors other than clinic relocation. Being slowed by poor workflow, having to write more documentation and needing time to chart probably led to less clinical service. Many providers were allowed to decrease how many patients they received, though factors in the system made it improbable that changing templates alone led to the continuous decrease in patient load. Other difficulties emerged because the department did not select the EHR and did not include documentation assistants like scribes. Studies comparing ophthalmology with different specialties show that while some experience small changes in patient numbers, others notice decreases like those we have seen. Those who receive a stronger base of support during the switch to EHR can better avert lower volumes, suggesting that sufficient infrastructure and training matters a lot. No investigation into the effects of EHR use on quality, users' experience or patient outcomes was carried out in this study. Improper documentation was not examined in terms of how much time was spent directly with patients. Additional studies are important to look into these matters and find methods to efficiently use EHRs by bringing in assistance personnel such as scribes. In essence, although EHRs help manage patient data better, ease communication and boost safety, using them can unexpectedly reduce the number of patients seen through daily medical practices. Dealing with any problems caused by EHR systems plays a key role in helping health information technology improve care without affecting how patients can access services or how efficiently things are done.

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