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The impact of electronic medical records on patient–doctor communication during consultation: a narrative literature review

Aviv Shachak PhD[1] and Shmuel Reis MD MHPE[2]

[1]Postdoctoral Fellow, Galil Center for Medical Informatics, Telemedicine and Personalized Medicine, The R&B Rappaport Faculty of Medicine, Technion-Israel Institute of Technology, Haifa, Israel
[2]Chair, Galil Center for Medical Informatics, Telemedicine and Personalized Medicine, The R&B Rappaport Faculty of Medicine, Technion-Israel Institute of Technology and Department of Medical Education, The R&B Rappaport Faculty of Medicine, Technion-Israel Institute of Technology, Haifa, Israel

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Correspondence
Aviv Shachak
Department of Health Policy, Management and Evaluation
University of Toronto
155 College St.
Toronto
ON
Canada M5T 3M6
E-mail: aviv.shachak@utoronto.ca

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Abstract

Rationale, aims and objective The effect of Electronic Medical Record (EMR) use on Patient–Doctor Communication (PDC) has rarely been studied. As data accumulate, the purpose of this article is to review the literature on EMR effect on PDC, to identify recurring themes and to offer preliminary guidelines and future directions for medical education and research.

Method A database search was conducted and 14 articles that met inclusion criteria (published in the past 10 years, empirical investigations, direct assessment of the EMR impact on patient–doctor communication) were selected for review. A qualitative, grounded theory-like approach was employed to analyse the data.

Results EMR use often has a positive impact on information exchange, but exerts a negative influence on patient centredness. Some physician characteristics such as their computer skills and behavioural style assist in overcoming this negative influence.

Conclusion The use of EMR exerts both positive and negative impacts on physician–patient relationships. The negative impacts can be overcome by some simple means as well as better designs of EMR systems and medical education interventions. Physicians' everyday practices of integrating EMR use into the clinical encounter as well as better design of EMR systems and EMR and communication training may facilitate PDC in computerized settings.

Introduction

Electronic Medical Records (EMRs) are increasingly used in healthcare organizations in general and ambulatory settings in particular. Their use is being promoted by President Bush's administration in the USA [1], and organizations such as the National Health Service (NHS) in the UK, Canada Health Infoway, the US Institute of Medicine (IOM) and the American Medical Informatics Association (AMIA). A number of countries, among them Denmark, Canada and Israel develop strategies towards integrative national health record systems [2–4]. The potential benefits of computerization in healthcare have been discussed extensively [1,5–8]. These include comprehensive documentation of a patient's medical history, easy access to medical data from remote sites, improved communication among the various providers involved in health care, easy access to medical information and state of the art resources over the Internet (e.g. medical journals, guidelines, Evidence-based Medicine databases, medication databases, etc.) and clinical decision support. A recent systematic literature review suggests that the use of information technology improves healthcare by increasing adherence to guidelines or protocol-based care, reduction of medical errors, and clinical monitoring and data aggregation which are not feasible with paper [9].

Despite these apparent benefits, some disadvantages of EMR use have also been reported. It has been demonstrated that the use of EMR altered the process of clinical reasoning [10], resulting in possible loss of information. Unintended adverse consequences of medical information systems (e.g. EMR or CPOE – Computerized Provider Order Entry) such as more or new work for clinicians, unfavourable changes in clinical workflow, high system demands and new types of errors have been reported [11–13].

A growing concern is the influence of computer use on patient–doctor communication (PDC) during the patient visit. Communication is one of the 'most powerful, encompassing, and versatile instrument[s] available to the physician.' [14]. It is currently widely accepted and evidence-based that patient–doctor communication is perhaps the most significant component of the healthcare visit, with ramifications for patient satisfaction [15–17], compliance/adherence [18], conflict-resolution [19] and clinical outcomes [17,20]. A growing literature linking PDC to a host of important patient outcomes has broadened definitions of medical care quality to include physicians' interpersonal skills in the medical interview [21]. Such outcomes have ranged from reports of improved physical and emotional health status, and better performance in activities of daily living, to enhancements in markers of disease control such as Haemoglobin A1C and blood pressure and finally to specific disease states such as Myocardial Infarction [17,22,23].

It has been suggested that information systems have the potential to help sharing understanding between doctors and patients, thereby educate and empower both and make the patient–doctor encounter more effective [5,6]. However, the *actual* influences of EMR use on PDC are just beginning to be realized.

The purpose of this paper is to review the existing research on the effect of EMR on PDC, which accumulated during the last decade. As the existing included literature is largely qualitative, the paper's goal is to report the results of a narrative analysis resulting in synthetic recurring themes, adjustment of proposed best practices [24] and delineation of present knowledge gaps. Potential implications for the design of EMRs, educational interventions and future research are subsequently discussed.

Methods

Paper selection

A search of MEDLINE database was performed with the following Boolean queries:

1 patient AND doctor AND (communication OR relations* OR interaction OR encounter)

2 computer OR computers; limited to the Title and Abstract fields

3 electronic medical record OR electronic health record; limited to the Title and Abstract fields

4 The above searches were combined as followed: #1 AND (#2 OR #3).

Search results were limited to papers in English, published in the past 10 years. This timeframe has been chosen for two reasons. First, widespread implementation of EMRs started in the mid 1990s. There is a limited number of studies on the use and impact of EMRs prior to that time. Second, the technology itself rapidly develops. Therefore, findings from old studies may not be relevant today. The cut-off of 10 years reflects a balance between our need to include as many papers as possible in this review and maintaining relevance for the present technology. The database search yielded a total of 167 articles as of April 17, 2007.

The titles and abstracts of the papers retrieved were manually screened. Papers meeting the following inclusion criteria were selected for the final analysis: empirical investigations (quantitative or qualitative); direct assessment of the EMR impact on patient–doctor communication. Snowballing from found literature, that is, using a retrieved citation as a basis for a new search based on the article's bibliography, authors' names and the 'related articles' search option was adopted when appropriate.

Data analysis

A qualitative–interpretive approach (grounded theory-like) to data analysis was employed. Following the general principles of qualitative data analysis, researchers first familiarized themselves with the data by reading through the selected articles and reflecting on them (e.g. by margin notes). Then, open coding – the process of 'selectively attach[ing] meaningful tags to words, phrases, events, situations, and so forth, naming what is potentially important about them and distinguishing them from the rest of the data' [25] was employed. Next, thematic categories were developed and relationships between categories were determined. An analytic induction [26] process was employed to reach interpretation. Finally, emergent themes were compared and contrasted with the tips provided by Ventres *et al.* [24] to modify and provide potential extensions to those tips.

To establish trustworthiness, the two authors, who have different backgrounds, scrutinized the data independently. The first author holds a PhD in Information Science and specializes in Human–Computer Interaction and Health Informatics while the second author is a practicing family physician, medical educator and researcher in communication in healthcare. Despite these different backgrounds initial agreement on themes between researchers was high. Open discussions were held to solve disagreements, refine and re-conceptualize themes, until reaching consensus.

Results

A total of 14 papers met the inclusion criteria. In 11 of them [27–37], the effect of computer usage on patient–doctor communication was the primary scope. One study [38] was aimed at developing a methodology to transcribe data regarding computer–patient–doctor communication and one study [39] investigated patient–doctor communication in general. However both these studies describe some results concerning the effect of computers on patient–doctor communication and therefore, were included in this review. Another study compared physicians' satisfaction with using desktop and mobile computers, and included patient–doctor communication as one of the dependent variables [40].

The methodological approaches of the various studies included in this review are summarized in Table 1. The majority of studies used videotape recording of clinical encounters as a primary data collection method, sometimes in combination with interviews or observation. A qualitative approach to data analysis was taken in the majority of these studies; specific methods include ethnography, grounded theory and conversation analysis. Two studies, however, analysed videotaped encounters quantitatively using a checklist of communication tasks [30] and the Roter Interaction Analysis System (RIAS) [34]. Other studies used physician and/or patient satisfaction written questionnaires or patient telephone structured interviews for data collection [27,36,37,40].

Our review suggests four major themes discussed by the literature on patient–doctor–computer communication. These are: computer use, effect of EMR use on PDC, factors affecting PDC in computerized settings and classification of physicians' behaviour.

Table 1 Methodological approaches of studies on patient–doctor–computer relationships

Study	Setting & design	Sample	Data collection method	Data analysis method	Reference
1	Primary care, longitudinal pre- and post-study	113 Patients	Pre- and post-visit satisfaction questionnaires, videotaped encounters and computer screen	Multivariate regression models	[27]
2		10 GPs, accustomed to using computers	Videotaped consultations	Ethnography	[28]
3	4 primary care practices, urban & rural	23 physicians, 1 nurse, 12 clinic staff, 52 patients	In-depth & Brief interviews, Videotaped encounters, Focus group interviews, Participant observation	Ethnography, various perspectives	[29]
4	Urban academic medical centre. Controlled trial	3 physicians, 18 months experience of EMR use, 3 control physicians. 204 encounters	Review of medical record, videotaped encounters	Content analysis using nominal (yes/no) checklist of critical communication tasks	[30]
5	Urban family practice	Five family physicians, 29 encounters	Videotaped encounters	Ethnography	[31]
6		5 GPs, 39 encounters	Videotaped encounters, Patient and doctor interviews while watching their videos,	Qualitative (grounded-like)	[32]
7	Primary care clinic. Longitudinal study, pre- and post-implementation of exam room computers	6 physicians, 2 physician assistants and 1 nurse,	Videotaped encounters	Grounded theory	[33]
8	3 Primary care clinics	3 physicians, 30 patients	Videotapes of physicians only during encounters	RIAS	[34]
9	Cross-sectional study, internal medicine clinic in a veterans hospital	6 physicians, 50 encounters	Direct observations and videotaped encounters	Content analysis, based on conversation analysis and ethnomethodology	[35]
10	Cross-sectional surveys of physicians and patients in a VA primary care clinic	12 internal medicine residents and 11 faculty internists; 155 patients	Physicians' and patients' questionnaires	Chi square and *t*-tests as appropriate	[36]
11	Cross-sectional surveys of patients in 2 EMR and 2 non-EMR primary care clinics	249 patients from EMR and 184 from non-EMR clinics	Structured telephone interview about medication counseling.	Frequencies, Chi square and *t*-test as appropriate	[37]
12	Methodology development,	16 pre-implementation and 6 post-simulated encounters	Videotaped simulated encounters	Transcription method, developed in the study	[38]
13	Observations at primary care clinics, part of a general study of patient–doctor communication	16 healthcare centres, 127 students' reports in 2002 and 118 reports in 2003–2004	Written reports of students' observations	Coding according to agreed categories	[39]
14	RCT comparing desktop and mobile computer users	10 emergency physicians, each working randomly 5 shifts with desktop and 5 shifts with mobile computer	End of shift satisfaction questionnaires	Repeated-measure analysis of variance	[40]

GP, general practitioner; EMR, Electronic Medical Record; VA, Veterans Affairs; RIAS, Roter Interaction Analysis System; RCT, randomized controlled trial.

Computer use

Five papers discussed issues related to computer use. Computers were employed for various purposes: general review of patients' medical record, checking medications taken by the patient, retrieving test results, entering information, writing prescriptions and letters, and, occasionally, displaying changes in clinical data over time to patients and printing educational material for them [28–31].

The intensity of computer use is discussed in two studies. In one of them, usage intensity during the visit was low, and paper records

were used to a greater extent than EMR. In the other, physicians screen gaze averaged 23%, and in some cases reached about 40% of the visit time. Heavy keyboard typing was observed in 24% of the visits. Data entry procedures varied between settings. While in some cases data entry was carried out during the visit, in other cases it was done after the patient left. One study reports data entry by dictating to a clinical assistant. This depended on monetary considerations, as typing by the physician seemed as a way to limit expenditures [28,29,31,34].

Another use of computers was encounter management. The computer guided physicians' questions and information gathering, dependent on physician style as discussed below. Physicians' gestures involving the computer (e.g. turning gaze to or from the screen, typing or putting a hand on the mouse), were employed to indicate changes in conversation topic, physician's attention or conversation rhythm and were used as non-verbal cues to conclude the visit. Physicians employed the computer to take a break in order to solve a problem or rest [31,32]. In the early days of computer implementation, the computer was sometimes used as a 'magic box' that gives a higher value to medical statements: physicians looked at the screen or pointed to it before making important medical statements [32]. This behaviour has not been reported in later studies.

Effect of EMR use on PDC

Although patient surveys report high overall satisfaction with physicians' use of computers, including high levels of satisfaction with face to face communication, physicians' listening to their concerns and the quality of explanations provided by the physician [27,41], a more detailed analysis suggests both positive and negative influences on patient–doctor communication.

Electronic Medical Records use had a positive influence on exchange of medical information. Physicians who used EMR accomplished information related tasks such as checking and clarifying information, encouraging patients to ask questions and ensuring completeness at the end of visit to a greater extent than physicians who used paper records. Computer use was positively related to biomedical exchange, including questions about therapeutic regimen, patient education and counselling as well as patient disclosure of medical information to the physician. Patients' satisfaction with physicians' familiarity with them, communication about medical issues and comprehensiveness of medical decisions increased after EMR implementation [27,30,34,35,37].

As a subset of this general theme, two articles discuss the effect of EMR use on information exchange specifically regarding medications. The EMR assisted physicians in preparing medication lists, refills and checking prescriptions by other physicians. When patients talked about medications, they often gave general descriptions of the medications that they were taking rather then generic or brand names. In such cases the EMR was employed by physicians to identify medication names. The EMR enhanced information exchange about active medications, helped in immediate renewal of prescriptions, facilitated discussion about pharmacy procedures and assisted in identifying mailing problems and monitoring adherence [35]. Patients from EMR clinics reported significantly higher rate of multi-mode medication counselling, which included both oral and written counselling, than patients from paper record clinics. However, they obtained less oral counselling on medication indications. Lower rate of oral counselling on indications and multi-mode counselling were associated with higher rates of asking the doctors questions about medications [37].

In contrast with the positive effect on information exchange, EMR use usually had negative effect on patient centredness. It has been reported that physicians most commonly walked straight to the monitor after only a short greeting, screen gaze averaged about one quarter of the visit time and heavy keyboarding was recorded in about 24% of the encounters. The computer often caused physicians to lose rapport with patients; for example, physicians logged into the computer or screen gazed while talking to patients or while the patient was talking. Screen gaze was inversely related to physicians' engagement in psychosocial question asking and emotional responsiveness [28–30,34,39]. On the other hand, in some cases computer implementation assisted physicians in visit organization and had a positive influence on verbal and non-verbal communication. As discussed below, it has been suggested that EMR use amplified physicians' baseline skills in these two domains [33].

Factors affecting PDC in computerized settings

Several factors affected PDC in computerized setting, including cognitive limitations, physician characteristic and spatial organization of the clinic.

In some cases the introduction of computers provided a tool to organize data and visit tasks. In other cases it added complexity to the visit and introduced new tasks. It has been suggested that both computer use and communicating with the patient require the physician's focused attention, and that multi-tasking or computer use in the background are not possible [28,33].

Physicians' characteristics affected their ability to handle the additional cognitive load imposed by computer. Computer mastery enhanced PDC in a computerized setting. Typing skills were viewed by physicians as crucial for using the EMR effectively during the clinical encounter, reduced physicians' need to focus attention on the computer, and positively affected PDC [29,30,33]. Physicians' ability to navigate the computer, search for and organize information was also associated with their ability to communicate with patients effectively [33]. Physicians' experience and baseline communication skills have been proposed to affect PDC in a computerized setting. Patients in a Veterans Affairs (VA) medical centre, who were seeing residents, were significantly more likely to agree that the EMR had a negative effect on the time physicians spent talking, looking at and examining them than patients seeing faculty physicians. Similar trends, though not statistically significant, were reported by the physicians. Basic communication skills were highly related to the quality of PDC, and the computer seemed to amplify both positive and negative pre-implementation communication patterns [33,36]. Another physician characteristic which influenced PDC in computerized setting was their behavioural style. This issue is discussed in detail below.

Spatial organization of the computerized environment affected physicians' ability to utilize the EMR effectively. In some cases location of the screen interfered with eye contact. Fixed positioning limited physicians' ability to face patients directly, sometimes forcing them to shift their body or move the chair to face patients

[29,30,33]. In other cases, location of the screen or using flat monitors on mobile arms helped sharing information with patients; thereby facilitating PDC and patient education. However, in another study, post-shift surveys of emergency physicians did not find significant difference in perceived effect on PDC between using desktop and mobile computers [29,33,40].

In one study, the accessibility of computer created a need to immediately enter data into the EMR resulting in a conflict between this need and the need to pay full attention to the patient. On the other hand, the opportunity to access EMR from different locations gave both patients and doctors a feeling of seamless communication over time and location [29].

Physician behaviour classification

Ventres *et al.* [29,31] and Booth *et al.* [28] classify physicians' behavioural style, which affected PDC in computerized settings. Although they use different terminology, there are many similarities in the behavioural styles reported. Therefore, we suggest a unified classification consisting of three major styles: informational-ignoring style, controlling-managerial style and interpersonal style.

The informational-ignoring style is characterized by its focusing on details of information and extensive information gathering, which is often computer-driven [29,31]. Informational-ignoring physicians tended to lose rapport with patients while engaged with the EMR, leaving patients idle while they enter data. They frequently talked while screen gazing, hardly faced the patient while working with the computer and did not usually utilize the computer to share information with patients [28,31].

The controlling-managerial style is characterized by controlling the encounter's dynamic to separating computer use from PDC. Physicians with this style alternated their attention between patient and computer in defined intervals or stages of the encounter. While with the patient, they turned away from the computer and *vice versa* [28,29,31]. Controlling-managerial physicians often indicated switches of attention between patient and computer by gestures such as turning body or gaze [28,31]. A variant of this style is the responsive-opportunistic physician, who utilizes gaps in the flow of consultation to use the computer [28].

The third behavioural style is the interpersonal style, characterized by focusing on the patient. Physicians of this style did not talk while using the computer; oriented themselves to the patient even when using the EMR and utilized the computer to share and review information together with the patient. They had little or no computer guided questions, spent less time entering data and refrained from using the computer in the beginning of the encounter [29,31].

Discussion

EMR impact on PDC

There is a wealth of research in recent years regarding the effect of Information and Communication Technology (ICT) on health care. Numerous studies deal with issues surrounding the implementation of EMRs, CPOE and Decision Support Systems, their effect on patient safety, quality of care as well as their unintended consequences [9,11,42–46]. In respect to communication, many papers deal with the influences of ICTs such as email, and health information on the web, on patient–doctor relationships [47–50]. The present literature review attempts to highlight a specific angle of these relationships, which has received less attention, but nevertheless influences quality of care: the impact of using EMR systems on patient–doctor communication during the clinical encounter.

This review of the literature revealed four major themes: EMR uses, effect of EMR on PDC, factors affecting PDC in EMR settings and Physician behavioural styles. Several uses of the computer had been discussed, including some that are probably unplanned and unintended, such as using the EMR to manage the encounter, take a break for problem solving or rest.

Our present understanding of PDC is grounded in the biopsychosocial model [51–53], which places suffering, disease and illness in the broad context of biological, psychological and social dimensions. From this orientation, the concept of 'Patient-centred Care' evolved. Patient-centred care acknowledges the web of relationships and contexts within which a patient exists, allowing the physician to understand both the disease and the patient. It promotes patient partnership and encourages empowerment and involvement [54]. Focusing the biopsychosocial view on the clinical encounter, the three function model of the medical interview offers a useful framework to discuss our findings. The model suggests three core functions of PDC: data gathering, establishing rapport and responding to the patient and, patient education and behaviour management [55,56].

Multiple additional models and assessment tools exist. One tool (RIAS) which is theory-driven was applied in one study [34], but no attempt to inform theory building for this specific subset can be gleaned from this review.

Patients were usually satisfied with their physician's use of EMR. However, a detailed analysis highlights the diverse effects of EMR on patient doctor communication. While having a positive impact on information related tasks and information exchange (the first function of the medical interview), particularly about medications, EMR had a negative impact on the second function – psychological and emotional talk, establishing rapport with patients and patient centredness. There is some indication that the introduction of the EMR organizes encounters around data gathering demands rather than patients' narratives. Our analysis suggests that physicians rarely used the computer for the third function of the medical interview, that is, patient education and behavioural management.

We identified a number of factors affecting PDC in EMR settings, including cognitive limitations, spatial organization and physician characteristics. One of the most important physician characteristics which affected PDC in EMR settings was their behavioural style. As discussed above we propose a three-style classification: informational-ignoring style, controlling-managerial style and interpersonal style.

However, the negative impact of EMR on the second function of the clinical encounter (development of rapport) could be overcome, at least in part, by enhanced computer and communication skills and physician experience. Recently, Ventres *et al.* [24] proposed 10 tips to physicians for effective PDC in EMR settings. Based on the present literature review and personal experience of working in a computerized setting (S Reis), we propose some extensions to these tips (Table 2). For example:

Table 2 Tips for effective use of Electronic Medical Record

Tip No.	Original tip (Ventres)	Modified tip
1	Use mobile computer monitors	Use mobile computer monitors (no modification)
2	Learn to type	Learn to type; enhance your surfing skills for patient education, decision support and evidence resources and practice fast screen scanning
3	Integrate typing around your patients' needs	Integrate typing around your patients' needs. (no modification)
4	Reserve templates for documentation	Reserve templates for documentation (no modification)
5	Separate some routine data entry and healthcare maintenance issues from your patient encounters	separate some data entry from the encounter; review problem list and previous visit before you call patient in, use time of patient's undressing and putting cloths on (when contextually appropriate, not in the USA) for data entry
6	Start with your patients' concerns	Start with your patients' concerns, and make sure the encounter is driven by them. Data gathering is important, but secondary
7	Tell your patients what you are doing – as you're doing it	Tell your patients what you are doing as you're doing it. Verbalize shifts to the computer by apologizing or asking permission. If possible, keep the conversation going
8	Point to the screen	Point to the screen; highlight the discussed data; print out when appropriate
9	Encourage patients' participation in building their charts	Encourage patients' participation in building their charts. Promote future supplementary virtual communication. Create interface with on call, house calls
10	Look at your patients	Look at your patients. Make sure your full attention is in listening to the patient, especially in the encounter beginning-patient monologue and when sensitive issues are brought up. Indicate this by pushing monitor away, positioning yourself facing the patient with eye contact, and have your hands off keyboard and mouse

• 'Learn to type': Our review suggests that blind typing, although highly important, is part of a larger set of computer mastery skills which include computer navigation, fast screen scanning and Internet surfing. These skills would enable physicians to focus their attention on the patient, thereby contributing to a seamless clinical encounter. Extrapolating from this set, Internet surfing skills and familiarity with decision support and evidence resources would enable physicians to better employ the computer in patient education.

• 'Separate some routine data entry and healthcare maintenance issues from your patient encounters': Our analysis indicates that dividing attention between the patient and EMR is difficult. Therefore, separating them is a useful approach that should be extended beyond data entry. We propose that scanning the EMR for problem list, constant medication and previous visit precedes calling the patient in. Gaps between or within encounters (e.g. when patient dresses after physical examination) may be used for typing.

• 'Start with your patients' concerns': This review suggests that in some cases the clinical encounter may increasingly become information gathering-driven. It is therefore important not only to start with the patients' concerns, but also to ensure the encounter is driven by them and the patient's narrative.

• 'Look at your patients': Our review suggests that eye contact is just one aspect of non-verbal communication involving the computer. Body language and gestures – for example, turning body towards the patient, taking hands off the keyboard and mouse and pushing the monitor away – are as much as important for indicating that the physician's full attention is to the patient as well as for encounter management.

More generally, we propose basic and continuing medical education as the main strategies to enhance PDC in a computerized setting. As EMR use continues to grow, EMR training should focus not only on the technical aspects of using it, but also on how to incorporate it into a seamless patient–doctor encounter. Some simple means such as blind typing could have a great influence on the efficiency of EMR use as well as its effect on communication. Conversely, the changing environment should be considered and the use of EMR integrated into the standard medical communication education.

Overcoming the negative influences of EMR on communication is just a first step. Computers have the potential to enhance patient–doctor communication, sharing understanding and patient education, thereby positively affect patient satisfaction, compliance/ adherence and, possibly, clinical outcomes [5,6]. However, our review of the literature suggests that the EMR is rarely utilized for these purposes. Simple tips such as using flat mobile monitors, pointing to the screen, showing the patient what the physician is doing and encouraging patients to participate in building their own charts as well as promoting electronic communication (Table 2; tips 1, 7–9) can help utilizing the potential of EMRs to a greater extent.

Implications to design of EMR systems

The design of successful EMR systems requires careful consideration of the user, system and task characteristics [57]. PDC is an important component of the task supported by the EMR – providing high quality care – which has often been ignored. This review of the literature implies that EMRs are successful in supporting the primary task for which they were designed, that is, collecting and documenting patient information. This is evident from the positive impact on information exchange.

However, EMRs have a greater potential to improve other aspects of healthcare quality but documentation. One such aspect is the physician's ability to share information with patients, for example, by showing trends of lab results over time, use of risk calculating

software, links to external credible health information resources, printing patient handouts and using anatomical images to explain medical problems. Our analysis suggests that these potential functions are hardly used. Future designs of EMR systems should contain functions to assist physicians in patient education as well as reduce time and cognitive load associated with EMR use, for example, easy to share and visually scan screens with problem lists, previous visit and summary, access to digital data from other relevant sources, pre-prepared templates for routine tasks and integration of decision support and evidence into the chart screen.

Voice recognition, handwriting recognition and touch screens are powerful means to improve data entry [58]. As this review indicates typing has a negative impact on communication. Therefore, these technologies may strongly enhance PDC while using the EMR. Although EMRs with voice recognition are being implemented in some settings, there is a dearth in research regarding the impact of this technology on clinical practice. Some results indicate that compared with electronic signature of letters typed by experienced transcriptionist and imported into the EMR, using voice recognition software for writing letters required additional physicians' time, is less accurate and more costly [59]. However, to our knowledge currently there is no comparison of using EMR with voice recognition and typing by physicians during the clinical encounter.

Limitations and directions for future research

The present study has a number of limitations. First, only 14 papers met inclusion criteria. Therefore, we could not reach theoretical saturation. Still, we were able to identify a number of overarching recurrent themes as discussed above. Moreover, the qualitative–interpretive approach used for analysing the data allowed us to highlight some isolated findings that may be interesting to study in future investigations, though not necessarily representative. An example is the use of computers to give credibility to clinical statements, which has been reported by one article.

Present theories and models of PDC, as far as we can detect in the literature (by 1 February 2008) have not yet included the computer. We are able to find only two examples of instructional modules supporting introduction of computers to clinical care settings [60,61], neither of which include a theoretical framework. This review attests to this need. As present theories and models are based on encounter recordings and theory-driven analysis, the incorporation of the impact of the computer on PDC into these frameworks will probably follow a similar route.

As non-verbal communication (such as eye-gaze, body positioning and hands place on/off keyboard and mouse etc.) are crucial to PDC as this review demonstrates, it will behove future researchers to video record encounters and make sure to capture these nuances. One necessary additional technology may be eye-tracking cameras placed on desktop screens. A necessary additional methodology to be employed may be 'think aloud' of both patient and clinician, while observing recordings of encounters, recalling their cognitions and emotions in particular instances of computer-related occurrences.

A set of questions for future studies on EMR in PDC, which may facilitate the development of such theories, has been proposed by Ventres *et al.* [29]. Here we elaborate on some of these questions and the findings of this review to propose directions and potential methods for future research:

- 'Can EHR software be designed to facilitate communication between physicians and patients?' [29] To answer this question, there is a need to better understand the cognitive elements in using EMR during the patient–doctor encounter, such as focus of attention, memory load and automaticity of actions. Methodologies drawn from Cognitive Sciences and Human–Computer Interaction (e.g. Cognitive Task Analysis) [62] may shed light on these elements and provide useful guidelines for design of EMR systems that support patient–doctor communication. Another direction is to evaluate the impact of new technologies and designs on PDC during the patient visit, compared with present systems. A case in point, which as discussed above has rarely been studied, is EMR with embedded voice recognition.
- 'Are there examples of best practices – standard procedures or phrases – that physicians can use to assist patients as they are introduced to the EHR?' [29] To identify best practices of EMR use and effective strategies for incorporating it into PDC, it would be useful to compare experts (in PDC, clinically and in EMR use) with novices and intermediates. Our research in progress [63] already revealed some of the strategies and job smarts developed by experts to overcome the negative influence of EMR on communication (e.g. dividing the visit into separate patient- and EMR-centred stages, typing while patients dress after physical examination and reading out loud while typing).
- 'When and how should medical educators introduce the EHR to students and residents, especially given the current emphasis on training patient-centred interviewing skills?' [29] Expert strategies and best practices may be employed to developing medical education interventions aimed at facilitating PDC in a computerized setting. Then, alternative educational approaches to employ these strategies should be developed and evaluated by comparing control and intervention groups pre- and post-intervention.

Conclusion

This review indicates that the use of EMR has a positive influence on information sharing between patients and doctors, but exerts a negative impact on patient centredness, emotional and psychological communication and establishing rapport between physicians and patients. The negative impact on communication can be partially overcome by spatial organization of the doctor's office and by physician computer skills and behavioural style. This review highlights the need to extend present communication theories to incorporate computer use during the clinical encounter.

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References

1. Blumenthal, D. & Glaser, J. P. (2007) Information technology comes to medicine. *New England Journal of Medicine*, 356 (24), 2527–2534.

2. McConnell, H. (2004) International efforts in implementing national health information infrastructure and electronic health records. *World Hospitals and Health Services*, 40 (1), 33–37, 39–40, 50–52.
3. Giokas, D. (2005) Canada health infoway – towards a national interoperable Electronic Health Record (EHR) solution. *Studies in Health Technology and Informatics*, 115, 108–140.
4. Lippert, S. & Kverneland, A. (2003) The Danish national health informatics strategy. *Studies in Health Technology and Informatics*, 95, 845–850.
5. Sullivan, F. & Wyatt, J. C. (2005) How computers help make efficient use of consultations. *British Medical Journal*, 331 (7523), 1010–1012.
6. Sullivan, F. & Wyatt, J. C. (2005) How computers can help to share understanding with patients. *British Medical Journal*, 331 (7521), 892–894.
7. Hersh, W. R. (2002) Medical informatics: improving health care through information. *Journal of the American Medical Association*, 288 (16), 1955–1958.
8. Sujansky, W. V. (1998) The benefits and challenges of an electronic medical record: much more than a 'word processed' patient chart. *Western Journal of Medicine*, 169 (3), 176–183.
9. Chaudhry, B., Wang, J., Wu, S., Maglione, M., Mojica, W., Roth, E., Morton, S. C. & Shekelle, P. G. (2006) Systematic review: impact of health information technology on quality, efficiency, and costs of medical care. *Annals of Internal Medicine*, 144 (10), 742–752.
10. Patel, V. L., Kushniruk, A. W., Yang, S. & Yale, J. F. (2000) Impact of a computer-based patient record system on data collection, knowledge organization, and reasoning. *Journal of the American Medical Informatics Association*, 7 (6), 569–585.
11. Campbell, E. M., Sittig, D. F., Ash, J. S., Guappone, K. P. & Dykstra, R. H. (2006) Types of unintended consequences related to computerized provider order entry. *Journal of the American Medical Informatics Association*, 13 (5), 547–556.
12. Ash, J. S., Berg, M. & Coiera, E. (2004) Some unintended consequences of information technology in health care: the nature of patient care information system-related errors. *Journal of the American Medical Informatics Association*, 11 (2), 104–112.
13. Han, Y. Y., Carcillo, J. A., Venkataraman, S. T., Clark, R. S., Watson, R. S., Nguyen, T. C., Bayir, H. & Orr, R. A. (2005) Unexpected increased mortality after implementation of a commercially sold computerized physician order entry system. *Pediatrics*, 116 (6), 1506–1512.
14. Engel, G. (1988) How much longer must medicine's science be bounded by a seventeenth century world view? In The Task of Medicine, Dialogue at Wickenburg (ed. K. L. White), pp. 113–136. Menlo Park: The Henry Kaiser Family Foundation.
15. Bertakis, K. D., Roter, D. & Putnam, S. M. (1991) The relationship of physician medical interview style to patient satisfaction. *Journal of Family Practice*, 32 (2), 175–181.
16. Robbins, J. A., Bertakis, K. D., Helms, L. J., Azari, R., Callahan, E. J. & Creten, D. A. (1993) The influence of physician practice behaviors on patient satisfaction. *Family Medicine*, 25 (1), 17–20.
17. Kurtz, S. & Silverman, J. D. (2005) Teaching and Learning Communication Skills in Medicine. Abingdon, Oxon: Radcliffe Medical Press.
18. Schneider, J., Kaplan, S. H., Greenfield, S., Li, W. & Wilson, I. B. (2004) Better physician–patient relationships are associated with higher reported adherence to antiretroviral therapy in patients with HIV infection. *Journal of General Internal Medicine*, 19 (11), 1096–1103.
19. Levinson, W., Gorawara-Bhat, R., Dueck, R., *et al*. (1999) Resolving disagreements in the patient–physician relationship: tools for improving communication in managed care. *Journal of the American Medical Association*, 282 (15), 1477–1483.
20. Joos, S. K., Hickam, D. H., Gordon, G. H. & Baker, L. H. (1996) Effects of a physician communication intervention on patient care outcomes. *Journal of General Internal Medicine*, 11 (3), 147–155.
21. Lipkin, M. Jr & Williamson, P. R. (1995) Teaching interviewing using direct observation and discussion of actual interviews. In The Medical Interview: Clinical Care, Education, and Research (eds M. Lipkin Jr, S. M. Putnam & A. Lazare), pp. 413–421. New York: Springer-Verlag.
22. Fremont, A. M., Cleary, P. D., Hargraves, J. L., Rowe, R. M., Jacobson, N. B. & Ayanian, J. Z. (2001) Patient-centered processes of care and long-term outcomes of myocardial infarction. *Journal of General Internal Medicine*, 16 (12), 800–808.
23. Stewart, M. A. (1995) Effective physician–patient communication and health outcomes: a review. *Canadian Medical Association Journal*, 152 (9), 1423–1433.
24. Ventres, W., Kooienga, S. & Marlin, R. (2006) EHRs in the exam room: tips on patient-centered care. *Family Practice Management*, 13 (3), 45–47.
25. Strauss, A. L. & Corbin, J. M. (1990) Basics of Qualitative Research: Grounded Theory Procedures and Techniques. Newbury Park, CA: Sage Publications.
26. Miles, M. & Huberman, A. (1994) Qualitative Data Analysis: An Expanded Sourcebook. London: SAGE Publications.
27. Hsu, J., Huang, J., Fung, V., Robertson, N., Jimison, H. & Frankel, R. (2005) Health information technology and physician–patient interactions: impact of computers on communication during outpatient primary care visits. *Journal of the American Medical Informatics Association*, 12 (4), 474–480.
28. Booth, N., Robinson, P. & Kohannejad, J. (2004) Identification of high-quality consultation practice in primary care: the effects of computer use on doctor-patient rapport. *Informatics in Primary Care*, 12 (2), 75–83.
29. Ventres, W., Kooienga, S., Vuckovic, N., Marlin, R., Nygren, P. & Stewart, V. (2006) Physicians, patients, and the electronic health record: an ethnographic analysis. *Annals of Family Medicine*, 4 (2), 124–131.
30. Makoul, G., Curry, R. H. & Tang, P. C. (2001) The use of electronic medical records: communication patterns in outpatient encounters. *Journal of the American Medical Informatics Association*, 8 (6), 610–615.
31. Ventres, W., Kooienga, S., Marlin, R., Vuckovic, N. & Stewart, V. (2005) Clinician style and examination room computers: a video ethnography. *Family Medicine*, 37 (4), 276–281.
32. Als, A. B. (1997) The desk-top computer as a magic box: patterns of behaviour connected with the desk-top computer; GPs' and patients' perceptions. *Family Practice*, 14 (1), 17–23.
33. Frankel, R., Altschuler, A., George, S., Kinsman, J., Jimison, H., Robertson, N. R. & Hsu, J. (2005) Effects of exam-room computing on clinician-patient communication: a longitudinal qualitative study. *Journal of General Internal Medicine*, 20 (8), 677–682.
34. Margalit, R. S., Roter, D., Dunevant, M. A., Larson, S. & Reis, S. (2006) Electronic medical record use and physician–patient communication: an observational study of Israeli primary care encounters. *Patient Education and Counseling*, 61 (1), 134–141.
35. Arar, N. H., Wen, L., McGrath, J., Steinbach, R. & Pugh, J. A. (2005) Communicating about medications during primary care outpatient visits: the role of electronic medical records. *Informatics in Primary Care*, 13 (1), 13–22.
36. Rouf, E., Whittle, J., Lu, N. & Schwartz, M. D. (2007) Computers in the exam room: differences in physician–patient interaction may be due to physician experience. *Journal of General Internal Medicine*, 22 (1), 43–48.
37. Kuo, G. M., Mullen, P. D., McQueen, A., Swank, P. R. & Rogers, J. C. (2007) Cross-sectional comparison of electronic and paper medical records on medication counseling in primary care clinics: a Southern Primary-Care Urban Research Network (SPUR-Net) study. *Journal of the American Board of Family Medicine*, 20 (2), 164–173.

38. Gibson, M., Jenkings, K. N., Wilson, R. & Purves, I. (2005) Multitasking in practice: coordinated activities in the computer supported doctor-patient consultation. *International Journal of Medical Informatics*, 74 (6), 425–436.
39. Miettola, J., Mantyselka, P. & Vaskilampi, T. (2005) Doctor-patient interaction in Finnish primary health care as perceived by first year medical students. *BMC* Medical Education, 5 (1), 34.
40. Bullard, M. J., Meurer, D. P., Colman, I., Holroyd, B. R. & Rowe, B. H. (2004) Supporting clinical practice at the bedside using wireless technology. *Academic Emergency Medicine*, 11 (11), 1186–1192.
41. Garrison, G. M., Bernard, M. E. & Rasmussen, N. H. (2002) 21st-century health care: the effect of computer use by physicians on patient satisfaction at a family medicine clinic. *Family Medicine*, 34 (5), 362–368.
42. Ash, J. S., Sittig, D. F., Dykstra, R. H., Guappone, K., Carpenter, J. D. & Seshadri, V. (2007) Categorizing the unintended sociotechnical consequences of computerized provider order entry. *International Journal of Medical Informatics*, 76 (Suppl.), s21–s27.
43. Harrison, M. I., Koppel, R. & Bar-Lev, S. (2007) Unintended consequences of information technologies in health care – an interactive sociotechnical analysis. *Journal of the American Medical Informatics Association*, 14 (5), 542–549.
44. Ash, J. S., Gorman, P. N., Seshadri, V. & Hersh, W. R. (2002) Computerized physician order entry in U.S. hospitals: results of a 2004 survey. *Journal of the American Medical Informatics Association*, 11 (2), 95–99.
45. Kaushal, R., Shojania, K. G. & Bates, D. W. (2003) Effects of computerized physician order entry and clinical decision support systems on medication safety: a systematic review. *Archives of Internal Medicine*, 163 (12), 1409–1416.
46. Kuperman, G. J., Bobb, A., Payne, T. H., Avery, A. J., Gandhi, T. K., Burns, G., Classen, D. C. & Bates, D. W. (2007) Medication-related clinical decision support in computerized provider order entry systems: a review. *Journal of the American Medical Informatics Association*, 14 (1), 29–40.
47. Wald, H. S., Dube, C. E. & Anthony, D. C. (2007) Untangling the Web – the impact of Internet use on health care and the physician–patient relationship. *Patient Education and Counseling*, 68 (3), 218–224.
48. Akesson, K. M., Saveman, B. I. & Nilsson, G. (2007) Health care consumers' experiences of information communication technology – a summary of literature. *International Journal of Medical Informatics*, 76 (9), 633–645.
49. McMullan, M. (2006) Patients using the Internet to obtain health information: how this affects the patient-health professional relationship. *Patient Education and Counseling*, 63 (1–2), 24–28.
50. Ball, M. J. & Lillis, J. (2001) E-health: transforming the physician/patient relationship. *International Journal of Medical Informatics*, 61 (1), 1–10.
51. Engel, G. (1977) The need for a new medical model: a challenge for biomedicine. *Science*, 196 (4286), 129–136.
52. Engel, G. (1980) The clinical application of the biopsychosocial model. *American Journal of Psychiatry*, 137 (5), 535–544.
53. Borrell-Carrio, F., Suchman, A. L. & Epstein, R. M. (2004) The biopsychosocial model 25 years later: principles, practice, and scientific inquiry. *Annals of Family Medicine*, 2 (6), 576–582.
54. Epstein, R. M., Franks, P., Fiscella, K., Shields, C. G., Meldrum, S. C., Kravitz, R. L. & Duberstein, P. R. (2005) Measuring patient-centered communication in patient–physician consultations: theoretical and practical issues. *Social Science & Medicine*, 61 (7), 1516–1528.
55. Bird, J. & Cohen-Cole, S. (1990) The three function model of the medical interview: an educational device. In Methods in Teaching Consultation-Liaison Psychiatry (ed. M. Hale), pp. 65–88. Basel: Karger.
56. Epstein, R. M., Campbell, T. L., Cohen-Cole, S. A., McWhinney, I. R. & Smilkstein, G. (1993) Perspectives on patient–doctor communication. *Journal of Family Practice*, 37 (4), 377–388.
57. Jaspers, M. W., Steen, T., van den Bos, C. & Geenen, M. (2004) The think aloud method: a guide to user interface design. *International Journal of Medical Informatics*, 73 (11–12), 781–795.
58. Weber, J. (2003) Tomorrow's transcription tools: what new technology means for healthcare. *Journal of AHIMA*, 74 (3), 39–43, quiz 45–46.
59. Issenman, R. M. & Jaffer, I. H. (2004) Use of voice recognition software in an outpatient pediatric specialty practice. *Pediatrics*, 114 (3), e290–e293.
60. Institute for Healthcare Communication (2008) *Connected: Communicating and Computing*. Available at: http://www.healthcarecomm.org/index.php?sec=courses&sub=faculty&course=3 (accessed 9 June 2009).
61. Simpson, L., Robinson, P., Fletcher, M. & Wilson R. (2005) e-Communication Skills. Oxford: Radcliff.
62. Kushniruk, A. W. & Patel, V. L. (2004) Cognitive and usability engineering methods for the evaluation of clinical information systems. *Journal of Biomedical Informatics*, 37 (1), 56–76.
63. Shachak, A., Hadas-Dayagi, M., Ziv, A. & Reis, S. (2006) A cognitive task analysis of primary care physicians' use of electronic medical records: implications for design. In *Human Factors Engineering in Health Informatics*; 2006 June 7–8; Arhus, Denmark; pp. 32–33.

