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Using Electronic Health Record Systems in Medical Education – A Needs Assessment

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Abstract
The aim of this study was to determine the features needed in electronic health record systems by supervising physicians for teaching medical students and residents. We conducted in-depth semi-structured interviews with seven faculty members at a public-funded medical college. Emergent concepts were extracted in a qualitative thematic approach based on the realist paradigm. Thematic analysis revealed the need for clinical guidelines, medical calculators and research evidence. Documenting differential diagnoses for clinical reasoning and the use of medical images for pedagogical needs were requested as well. Clinical supervisors in this study suggested several features within electronic health records for teaching needs. The study findings provide a reference for developing teaching resources within electronic health records systems.

Keywords: Electronic Health Records; Medical education; Teaching; Clinical Decision Support

Introduction

Electronic health records (EHRs) are increasingly being implemented and used for clinical and research needs. The focus of implementation has generally been on usability and user interactions [1]. EHR systems are typically designed for clinical workflows catering to the needs of healthcare professionals such as physicians and nurses. Core features include clinical documentation, computerized physician order entry, medication administration records, and laboratory and digital imaging reports. A major focus of health informatics has been coding of medical knowledge using controlled medical vocabularies [3]. The primary driving force appears to be administrative needs such as billing to third-party payers and meeting regulatory compliance. At the same time, benefits to patients are just being realized such as better documentation of chronic disease care, avoiding drug-drug interactions and access to patient records at multiple sites. Clinical decision support systems within EHRs assist physicians in making complex medical decisions by providing structured guidance based on patient data and expert systems.

However, the role of EHRs in supporting clinical teaching has received limited attention. A few studies have analyzed these systems in the academic environment [5]. For instance, the College of Physicians and Surgeons Pakistan has implemented an electronic logbook for teaching purposes in which trainees receive regular feedback from supervisors [6]. The system is in use by more than 1,500 clinical supervisors for assessment and training in postgraduate medical education. Another system developed at an academic medical center provides clinical information used by 75% of its residents and fellows [7]. Among its range of features are clinical notifications, answers to frequently asked

clinical questions, care process models and an expert directory. Despite this substantial investment, 49% of clinical staff reported never using the system. Moreover, only 17% used the system for teaching activities. Another study conducted among junior doctors found that a point of care mobile application was useful for improving access to clinical guidelines [8]. However, the quality of these apps for use in teaching remains limited [9]. Despite expert recommendations, most clinicians tend not to use health informatics tools for teaching medical students [10]. Even those using an EHR for clinical documentation find it challenging to use these systems for medical education [10]. Thus, in a survey of clinical faculty in Portland, Oregon, almost half felt reduced enthusiasm for teaching after EHR implementation [11]. Nearly two-thirds indicated that EHR distracted from teaching and few perceived its advantages. Most respondents felt that electronic documentation led them to teach less [11]. On the whole, the impact of EHRs on medical education has been mixed, and the potential to support learning is yet to be fully developed [12].

While these studies indicate the potential usefulness of EHRs for learners in healthcare settings, there appear to be hardly any published studies that evaluate the requirements of teaching physicians working in academic environments. Our study aimed to find out the EHR features and usability needs of teaching physicians who supervise medical students and postgraduate registrars/resident physicians in clinics and hospitals.

Materials and Methods

Qualitative Framework

We employed a qualitative study design to carry out in-depth, semi-structured interviews among medical college faculty. Our approach was grounded in the realist paradigm [13]. This approach assimilates the core values of positivism (credible, confirmable, and verifiable findings) with the notion that researchers can only know reality from their perspective of it. Our iterative cycles of interviews were guided by the 3-point framework suggested by Fernald and Duclos [14]: (1) focus on the main issues or themes; (2) list ideas and reflections; and (3) suggest new or unanswered questions.

Sampling and Interviewing

The study was conducted at the College of Medicine and Health Sciences, United Arab Emirates University, Al Ain. As the largest university in the United Arab Emirates, it is funded by the federal government and hosts an international, multicultural faculty. The study interviews were conducted from 17 July to 2 August 2012. Inclusion criteria included being a physician with clinical and teaching responsibilities at a hospital or a clinic. Key participants were selected using purposive sampling for a broad representation of clinical specialties. All faculty members who were invited to join the study agreed to participate. Semi-structured interviews were conducted with individual faculty members after obtaining written informed consent. In the first part of the interview, the participant was shown a printed screen layout of a generic electronic health record system and asked to suggest features needed as a medical teacher. Next, the participant was shown a printed list of features suggested by previous participants (updated after each interview) and asked to recommend any additional features not mentioned previously. The interview was continued for as long as needed until the participant felt that they had expressed their needs. Participants were not restricted in any way such as to their specialty needs. All participants had the opportunity to ask questions. The semi-structured interview process used open-ended questions and avoided any judgments or criticism of the participants' responses. Participants had the option to retake the interview. However, none of them availed it. There was no pre-specified sample size for this study. Additional participants were recruited and interviewed until no new information or insights were being gained. Concerning qualitative research methods, interviews were conducted until saturation was achieved. The mean interview duration was 28 minutes (standard deviation of 15 minutes).

Qualitative Analysis

Interviews were not audio-recorded; however, written notes were taken during each session. We analyzed cases using a coding system to discern themes and categories [15]. New concepts were extracted from the notes using a qualitative thematic approach. Contextual factors such as a participant's specialty were considered in the analysis to maximize the usefulness of participants' insights. Thus, we assessed diverse perspectives, multiple levels, and both formal and informal systems. QDA Miner software (Provalis Research, Montreal, Canada, 2014) was used to assist in coding and analysis. Research ethics approval (Ref. No. VPRGS/101/2012; dated 14 May 2012) was obtained before the start of the study and a university faculty grant (UAE University faculty research grant NP/12/19; dated 4 March 2012) funded the research.

Results

We conducted semi-structured interviews with seven medical college faculty members, of which three were assistant professors, three associate professors, and one full professor. The clinical specialties represented included internal medicine (three participants) and one participant each from general practice/family medicine, obstetrics and gynecology, pediatrics, and surgery. Only one participant was female. While participants were of different ethnic origins, their specialty board certifications were mostly from the United Kingdom and Sweden, representative of most faculty members at the College. The mean duration since graduation from medical school was 21 years (standard deviation 9). All participants were using the same EHR (Cerner Millennium, Cerner Inc., USA).

Table 1 shows the EHR features suggested by the participants. These suggestions were grouped into a typology of six categories: diagnosis, treatment, documentation, usability, decision support, and layout. Thematic analysis revealed the following major functional domains: access to clinical guidelines, medical calculators, and current research evidence through internet-based search engines (Figure 1). One participant, a professor of surgery, expressed concern about the negative impact of information provision on "clinical reasoning" in medical students, stating the possibility of "fixation" on a particular diagnostic possibility.

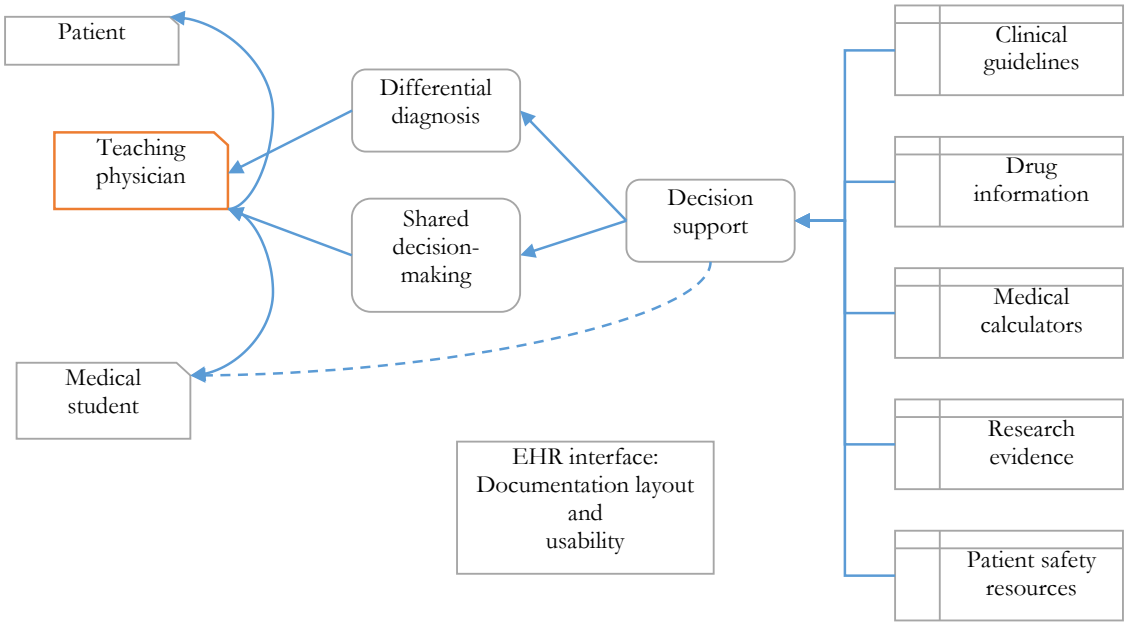

Figure 1. Mapping of themes and categories based on the information needs of teaching physicians

Table 1. electronic health records features for teaching needs as recommended by clinical faculty

Cat	Suggested features	Specialty*
Diagnosis	Divide differential diagnosis into common and less frequent causes	GP
	Display growth charts, pediatric body mass index percentiles	Peds
	Document family history including cardiac risk factors	Peds
	Link charts to identify family members for screening	Peds
	Reduce clinical reasoning errors such as 'fixation'	Surg
	Document peak-flow rates, and body surface area	IM
	Document geriatric performance status	IM
	Flag if a patient has a drug abuse history	IM
	Provide clinical scales such as the mini-mental status examination	IM
	Display estimated glomerular filtration rate (eGFR)	IM
Treatment	Provide regional cost data for drugs and investigations	GP
	Automatically calculate drug dosing for a patient	GP
	Support documenting multiple working diagnoses	IM
	List all vaccinations received by the patient especially in transplant recipients	IM
Doc+	Provide ready to use templates	GP
	Flag if the patient has died or left the country	IM
	Track laboratory results such as serum tumor markers	Gyn
Usability	Develop an easy to learn interface	GP
	Allow clicking over using the keyboard	Peds
	Add prescription drugs with one click	GP
	Provide drop-down lists and pre-completed text boxes	Peds
Decision support	Display links to review articles and topic summaries	GP
	Provide treatment guidance	IM
	Use unbiased information sources	IM
	Show information that is not outdated	GP
	Display prompts linked to current patient data	GP
	List potential drug adverse effects	IM
	Display guidelines from professional societies	IM, Peds
	Display short diseases summaries	Peds
	Emphasize clinical reasoning, not recall of medical knowledge	Surg
	Be able to attach a link to an article in a patient's file	IM
	Automatically flag drug interactions such as with warfarin	IM
	Consider online resources as CDS tools	IM
	Avoid repeating the same clinical alerts to a physician	IM
	Display images of clinical conditions	IM
	Display alert if patients meet inclusion criteria for a study	IM
	Provide random allocation for equivocal clinical decisions such as drug selection within a therapeutic class	IM
	Indicate local practices within the community for a patient's diagnosis	IM
	Link combination of clinical findings to differential diagnoses	IM
Layout	Show complete patient note at a glance	Peds
	Ability to increase the font size	Peds
	Implement interface for low-cost touchscreen tablet devices	IM
	Avoid too much information in the CDS	Gyn

Cat = category; *of the physician: CDS, clinical decision support; GP, general practice/family medicine; Gyn, obstetrics and gynecology; IM, internal medicine; Peds, pediatrics; Surg, surgery. + Documentation

Discussion

In this qualitative study, medical college faculty members described their information needs as medical teachers. These needs reflect the unique challenges of patient complexity and the diverse learning needs of students at medical teaching sites [16].

Our participants pointed out the need for EHR tools such as current guidelines and clinical calculators (Figure 1, Table 1) as already described in the scientific literature [17]. Such tools could potentially be useful when discussing management options with medical students [18]. This perceived need is in contrast to cognitive task analysis focusing on clinical documentation in which clinicians highlighted the assessment and plan sections of the medical record. Our study implies that clinicians with teaching responsibilities (as opposed to clinicians without students) appear to have different information needs. This finding suggests the possibility of distinct EHR interfaces for clinical and teaching needs, or perhaps a 'teaching mode' that is more information rich.

Participants in our study were comfortable with direct links to search engines (including Google) as well as secondary information sources such as Medscape, professional societies websites and full-text review articles. Academic physicians tend to use such information sources routinely for teaching as well as for developing critical appraisal skills to evaluate published studies. In the context of teaching during patient care, the request for clinical images may be worth noting. Disease-related images can be easily retrieved from the internet and may be useful as teaching aids for discussing variations in clinical presentations. Videos of surgical procedures are becoming increasingly popular as a learning tool [19].

Another unique requirement was the ability to document a structured differential diagnosis with annotated probabilities. While typical EHR notes limit documentation to the most likely diagnosis (at least in the coded form), teaching physicians recognize the necessity of maintaining a differential diagnosis that includes unlikely but clinically severe conditions (Table 1). Such functionality could open up the possibility of visualizing medical decisions. Thus, when integrated with the sensitivity and specificity of a test, a graph could show when the treatment threshold is exceeded. Students can be guided by 'what if' scenarios of post-test probabilities and expected values of different outcomes. Innovative visual methods of graphically representing a differential diagnosis can assist in teaching clinical reasoning to medical students [20].

Clinical teachers have expressed concern about the potentially harmful effect of EHRs on learning [21]. The use of templates for documentation may allow learners to skip the steps in writing a note from memory [10]. Reliance on online expert systems could erode learners' confidence in their clinical judgment leading to overdependence on EHRs. Time limitations are a barrier to teaching using EHRs [10]. On the other hand, information at the point-of-care has the potential to reinforce prior learning. Medical students have expressed their desire for more hands-on training especially using electronic media [22].

The small number of participants recruited from a single institution and the lack of a control group of clinicians without teaching roles are the main limitations of our study. Furthermore, the study relied on participant recall and perceptions instead of direct observation. Overall the study provides useful and generalizable findings, as the participants represent a wide range of international backgrounds and specialties, and are active users of EHR systems.

Conclusions

Clinical faculty in this study expressed the need for several domains of clinical decision support for teaching needs. These needs included current guidelines and clinical calculators, direct links to search engines, clinical image banks, and the ability to document a structured differential diagnosis. The study findings may be useful as a reference for the development of teaching resources within electronic health records systems.

List of abbreviations

EHRs = electronic health records
CDS, clinical decision support
GP = general practice/family medicine
Gyn = obstetrics and gynecology
IM = internal medicine
Peds = pediatrics
Surg = surgery

Conflict of Interest

The authors declare that they have no conflicts of interest.

Authors' Contributions

MH defined the aim of research and the design of the experiment. MH conducted the semi-structured interviews. MK helped carry out the qualitative analysis and reviewed the manuscript. All authors read and approved the final manuscript.

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