ORIGINAL ARTICLES

Effects of Exam-Room Computing on Clinician–Patient Communication

A Longitudinal Qualitative Study

Richard Frankel, PhD,[1,2] Andrea Altschuler, PhD,[3] Sheba George, PhD,[4,5] James Kinsman,[3] Holly Jimison, PhD,[6] Nan R. Robertson, RPh,[7] John Hsu, MD, MBA, MSCE[3]

[1]Center on Implementing Evidence-Based Practice, Roudebush, VAMC; [2]Indiana University School of Medicine, Indianapolis, Ind, USA; [3]Kaiser Permanente Medical Care Program, Division of Research, Oakland, Calif, USA; [4]University of California, Los Angeles, Calif, USA; [5]Charles R. Drew University of Science and Medicine; [6]Oregon Health and Sciences University; [7]The Robertson Group, Portland, Ore, USA.

OBJECTIVE: To evaluate the impact of exam-room computers on communication between clinicians and patients.

DESIGN AND METHODS: Longitudinal, qualitative study using videotapes of regularly scheduled visits from 3 points in time: 1 month before, 1 month after, and 7 months after introduction of computers into the exam room.

SETTING: Primary care medical clinic in a large integrated delivery system.

PARTICIPANTS: Nine clinicians (6 physicians, 2 physician assistants, and 1 nurse practitioner) and 54 patients.

RESULTS: The introduction of computers into the exam room affected the visual, verbal, and postural connection between clinicians and patients. There were variations across the visits in the magnitude and direction of the computer's effect. We identified 4 domains in which exam-room computing affected clinician–patient communication: visit organization, verbal and nonverbal behavior, computer navigation and mastery, and spatial organization of the exam room. We observed a range of facilitating and inhibiting effects on clinician–patient communication in all 4 domains. For 2 domains, visit organization and verbal and nonverbal behavior, facilitating and inhibiting behaviors observed prior to the introduction of the computer appeared to be amplified when exam-room computing occurred. Likewise, exam-room computing involving navigation and mastery skills and spatial organization of the exam-room created communication challenges and opportunities. In all 4 domains, there was little change observed in exam-room computing behaviors from the point of introduction to 7-month follow-up.

CONCLUSIONS: Effective use of computers in the outpatient exam room may be dependent upon clinicians' baseline skills that are carried forward and are amplified, positively or negatively, in their effects on clinician–patient communication. Computer use behaviors do not appear to change much over the first 7 months. Administrators and educators interested in improving exam-room computer use by clinicians need to better understand clinician skills and previous work habits associated with electronic medical records. More study of the effects of new technologies on the clinical relationship is also needed.

KEY WORDS: communication; electronic medical records; integrated delivery system; exam-room computers.
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Computers and electronic medical records are widely used by clinicians in ambulatory settings. Indeed, both the United States federal government and the National Health Service (NHS) in the United Kingdom have recently announced large initiatives to increase the use of computers as part of routine ambulatory care.[1,2]

Unfortunately, there is little information on how physicians' use of computers in the outpatient exam room affects physician–patient communication.[3] This dearth of knowledge is particularly concerning given that communication arguably is one of the "most powerful, encompassing, and versatile instrument[s] available to the physician."[4] Several recent studies suggest that good communication could improve health care outcomes ranging from better treatment adherence to fewer interactions leading to malpractice suits.[5–11] Currently, there are no published guidelines and no evidence on how, and under what conditions, exam-room computers can or should affect the processes and dynamics of care. Understanding how computers may systematically affect the dynamics of physician–patient interaction is vital given the central role of communication in medical care processes and outcomes.[12,13]

To address this gap, we conducted a video-based, longitudinal qualitative study to investigate the effects of exam-room computers on clinician–patient communication in a single multispecialty clinic. In this paper, we describe how exam-room computing affects clinician–patient communication.

METHODS

We recruited 9 primary care clinicians from a single medical office center in a prepaid, integrated health care delivery system. The study site selection was based, in part, on the fact that exam-room computers were to be installed throughout the center prior to the beginning of our study. This provided an unusual opportunity to observe clinicians prior to the introduction of the computers and again at 1 and 7 months post-introduction. All clinicians had used electronic medical records that had been available at the nurses' stations and in each of the clinician's private workspaces for 6 years prior to the beginning of the study. Since the clinicians had experience with computers and the electronic medical record software, we were able to separate the effects of learning how to use a new information system from using that system in a new context, the exam room.

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Address correspondence and requests for reprint to Dr. Frankel: 1481 West Tenth Street, Indianapolis, IN 46202 (e-mail: RFrankel@IUPUI.Edu).

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We obtain consent from clinicians, staff, and patients for the study. We observed clinicians (using both video and audio recordings) during their routinely scheduled outpatient visits at 3 points in time: 1 month before, 1 month after, and 7 months after the introduction of exam-room computers. Two members of the research team (A.A. and S.G., qualitative sociologists) independently reviewed the videotapes and made detailed field notes for each visit. In this article, we based the analysis on a random sample of 2 visits per clinician per period (54 total visits).

Using basic communication concepts from the Four Habits Communication Model[14] as a base, we used an iterative consensus-building process to identify additional themes. Five members of the research team (R.F., A.A., S.G., J.K., and J.H.) met periodically after viewing the videotapes to discuss journal notes, and to develop and challenge hypotheses using a variant of grounded theory.[15] We presented preliminary findings for skeptical peer review to improve the validity and reliability of the findings.[16] We assured all subjects that their identities, medical information, and comments would remain confidential. The health system's Institutional Review Board approved the study protocol.

RESULTS

Study Participant Characteristics

The medical office center, located in a major metropolitan area, had 21 primary care physicians trained in internal medicine or family practice, 4 nurse practitioners (NP), and 5 physician assistants (PA). From this pool, 13 (43%) clinicians volunteered to participate in the study: 10 physicians, 2 NPs, and 1 PA. Prior to any analyses, we excluded 2 clinician volunteers whose practice did not consist primarily of adult primary care, and 2 clinicians who left the clinic during the study period. The 9 clinician-participants were nearly evenly divided by gender (56% female) and by specialty (56% family practice). They were predominantly white (67%), and had practiced in the health system for at least 3 years (80%). There were no differences in the available characteristic information between the clinicians who participated in the research and those that did not.

Table 1 describes the self-reported characteristics of the patient-participants. The majority were females (70%). The mean age was 53 years; 85% of participants reported their race/ethnicity as white and 15% declined to state it. Forty-five percent of the participants reported annual household incomes below $35,000 (U.S.), and 70% reported having a high school education or less ($\leq$ 12 years). Eighty-four percent had seen the clinician at least once prior to the study visit.

Computer Use and Quality of Communication

An exam-room computer has the potential to shift the clinician's attention and involvement away from the patient to the keyboard and monitor. Since attention to the patient may be associated with positive outcomes of care,[17] we focused on whether the computer enhanced or interfered with the clinician's attention to the patient. We observed three ways by which clinicians maintained communication with patients during computer use: (1) *verbally*, the clinician maintained conversation when looking at the screen or typing; (2) *visually*, the clinician made eye contact with the patient intermittently during computer use (at least every 15 seconds or when talking with the patient); and (3) *posturally*, the clinician positioned her head or torso toward the patient rather than having her back to the patient during computer use.

Although it is likely that having all 3 modes of attention yields the best communication, we credited clinicians who used any of the 3 modes as having higher quality communication. Likewise, we defined the absence of verbal, visual, and postural orientation toward the patient for more than 30 seconds when using the computer as an example of a barrier to clinician–patient communication.

Facilitators and Barriers to Communication

Based on a synthesis of our observations, we identified 4 domains in which exam-room computing affected clinician–patient communication: visit organization, verbal and nonverbal behavior, computer navigation and mastery, and spatial organization of the exam room. We observed examples of the computer facilitating and inhibiting communication in all 4 domains. For 2 domains, visit organization and verbal and nonverbal behavior, we could compare communication before and after the introduction of exam-room computing. In these 2 domains, we observed that clinicians' baseline communication skills, both negative and positive, appeared to be amplified in the presence of the computer. Computer navigation, mastery, and physical placement of the computer were compared at the point of introduction and 7 months later.

Visit Organization

The medical visit requires the clinician to gather and record historical data, physically examine the patient, deliver diagnostic and prognostic news, make treatment recommendations, and educate the patient. In practice, many of these tasks overlap and do not always follow in a fixed progression. Exam-room computers added complexity to the organization and flow of the visit by increasing the amount of clinical infor-

Table 1. Patient–Subject Characteristics in Each Study Period

	All (n=54)	Period 1 (n=18)	Period 2 (n=18)	Period 3 (n=18)
Age Mean (SD)	53 (16)	53 (18)	50 (12)	56 (17)
Female (%)	70	61	72	72
Educational attainment ($\leq$ high school) (%)	70	71	69	69
Annual household income <$35,000 (%)	45	42	57	36
Self-reported health status: excellent/very good (%)	24	11	33	28
Initial visit to PCP (%)	16	22	6	17

Period 1 refers to visits occurring 1 month before the introduction of computers into the exam room; Period 2 refers to 1 month after the introduction; and Period 3 refers to 7 months after the introduction. None of the patient-subjects had visits in multiple periods.
PCP, primary care physicians.

Box I. Organizational Skills and Communication Behavior

Period 1	Period 3
1A. Good baseline visit organization skills: In this baseline visit, the clinician enters the room, greets the patient warmly, commenting on the presence of the video camera, "Do you have stage fright like me?" As there is no desk in the room, the clinician places the paper chart on a supply cabinet opposite the patient and leans toward him as they discuss his concerns. The clinician begins writing in the chart as the patient speaks, but looks up from time to time to make eye contact with the patient. Shortly after the patient finishes speaking, the clinician notes that they had spoken on the phone about the problem and comments that "I was looking at my notes before I came in," thus making visible additional interest in the patient's care.	**1B. Amplification of good visit organization skills while using an exam-room computer**: The clinician enters the room, introduces the computer, and explains confidentiality of information in the electronic medical record, before eliciting an agenda from the patient. After some discussion, the clinician glances at the computer screen, clarifies the patient's goal for the visit, and solicits for additional concerns. The patient adds an additional concern about a spot that she was told might be cancer. The clinician immediately gets up from the computer, examines the spot, and confirms to the patient that it is not cancerous. The clinician then returns to the computer and continues to deal with the patient's less pressing concerns.
2A. Poor baseline visit organization skills: In this baseline visit, the clinician never sets a formal agenda. The patient has multiple medical concerns. Problems are discussed serially as the patient brings them up and without regard to their number, relationship, or severity. The visit appears quite inefficient and poorly organized. Each of the patient's concerns is quickly superseded by the next concern; some of the patient's concerns are never fully addressed by the end of the visit.	**2B. Amplification of poor visit organization skills while using an exam-room computer**: After the introduction of the computer, the clinician appears to have the same visit organization style observed in period 1, except that now there is an increase in the number and complexity of visit tasks associated with the computer. The clinician does not set a formal agenda in this visit. Instead, the clinician appears to become confused between concerns that the patient raises and information on the computer screen. Whenever the clinician looks at the computer, the information on the monitor becomes the topic of discussion, often displacing the on-going topic of conversation. The changes in topics and lack of resolution before switching topics appear to confuse the patient. The presence of the computer multiplies the sense of disorganization of this visit, and extends its length.

mation (mental tasks) or introducing additional physical tasks such as typing information on the computer keyboard. For more skilled clinicians, the computer provided a new tool to help organize relevant clinical data as well as visit tasks, thus reducing visit complexity. We observed examples of the computer increasing the number of tasks and both assisting and creating barriers for clinicians in organizing the visit. We also observed how changes in visit complexity introduced by the computer increased or decreased the quality of clinician–patient communication. The following 2 sets of examples, drawn directly from our field notes, illustrate how the baseline visit organization skills (eliciting the patient's agenda at the beginning of the visit) of two different clinicians are enhanced or diminished once exam-room computers are in use (Box I).

Verbal and Nonverbal Behavior

Study clinicians who integrated data gathering (interview) and data recording (written chart entry) activities into their conversations with patients during the baseline observation period also were able to seamlessly integrate the computer into their visits during the second and third observation periods. Those who performed less well at baseline also had additional difficulties using the computer as an interpersonal communication tool. The following examples illustrate how good and bad verbal and nonverbal skills that facilitate or constrain communication at baseline are carried forward and amplified after the introduction of the computer (Box II).

Box II. Verbal and Nonverbal Skills and Communication Behavior

Period 1	Period 2
3A. Good baseline verbal and nonverbal skills: During this baseline visit, the clinician sits on a low stool directly facing the patient and maintains eye contact with the patient while speaking. The clinician writes in the medical chart only intermittently and when the patient has finished speaking. When writing, the clinician frequently pauses and makes eye contact with the patient.	**3B. Amplification of good verbal and nonverbal skills while using an exam-room computer**: The same clinician sees a patient who has had several recent emergency room visits for panic attacks. After consulting the computer, the clinician notes that the patient recently started taking a medication known to produce similar symptoms as a side effect. The clinician tilts the computer screen so that both can read the drug information and visit notes, and offers the hypothesis that the medication could be responsible for the new symptoms. The clinician then reinforces the message by pushing away the computer screen, re-establishing eye contact, and checking to see whether the patient understands the discussion.
4A. Poor baseline verbal and nonverbal skills: During much of this baseline visit, the clinician focuses on the patient's paper records and speaks very little. As a result, the patient is left sitting for long periods of time while the clinician reviews the record. It is evident that when the patient does speak, many times it is simply to fill the gap in the interaction.	**4B. Amplification of poor verbal and nonverbal skills using an exam-room computer**: Once the clinician's logs on to the computer, a little less than halfway into the visit, he spends most of his time on the computer, and does not have much eye contact with the patient. While the clinician is still looking at the screen, the patient volunteers information about his pharmacist's recommendation to help lower his cholesterol. The clinician looks upbriefly but makes no comment. The patient continues on the topic of diet and weight loss. The clinician continues to gaze at the screen, looks up briefly and softly says "yeah" before changing the topic.

Box III. Computer Mastery Skills and Communication Behavior

Period 2	Period 3
5. Computer navigation and mastery facilitates communication: In this visit, the clinician uses the computer very effectively in visually sharing data trends with a patient and his wife. As they go over histograms of blood pressure readings for the past 2 y everyone is focused on the computer screen. The clinician also retrieves all of the patient's hemoglobin A1c test results over the same period after the patient's wife expresses concerns about the patient's blood sugars. The graph of the test results appears to reassure the patient and his wife and assist the clinician in communicating the message quickly. Use of the computer in this visit appears seamless and natural.	**6. Lack of computer navigation and mastery inhibits communication**: While searching for a patient's recent medical history on the computer, a different study clinician appears to pay little attention to the patient, and instead focuses entirely on navigating through the computer screens. Meanwhile, the patient attempts unsuccessfully to provide information about her medications as the clinician struggles with the computer. Both clinician and patient seem frustrated with the process, which takes a long time.

Computer Navigation and Mastery Skills

The clinician's ability to navigate on the computer is another factor that appears to influence whether its use during a visit facilitated or impeded communication. We also found a range of other technical mastery issues, including typing and organizing information efficiently, that affected overall communication between the clinician and the patient. The following positive and negative examples illustrate how computer mastery skills in operating the computer can facilitate or inhibit communication (Box III).

Spatial Organization

The physical configuration of the computer, monitor, exam table, and the clinician's chair varied in each exam room in the study. In some rooms, the computer location easily permitted the clinician to alternate attention between the computer and the monitor while simultaneously entering information, and sharing the information on the monitor with the patient. In other rooms, clinicians had to sit with their backs to the patient and across the room from the patient in order to use the computer. In these rooms, clinicians had to stop using the computer completely in order to face the patient. While not an absolute barrier or facilitator, the physical placement of the computer did appear to make communication more or less challenging. The following positive and negative examples and reenacted screen shots illustrate the challenges that physical placement of the computer created (Box IV).

DISCUSSION

To our knowledge, this is the first study to prospectively examine the impact of exam-room computing on clinician–patient communication at several points in time. We found that exam-room computers affected clinician–patient communication by changing the verbal, visual, and postural connection

Box IV: Spatial Organization and Communication Behavior

Period 2	Period 2
Spatial organization inhibits communication: In this visit, another study clinician sits in front of the computer screen. Instead of tilting the screen toward the patient, the clinician positions it so that it is out of the patient's view. While discussing aspects of the patient's care, the clinician remains focused on the computer screen. During this episode, lasting several minutes, the clinician's eyes never leave the computer screen. At one point, the patient attempts to see the computer screen by leaning out from the exam table, almost falls off, and finally gives up (Fig. 1)	**Spatial organization facilitates communication**: The computer rests on the wall next to the foot of the exam table in this visit. During the clinician's computer use, the patient is able to watch the screen. At one point, the clinician pauses, turns the screen closer to the patient, and points to a section of the electronic record to discuss a recent test result. During the entire visit, the clinician is either standing right in front of the patient looking at her when talking, or turns slightly to the computer to type. When she is typing, it is very easy for her to pivot her head to look at the patient. The clinician and the patient also sit close to each other (Fig. 2)

FIGURE 1. Patient leaning for involvement.

FIGURE 2. Involved patient positioning.

between patients and clinicians. In so doing, computer use had the potential to alter the sense of connection identified in the literature as essential to relationship building and maintenance. We observed that the majority of study clinicians were able to maintain a connection with patients by way of at least one of these methods, while for a few physicians use of the computer created communication barriers.

Four broad factors appeared to influence the impact of computer use on communication. For visit organization and verbal and nonverbal behavioral factors, facilitators and barriers to that were present before the introduction of computers were carried forward and appeared amplified when exam-room computers were used. The other 2 areas, computer navigation, mastery, and spatial organization, were unique to the introduction of the computer. The effects of all of the factors on communication could be either positive or negative. Exam-room computing behaviors, both positive and negative, changed little from the point of introduction to the end of the study 7 months later. These findings have important implications for education and research efforts in this area.

Visit organization includes managing the cognitive, physical, and socio-emotional tasks that constitute the medical encounter. Although several conceptual models of the medical encounter have appeared in the literature on clinician–patient communication, none has directly addressed the role of exam-room computers.[18–22] Additional research is necessary to determine how best to integrate computer use into the flow of the visit.

Verbal and nonverbal behaviors such as empathy and support, posture, gesture, and tone of voice have been related to outcomes of care such as patient satisfaction, adherence, followthrough on referral, and risk of medical malpractice.[23–26] For example, more direct eye contact from clinicians is associated with patient satisfaction,[27] while warm, friendly tone of voice improved followthrough rates for alcohol counseling.[28] Tone of voice has also been shown to discriminate between physicians who were and were not sued by their patients. These findings suggest that maintaining a high level of interpersonal connection while using computers is a good medical practice.

The visual and cognitive attention required for a clinician to enter and retrieve data while maintaining the flow of the visit can be complex. We observed clinicians who were able, using frequent eye contact, bodily orientation, and vocalization, to stay connected to their patients as they used the computer. Although multitasking appears to facilitate connection with patients, little is known about its long-term effects on clinicians' levels of stress and coping or on clinicians' abilities to improve their multitasking skills. Whether multitasking can be taught as a communication or relationship skill also remains an unanswered question. It is possible that clinicians who have difficulty integrating exam-room computers into their visits may also be less able to carry out multiple complex noncomputer tasks simultaneously.

We were surprised to find that there were no discernable differences between clinicians' use of the computer or facility with integrating computer use into clinical interactions with the patient between the introduction of exam-room computing and 7 months later. We speculate that the lack of change may be because of the fact that clinicians had been using the electronic medical records on their office computers for 6 years prior to the introduction of exam-room computing. In other words, this study focused on the introduction of computers into the clinical encounter, and did not and could not examine effects associated with clinicians learning how to enter and retrieve information from the electronic medical record. Investigating how clinician use patterns change starting with the initial exposure to computers, and whether the behavior becomes fixed after a period of time deserves additional research.

The effects of variation in computer navigation and mastery on clinician–patient communication have not received much attention from communication researchers. An unanswered question here concerns goals and expectations that clinicians have about exam-room computing. For example, some clinicians may view exam-room computing as a way of carrying out rapid order entry, while others may view it as a tool for educating patients. As a result, apparent variations in practice may actually be the product of differences in assumptions and expectations across individual clinicians. If so, the variations we observed might turn out to be more a matter of personal preferences and style than facility with exam-room computing. Here too, more empirical research is needed.

Arguably, the most easily modifiable factor is the physical placement of the computer and monitor. Currently, only anecdote and personal opinion on optimal placement exist. In the study medical clinic, computers were located where the wiring was most physically convenient. In some locations, the clinician had little choice but to turn her/his back on the patient when using the computer, thus making interpersonal connection more difficult. These observations strongly suggest that physical placement of the computer in the exam room is critically important to communication during routine visits.

Limitations

Several limitations should be noted. First, we studied only outpatient care in the primary care setting with an established electronic medical record. Exam-room computing during outpatient subspecialty visits could differ significantly. Second, we studied a single medical clinic in an integrated delivery system. As such, we cannot comment on variation within the larger system of care or between systems. Third, this was a convenience sample of both clinicians and patients. Although there were no significant differences among those who did and did not participate, a larger random sample of subjects could be beneficial. Fourth, the vast majority of our sample self-reported as being white; thus, we cannot comment on possible communication differences introduced by race/ethnicity or culture. Finally, we studied computer use solely in the exam room. Any conclusions about time and workflow must be tempered by examining how and to what extent the study clinicians used their office computers to augment or complete their charting.

CONCLUSION

Additional research is necessary to discover how using computers in the exam room can be beneficial to communication and clinical productivity. As interest and investment in streamlining clinician work processes continue to grow, so too will pressures to maximize the use of technology during outpatient visits. While computers have the potential to im-

prove the quality and accuracy of information gathered and care delivered during medical visits, achieving these goals is not without challenges. Primary among these challenges is maintaining a connection and relationship with patients across multiple episodes of computer use during visits. Optimizing exam-room computing will require an active partnership between administrators, clinicians, and patients. It will also require an active research partnership between those who study the diffusion of information technology and those who study the human dimensions of medical care.

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