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Computers in the Consulting Room: A Case Study of Clinician and Patient Perspectives

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Introduction

Few clinicians in the United States use computers during patient encounters and many still worry that computers will depersonalize their interactions with patients. This case study describes patient and clinician reactions to a computer-based health appraisal system. Findings showed no difference in any aspect of patient satisfaction between computer and non-computer groups. Use of a computer in the consulting room neither depersonalized nor enhanced patient satisfaction. Clinicians (in this case, nurse practitioners and physician assistants) were willing to use the system, which they perceived as having benefits for patient care, but were concerned about the increased time required for exams, effort required to learn the system while still interacting appropriately with the patient, increased monitoring of their performance, and other organizational issues. Clinicians who used the system showed a higher tolerance for uncertainty and communicated more frequently with each other and with others throughout the department. Implementation was slowed by the need to demonstrate the monetary value of the system.

The Institute of Medicine of the National Academy of Sciences, in its 1991 report, called for automated medical records [1]. As a result, the U.S. Congress considered mandating automated record systems for all hospitals that receive federal funds [2]. These recommendations are based on a growing body of evidence that properly designed and implemented computerized patient records can be used effectively to change physician behavior and improve patient care [3,4,5].

Spurred by a report by the Royal College of General Practitioners [6], computer systems have been rapidly introduced into consulting rooms in Great Britain. It is estimated that 90% of primary care physicians in that country work in computerized practices and over 50% use computers during consultation [7,8,9,10,11,12]. In contrast, it was recently estimated

that fewer than 1% of U.S. physicians use a computer-based patient record [13]. Schoenbaum and Barnett [14] outline a number of reasons for the lack of acceptance of computerized medical records, including the need for clinicians to change long standing habits of data recording and to directly use the computer system while interacting with their patients.

In ambulatory care, recent estimates by industry experts indicate that computer-based patient records are in place at no more than 5% of group practices [15]. While automation is slowly gaining a foothold, roadblocks cited include the need for a leader or active physician champion, the need for reliable information about technology options, getting physicians to invest in information technology, and getting physicians to understand the system and use it appropriately [15,16]. Furthermore, while physicians are willing to embrace applications that make work easier and reject those that make it harder, computer-based patient record systems have had a marginal impact on physician work efficiency [17].

While the technology of computer-based record systems has advanced rapidly, knowledge of the impacts of such systems on physicians and patients during clinical encounters remains sparse. Through 1990, most research on computer use by clinicians has focused on informatics in hospital and specialty medicine. Legler [18] in a comprehensive review could only find 12 reports of the effects of the use of computers during medical consultation upon the physician–patient relationship.

Elson and Connelly [4] provide a more recent review of the impact of computerized patient record and decision support systems on physician behavior and patient outcomes, highlighting the role of these systems in influencing physician compliance with practice guidelines. Clinicians' attitudes and expectations regarding an information system, however, are critical factors in their successful implementation [19]. Anderson et al. [20] found that physicians' attitudes accounted for a significant amount of the variation in use of a hospital information system, even when other variables were controlled. In the UK, where computer use in the consulting rooms is widespread, computer-based patient record systems are perceived by physicians as helpful in improving the structure of medical records, checking prescriptions, providing online medical and regulatory information, and supporting standard protocols determined by the clinician.

Experts in the United States also suggest that when clinicians perceive that a computerized patient information system facilitates their practice, they will learn to use it, even if it requires changes in their practice behavior [16,17]. Bleich et al. [21], for example, reported that over 80% of healthcare providers used the computer system at Beth Israel Hospital most of the time to look up laboratory results, in large part because they perceived that the system made their work faster and more accurate. A later study of the use of a computer-based outpatient medical record system at the same hospital found that residents entered almost 50% of their notes directly into the system [22]. The investigators attributed the high level of use of the out-

patient system to the overall acceptance and use of the hospital information system. More recently, however, Beth Israel researchers noted that, rather than leading to paperless medical care, computerization had increased the amount of paper produced and managed by the organization. They cited comfort and convenience with paper, legal issues, and difficulty with organizational transitions to online records as reasons for the "paper paradox" [23].

In other settings, research on both physician and nurse acceptance of the HELP system at LDS Hospital suggested that access to patient data and clinical alerts were important factors in acceptance of the system [24]. Aydin and Forsythe [25], in their ethnographic study of a large group practice, reported that physicians said they would be willing to use an electronic medical record in the consulting room, but expressed concerns about learning to use the system and losing eye contact with patients during the consultation. A study conducted at a Veterans Administration General Medical Clinic, however, was unable to measure impacts on physician practice because the study design did not include methods to determine reasons for the unexpected low usage of the system [26].

Research on nurses' use of computers has focused primarily on staff nurses in hospitals. Early studies examined nurses' acceptance of systems such as order entry, measured attitudes toward computerization, including computer anxiety, and also explored whether computer systems would allow nurses more time at the bedside, for example [27,28,29,30,31]. Since computer use is rarely optional for staff nurses in hospital settings, the researchers used their findings to recommend specific teaching and implementation strategies to meet the learning needs of diverse users and enhance computer acceptance and use. More recent studies have continued to measure nurses' attitudes, but have also explored ways in which computer systems can be designed to contribute to and enhance nursing practice [32–34,35,36,37,38,39,40]. Like physicians, nurses have been found to be willing to use computer systems that they perceive can benefit their practice.

Little research to date has addressed the computerization needs of nurses in ambulatory care or of nurse practitioners, that is, advanced practice nurses with masters' degrees who generally see patients in a consulting room and whose information needs and practice patterns more closely resemble those of family practice physicians than of nurses in the hospital setting. Likewise, little research has addressed the needs of physician assistants who practice in ambulatory care. One of the few studies to include the needs of these clinicians was conducted in Kaiser-Permanente's Northwest Region. Chin and McClure [41] and Krall [42] detailed the implementation of an outpatient primary care system used by physician assistants and nurse practitioners as well as family physicians, internists, and pediatricians. Survey findings indicated gradual acceptance of the system over several months, with clinicians spending more time for each patient immediately

following system implementation to complete "orders" and "charting" tasks. It took clinicians approximately 30 days to reach the baseline visit rate for their clinic. No direct data was collected on patient satisfaction with the system, although clinicians' survey responses indicted that they felt that patients were more satisfied after system implementation.

The first studies on patient reactions to clinicians using a computer in the consulting room were conducted in the UK, with findings indicating that the overall impact on patients was mixed. Two studies demonstrated no difference in patient satisfaction when physicians used a computer during consultation [43,44]. One study from the early stages of computer use, however, did show increased stress in patients with dyspeptic symptoms when their physicians used a diagnostic computer system. The researchers urged doctors to take care to preserve their human touch [45], a concern still debated in more recent computer literature [46] and also expressed by physicians anticipating system implementation [25]. Also focusing on the patient encounter, Brownbridge et al. [47] found that midwives using a computer were inclined to give less information to patients, especially when they were new to the computer, and used more closed and leading questions. A more recent study conducted in Israel indicated that primary care physicians using computerized medical records during a patient encounter changed their working styles to devote more attention to the computer and longer uninterrupted intervals for data entry than when using the traditional paper record. These physicians changed from a "conversational pattern" in which they alternated frequently between the patient and the record to a "block pattern," first establishing a number of items of information and then entering them into the record [48]. The study did not, however, include patient reactions to the encounter.

Another recent study randomly assigned adult ambulatory care patients to one of three groups where during the encounter the physicians used either a paper-and-pencil charting system, a computerized medical record system with keyboard input, or a computerized medical record system with voice input [49]. Patient reactions were measured with a questionnaire. While there were few differences among the three groups, the voice input group rated explanations of patient problems by physicians significantly higher than the other groups. A similar study was conducted at a family practice office in a metropolitan area [13]. Patients were randomly assigned to a physician who made a written record and a physician who made a computer record during the clinical encounter. There were no significant differences in patient satisfaction between the two groups. Interviews were also conducted with 16 patients seen in the family medicine department at the Medical University of South Carolina where a computerized patient record system has been implemented [50]. Patients perceived that the computerized record provided physicians with ready access to medical information and facilitated the encounter between the physician and patient. The

only concern expressed about the computerized record was the confidentiality of patient data.

This chapter extends the literature on clinician use of computers in the consulting room in the United States by examining the impacts of the introduction of CompuHx, a computer-based health record for an interactive health appraisal system, on both clinicians and their patients in a large health maintenance organization. The project focuses on computerization of the health appraisal process in a setting that is likely to become increasingly important as the healthcare delivery system continues to evolve. Furthermore, the study is the first to include both clinician and patient reactions to the same system. First addressing the clinician's perspective, the study was designed to: (1) describe clinician (nurse practitioner and physician assistant) reactions to CompuHx in the consulting room, (2) explore the individual and organizational variables influencing those reactions, and (3) determine whether clinicians who report more stress from uncertainty in patient care have more positive reactions toward a system designed to ensure thoroughness and assist in reaching a diagnosis [51]. Social network analysis was then used to examine the effects of the use of the system on clinician communication patterns. From the patient's perspective, satisfaction of patients whose clinicians use CompuHx was compared to satisfaction of patients whose clinicians do not use the computer during consultations.

The research was designed as a case study of the experience of a single organization [52,53,54,55]. Such case studies rely on analytical rather than statistical generalization [55], that is, they generalize from the experience of the individuals in one organization to broader explanations about why similar change experiences might be expected in other organizations. This is also one of the few systematic studies to include an in-depth examination of the issues and concerns of clinicians and patients alike, using both quantitative and qualitative methodologies [53,56,57]. This multimethod approach can lead to insights beyond those possible with a single approach and help researchers explore some of the reasons for the mixed success of computer projects documented in numerous clinical settings.

The Health Appraisal Setting

The Kaiser-Permanente Medical Care Program provides a detailed complete history and physical examination to 50000 members per year in the San Diego Department of Preventive Medicine. The majority of these patients are the "worried well," patients whose care does not require the traditional, costly, sickness-care portion of the organization [58]. Despite this fact, however, personal interactions with the clinician are an essential part of the health appraisal process for these patients. Interviews with 53 patients indicated that, while about 20% came simply because they wanted

(or were required by their employer to have) an annual physical examination, 15% were referred by Primary Care because of specific symptoms or for baseline information, and approximately 60% came with specific symptoms, concerns, or fears to discuss, some of which resulted in a diagnosis or referral to an appropriate physician [59].

A complete medical evaluation is a two stage process with visits two weeks apart. Prior to the first visit, a medical history questionnaire is completed by the patient and mailed in. The first visit consists predominantly of a series of laboratory and other tests (e.g., mammography). During the second visit a nurse practitioner or physician assistant ("examiner") takes the patient history ("yes" answers on the mailed questionnaire define the areas of focus for the history), conducts a complete physical exam, and reviews lab results with the patient. There is a supervisory internist for each six examiners, making it possible to provide a conclusive categorization of each patient as well, ill, or at risk, and make the appropriate referrals [58].

CompuHx in the Consulting Room

CompuHx is designed to record patient information, assist in information gathering for a diagnosis if appropriate, and provide a legible summary of findings. CompuHx enforces thoroughness by (1) addressing all information contained in the original patient questionnaire, (2) ensuring that all information necessary for diagnosis (if applicable) has been obtained, and (3) recording, storing, and reproducing the information in a legible, structured, and easily accessible medium. CompuHx is intended to ensure the performance of the examiners and the quality of patient care.

Two categories of information are initially stored in the data base: patient history (based on the questionnaire completed by the patient prior to the visit) and laboratory values. Stored in the consulting room computer are almost 100 screens, each specific to a question in the medical history. When queried by the examiner, the program displays screens specific to questions answered affirmatively (or left unanswered) on the patient questionnaire. Following the patient history screens is a series of 20 screens to be used in similar fashion during the actual physical examination. At the end of the physical exam, the computer displays a list of all findings and diagnoses. The examiner eliminates findings that have been subsumed, prioritizes the diagnoses, relates a condition to a referral if necessary, and "ties" medications to a condition if prescribed. When complete, all information is sent back to the database and a written summary of the patient history and medical examination is generated along with a "to do" list. A summary letter to the patient discussing the implications of findings was in alpha testing at the time of the study. A new windows version of the program will facilitate products, such as the summary letter, which can be assembled in less than one minute to be sent to patients.

System Implementation

Five of the 22 examiners are CompuHx system users, with four actively using the system at the time of the study. System development and implementation began with one computer installed in one consulting room and was expanded to include one additional computer and examiner within the year, followed by two additional computers and examiners. Since examiners always see their patients in the same consulting room, the number of system users was effectively limited by the number of consulting rooms furnished with computers. The Director of the Department of Preventive Medicine asked for a volunteer to learn the system each time a new computer was to be installed. Once an examiner learned to use the system he or she used it with all patients.

Study Methodology

Examiner Surveys

The study began with a comprehensive survey completed by all 22 nurse practitioners and physician assistants (100% response) in the Department of Preventive Medicine [60]. The survey was distributed with a letter explaining that all responses were confidential and would not be available to anyone in the organization. To ensure confidentiality, completed surveys were mailed directly to an investigator not affiliated with Kaiser-Permanente.

Because research has shown that prior expectations concerning a system are important in understanding later reactions to it (e.g., expectations confirmed, disillusionment, etc.), the survey gathered baseline information from *all* examiners, system users and nonusers alike [61]. Respondents were instructed to answer *either* from their *experience* with the system (users) *or* their *expectations* about what using the system would be like (nonusers). Statistical analyses (*t*-tests) examined differences between responses of users and nonusers.

Independent variables included in the survey were basic demographic information, previous computer experience, personal attitudes about the desirability of computer applications in medical care [20], and reactions to uncertainty in patient care [51]. Dependent variables included expectations or opinions about the accuracy, format, and ease of use of the system [62]; and the impact of CompuHx on numerous aspects of individual job performance and the performance of the department as a whole [63,64,65].

Interviews

Following completion of the surveys, 10–20-min interviews were conducted with 11 of the 22 examiners, including 3 of the 5 system users and 8 nonusers.

The interviewer was not affiliated with Kaiser-Permanente and respondents were assured that their responses were confidential. Interviews were conducted at Health Appraisal on two separate days. The number of interviews was limited by the number of examiners working each day (some work part time) and their ability to make time for the interviews in their schedules (several were seen during their lunch breaks).

Examiners were asked what they knew about the system and how they had acquired the information, their opinions about CompuHx, learning to use the system, impacts on their job, the implementation process, interactions with patients and other clinicians, and other opinions they wished to share. The interview notes were analyzed using established qualitative procedures in which the interviewer codes the major issues or themes mentioned by each examiner [66,67]. Based on these identified themes, the researchers then examined the content of the interviews for explanations of what was going on in the setting.

Social Network Analysis

As part of the survey, examiners were also provided with a list of all nurse practitioners and physician assistants, doctors, and others (e.g., data processing clerks, chart room clerks, health assistants, radiology department, laboratory, etc.) [68]. They were asked to indicate the frequency with which they communicated with each person or occupational group as part of their jobs. The frequency was coded as follows: 0 = never have a contact; 1 = once a month; 2 = several times a month; 3 = once a week; 4 = several times a week; 5 = once a day; 6 = several times a day.

Social network analysis was used to study the pattern of relations among individuals and departments [69]. The following indices were created:

1. The average frequency of communication with other Department of Medicine staff initiated by nurse practitioners (NPs) and physician assistants (PAs) who use CompuHx.
2. The average frequency of communication with other Department of Medicine staff initiated by NPs and PAs who do not use CompuHx.
3. The average frequency of communication of CompuHx users with physicians on the service.
4. The average frequency of communication of nonusers with physicians on the service.
5. The average frequency of communication of CompuHx users with other departments.
6. The average frequency of communication of nonusers with other departments.
7. The density of communications (proportion of the total possible communication ties among and between groups of examiners) among NPs and PAs who use CompuHx.

8. The density of communication of CompuHx users with the other NPs and PAs who do not use the system; the medical director, other physicians in the department; and staff of other departments.

Patient Surveys

During Fall 1994, a convenience sample of 800 Health Appraisal patients were asked by examiners to complete a survey evaluating their experience at the Health Appraisal clinic. A total of 428 patients completed surveys for a response rate of 54%. Respondents included 195 patients whose examiners did *not* use the CompuHx computer program and 233 patients whose examiners used CompuHx during the history and physical exam [70].

Survey design was based on past research indicating that patient satisfaction is related to the affective quality of the clinician's manner, the amount of information conveyed, and the clinician's technical and interpersonal skill [71]. Of particular value to patients are interpersonal skills of the clinician. The scales included on the survey are described below. With the exception of the "global satisfaction with health appraisal scale," all of the scales were adapted for the health appraisal setting from scales with already established reliability and validity. Adaptations were necessary to change terminology (e.g., "examiner" instead of "doctor") and delete items not applicable to the health appraisal setting, for example, items such as "after talking with the doctor, I know just how serious my illness is" were eliminated from the scale [72, p. 396]. Thus, while results are not directly comparable to studies using the source instruments, the research benefited from being able to adapt items and scales with established validity in patient encounters. The reported reliabilities for each scale in the present study (Cronbach's alpha measuring internal consistency) were computed from the survey data.

Global satisfaction with health appraisal: 6-item scale developed for this project measuring different aspects of the patient's experience at Health Appraisal, e.g., "I am satisfied with the physical examination (second half)" (Cronbach's alpha = 0.92).

Cognitive: 6-item scale measuring perceptions of the examiner's explanations and information and the patient's understanding of and confidence in the findings of the exam, e.g., "the examiner is good at explaining the reasons for medical tests," "the examiner answered all of my questions" (Cronbach's alpha = 0.96) [72].

Affective: 7-item scale measuring perceptions of the treatment relationship, the examiner's positive regard for the patient and willingness to listen to his/her concerns, e.g., "the examiner gave me a chance to really say what was on my mind," "I really felt understood by the examiner" (Cronbach's alpha = 0.98) [72].

Behavior: 4-item scale measuring perceptions of the thoroughness of the examination and confidence in the examiner, e.g., "the examiner gave me

a thorough examination," "the examiner looked into all the problems I mentioned," (Cronbach's alpha = 0.97) [72].

Acceptance of advice: 5-item scale measuring patient's willingness to accept the examiner's advice, e.g., "I will follow the advice of the examiner completely" (Cronbach's alpha = 0.90) [73].

Computer in exam room: 3-item scale measuring the patient's attitude toward the use of the computer by the examiner—answered by CompuHx group only, e.g., "I think the computer helps the examiner take care of me" (Cronbach's alpha = 0.84) [47].

Responses to the scales, as well as to selected single items (e.g., personal computer use by patients), were analyzed for the total sample and for the CompuHx and non-CompuHx patients separately.

Findings

Examiner Demographic Data

Survey responses indicated that the 22 examiners included 7 nurse practitioners, 14 physician assistants and one examiner who had both credentials. They had a mean of 8.7 years healthcare experience (range = 1–18 years) and had worked in the department a mean of 4.4 years (range = 4 months–14 years). Fourteen (64%) were female and 8 (36%) were male.

Thirteen examiners (59%) had no previous computer experience while 9 (41%) had experience with word processing or other computer applications. Three of the five CompuHx users (60%) had previous computer experience, compared to six of the 17 (35%) nonusers. Four of the five CompuHx users (80%) were male. CompuHx users had volunteered to use the system and the demographic data indicate that male examiners and those with previous computer experience were more likely to volunteer. (In fact, the one woman who had used the system indicated that, while she was willing, she had initially been asked to use the system by the Director. At the time of the study, she had just returned from a leave and was not using the system.) The system had been implemented gradually over a two-year period and examiner experience with the system ranged from 1 month to two years at the time of the study.

Examiner Attitudes Toward CompuHx

Findings showed no significant differences in attitudes toward CompuHx between system users and nonusers. Respondents' ratings of the CompuHx system itself are shown in Table 10.1. The system received higher ratings for content, accuracy and format, but was rated as "easy to use" only "almost half the time." (Cronbach's coefficient alpha, a measure of internal consistency, is shown for scales composed of multiple questions.) The sample sizes are small (users = 5, nonusers = 17), but power analysis for a 5% level two-

Table 10.1. Ratings of CompuHx system.

Scoring: 1 = almost never, 3 = almost half the time, 5 = almost always						
	Users (n = 5)		Nonusers (n = 17)		Total (n = 22)	
	Mean	SD	Mean	SD	Mean	SD
Content	3.8	0.45	3.7	0.70	3.8	0.64
Accuracy (alpha = 0.90)	3.9	0.22	3.8	0.67	3.8	0.58
Format (alpha = 0.89)	3.8	0.27	3.6	0.88	3.7	0.77
Ease of use (alpha = 0.85)	3.0	0.71	3.3	0.87	3.2	0.82

sided two-group t-test of equal means with these n's indicates 80% power to detect a difference in means of approximately 1.0 (using a standard deviation of 0.7). A 95% confidence interval for the difference in means between the two groups will be approximately ±0.7 (assuming the within group standard deviation is about 0.7). These calculations apply to the items in Tables 10.1 and 10.2 with standard deviations of approximately 0.7. Power analysis for a standard deviation of 1.4 (e.g., some items in Table 10.2 as well as the data in Table 10.4), indicates 80% power to detect a difference in means of approximately 2.0. For the data in Table 10.5, with standard deviations of approximately 2.9, we have 80% power to detect a difference of approximately 4.0. Computations were done using nQuery Advisor based on formulas using the central and noncentral t distribution. (See www.statsol.ie/mtt0u.htm for a validation document and complete references.)

Impacts on Job Performance

Respondents rated potential impacts on job performance (see Table 10.2). Again, there were no significant differences between users and nonusers. Findings showed both groups were uncertain about positive effects on their job performance, but agreed that (1) their performance will be monitored more, (2) top management sees the system as important, (3) external relationships with departments such as primary care (who receive records of health appraisal exams) will improve, and (4) the system is a good teaching tool for new grads. The differences between users and nonusers on the adequacy of training and whether CompuHx would make their jobs more stressful were not statistically significant. Finally, both groups "slightly agreed" that the system would increase the ease and quality of their work and would be worth the time and effort to use it.

Predictors of Attitudes Toward CompuHx

Individual characteristics did not predict attitudes toward CompuHx. t-tests showed no differences between the attitudes of male and female

Table 10.2. Impacts on job performance.

	Users ($n = 5$)		Nonusers ($n = 17$)		Total ($n = 22$)	
	Mean	SD	Mean	SD	Mean	SD
Scoring: 1 = strongly disagree, 3 = uncertain, 5 = strongly agree						
Positive effects on job performance (alpha = 0.89)	3.3	0.45	3.1	0.62	3.2	0.58
Performance monitored more	4.0	0.71	3.8	0.75	3.8	0.73
Top management sees system important	3.6	0.55	3.9	0.66	3.9	0.64
Training sufficient/adequate (alpha = 0.63)	3.1	0.74	3.9	0.63	3.7	0.72
Improves external communication/relationships (alpha = 0.85)	3.4	1.24	3.6	0.57	3.6	0.74
Good teaching tool for new grads	3.4	0.89	3.7	1.26	3.6	1.18
Scoring: 1 = negative, 4 = neutral, 7 = positive[a]						
Makes job easier/interesting/fun/pleasant[a] (alpha = 0.89)	3.8	1.79	3.7	1.37	3.7	1.43
Makes job more stressful[a]	3.8	1.79	4.4	1.27	4.2	1.38
Scoring: 1 = strongly disagree, 4 = uncertain, 7 = strongly agree						
Increase overall ease/quality of department work (alpha = 0.89)	4.4	1.24	4.6	1.17	4.5	1.16
System worth the time and effort required to use	4.8	1.30	4.6	1.23	4.6	1.22

[a] Scoring: 1 = more difficult, 7 = easier; 1 = more interesting, 7 = less interesting; 1 = less stressful, 7 = more stressful; 1 = more fun, 7 = less fun; 1 = more pleasant, 7 = less pleasant. Reverse items recoded so that 1 indicates most negative response and 7 indicates most positive response.

Table 10.3. Correlation of computer impact on clinician role with selected impacts on job performance ($n = 22$).

	Diminish clinician role
Positive effects on job performance	$r = -0.63$[a]
Makes job easier/interesting/fun/pleasant	$r = -0.75$[a]
Increase overall ease/quality of department's work	$r = -0.61$[a]
System worth the time and effort required to use it	$r = -0.73$[a]

[a] $p < 0.05$ using Bonferroni adjustment for multiple tests.

examiners for survey items and scales (e.g., "system worth the time and effort required to use it", mean for males = 4.63, females = 4.64, t (11.2) = 0.03, $p = 0.98$). There was also no correlation between items such as "system worth the time and effort required to use it" and age ($r = 0.06$, $p = 0.79$), work experience ($r = -0.09$, $p = 0.68$), or prior computer experience ($r = -0.09$, $p = 0.70$).

As would be expected, opinions about the impact of computers in general on the role of the clinician were correlated with attitudes toward CompuHx as a specific system. There were significant correlations between the scale "computers diminish clinician role" (scale includes 5 items: be hard to learn, diminish clinician judgment, be a less efficient use of clinician time, depersonalize practice, and alienate clinicians from their patients, Cronbach's alpha = 0.89) and negative attitudes toward CompuHx. Table 10.3 shows findings for users and nonusers combined, with similar correlations for different aspects of attitudes toward CompuHx. Figure 10.1 illustrates the correlation between the general computer attitude scale and the item "system worth the time and effort required to use it." Responses of users and nonusers are differentiated on the graph. Only two nonusers gave the system negative ratings ("system worth the time and effort required to use it"), both of whom also felt that computers would diminish the clinician's role. Three users and 7 nonusers were uncertain, while 2 users and 8 nonusers gave CompuHx positive ratings.

Uncertainty in Patient Care and CompuHx

Respondents also answered 13 questions designed to measure reactions to uncertainty in patient care (alpha = 0.89). Higher scores indicate greater stress. While Stress from Uncertainty did not correlate with attitudes toward the system, CompuHx users did show less stress from uncertainty in clinical practice (mean 2.37) than did nonusers (mean 3.21), $t = 3.57$, $p < 0.003$. The 95% confidence intervals were (2.02, 2.72) for users and (2.80, 3.62) for nonusers. It is unclear, however, whether those with greater tolerance for uncertainty volunteered to be the first users or whether using the system contributed to their higher tolerance for uncertainty. In other research, both males and physicians in practice longer have shown less stress from uncer-

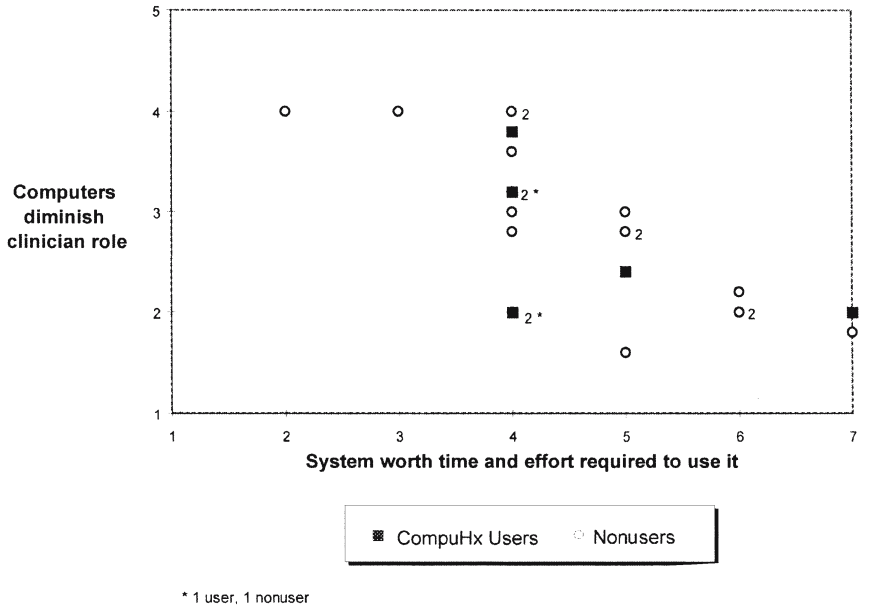

Figure 10.1. Relationship between responses to: "Computers diminish clinician role" and "System worth time and effort required to use it."

tainty. There were, however, no significant gender or time differences in the present study, although, understandably, examiners in the preventive medicine setting showed less stress than do physicians in other settings [51,74].

Interview Findings

Of the 11 examiners interviewed, 3 were already using the system and 7 of the 8 nonusers interviewed stated that they were willing to do so. The system was being implemented 1 or 2 examiners at a time and some of the respondents had already volunteered to be included in the future. Coding of the interview findings indicated that respondent attitudes toward the system clustered around four themes: (1) quality control, (2) depersonalization of patient care, (3) time concerns, and (4) the implementation process.

Thoroughness and Quality Control

One of the specific purposes of the system was to enforce thoroughness in history taking and the physical exam. Thoroughness emerged as one of the themes mentioned by respondents as well, although it was mentioned less frequently (by 5 of 11 respondents) than the other three themes. Four respondents (1 user and 3 nonusers) were concerned, however, that the program might not allow enough space for open-ended responses or direct patient quotations.

Depersonalization of Patient Care

Ten of the 11 examiners interviewed brought up the potential for depersonalizing patient care when the examiner's attention is focused on a computer terminal or keyboard and not on the patient. As one respondent noted, this is a "psychological and social visit" for these patients. "They come for the time and attention." While the CompuHx users did not feel that it was a problem, they did mention making a concerted effort (especially when they were first learning the system) to maintain eye contact with patients. One user noted that it was too disruptive to use the computer while conducting the physical exam. Rather, he enters the data into the computer after the patient leaves. A nonuser described mastering the computer system and continuing to meet patients' needs at the same time as an "art" that would have to be learned. Both users and nonusers also thought that patients might be pleased with the thoroughness of the computerized exam, feeling they get more time and attention from the examiner.

Time

Time was a third recurring theme, mentioned by 9 of the 11 examiners interviewed. Both users and nonusers noted that, at the time of study, examinations using CompuHx took more time and had an impact on examiner productivity. The additional time was attributed to the program's thoroughness. Two nonusers, however, also hoped the computer system might help them speed up their history taking.

Implementation Process

The fourth area of concern was the implementation process, mentioned by 8 of the 11 respondents, including the 3 users interviewed. Because implementation was intertwined with continuing system development and modification, all histories completed using CompuHx were reviewed in detail by the Director of Preventive Medicine, who sponsored and guided the development of the system. The Director also reviewed the performance of the examiner using CompuHx, with the process resulting in considerable time required of the examiner to correct or modify the final report for each patient based upon the Director's review. Each examiner learning to use the system actually became something of an apprentice to the Director, altering their working relationship, at least for a time. Several nonusers did not want to use the system until all modifications were complete, not wanting to spend the time editing reports or, as voiced by one respondent, subject themselves to the close scrutiny of the department Director.

Social Network Analysis of Practice Patterns

The survey and interview information was supplemented by analysis of the communication patterns of CompuHx users and nonusers. Only four exam-

iners were classified as users of CompuHx for this analysis since one user stopped using the system when she took maternity leave and was not using the system at the time of the study. Table 10.4 shows the average reported frequency of communications for users and nonusers of CompuHx with other examiners and physicians in the department. System users reported that they communicated several times a week with one another; while they communicated with NPs and PAs who do not use the system only once or twice a month on average. In comparison, examiners who do not use the system with patients reported communicating with users and nonusers of the system with about the same frequency, several times a month on average.

t-tests indicated that differences between users and nonusers in the frequency with which they communicate with physicians in the department were not statistically significant. NPs and PAs who use the system reported communicating with the medical director almost daily. Interview findings indicate that this communication likely resulted from the requirement that he review each history completed using CompuHx, although it is also possible that examiners who already had more frequent communication with the director were also more likely to volunteer to become system users. Nonusers reported communicating with him only about once a week.

Table 10.5 shows the frequency of communication with other department staff. NPs and PAs who use CompuHx communicate with staff in data processing several times a week on average. This difference was expected since data processing prepares data from the patient questionnaire and laboratory tests for examiners. Nonusers rarely communicate with the data processing department. *t*-tests showed no statistically significant differences between users and nonusers in communication with other departments.

Figure 10.2 illustrates the differences in the communication patterns of users and nonusers of the CompuHx system. Densities of communication within and between subgroups are shown. System users have higher densities of communication with one another than do examiners who do not use the system. System users also have more communication with nonusers and

Table 10.4. Average frequency of communication for users and nonusers of CompuHx with other examiners and physicians.

Communication with	Users ($n = 5$)	Nonusers ($n = 17$)
CompuHx-users	4.15	1.52[a]
Non-CompuHx-users	2.10	1.61
Medical director	4.50	3.00
Other physicians	2.60	1.99

[a] $p < 0.001$. Scoring: 0 = never have contact, 1 = once a month, 2 = several times a month, 3 = once a week, 4 = several times a week, 5 = once a day, 6 = several times a day.

Table 10.5. Average frequency of communication for users and nonusers of CompuHx with other department staff.

Communication with	Users ($n = 5$)	Nonusers ($n = 17$)
Data processing	4.00	0.22[a]
Service representatives	3.25	3.33
Chart room	3.00	2.83
Radiology	0.50	0.72
Laboratory	0.50	0.61
Others	2.02	1.00

[a] $p < 0.01$. Scoring: 0 = never have contact, 1 = once a month, 2 = several times a month, 3 = once a week, 4 = several times a week, 5 = once a day, 6 = several times a day.

with the medical director, medical staff, and other departments than do nonusers of CompuHx.

Patient Demographic Data

Demographic data indicated patient gender to be the only difference between the CompuHx and non-CompuHx groups. There was a significantly larger proportion of males in the CompuHx group (see Table 10.6). Approximately 50% of both male and female patients used computers at home or in the office. Computer users were younger (mean 49.2 years, standard deviation 13.6) than patients who did not use computers (mean 62.5 years, standard deviation 13.4), $t = 9.92$, $p = 0.0001$.

Impacts of CompuHx

There were no significant differences (two-tailed *t*-tests) in any of the satisfaction scales or items between patients whose examiners used CompuHx and those whose examiners did not (see Table 10.7).

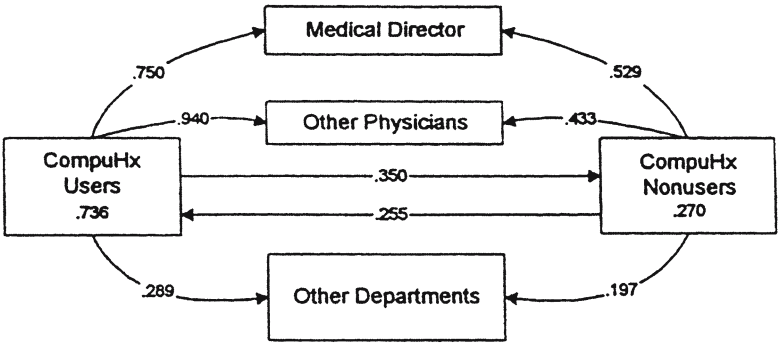

Figure 10.2. Network density of CompuHx users and nonusers.

Table 10.6. Selected demographic characteristics.

		Exams with		Exams without
		Total sample ($n = 427$)	CompuHx ($n = 233$)	CompuHx ($n = 194$)
Mean age		56.3 yrs	57.5 yrs	54.8 yrs
Gender	Male	52.1%	60.4%	42.3%
	Female	47.9%	39.6%	57.7%
	Chi-square (1, $n = 424$) = 13.92, $p < 0.001$			
Uses a computer at home or work				
	No	52.1%	54.6%	49.2%
	Yes	47.9%	45.4%	50.8%

In addition, *CompuHx patients* "agreed" with the positive statements in the "Use of Computer in the Exam Room" scale (mean 3.95, standard deviation 0.93). They also "agreed" with the statement, "If given a choice, I would choose an examiner who uses a computer" (mean 3.83, standard deviation 1.15). They "disagreed" with the statement, "The examiner seemed to have trouble using the computer" (mean 1.74, standard deviation 1.26). There were *no* significant differences in patient satisfaction with different examiners for those surveys where examiner codes were available. (Examiners were concerned about being identified and requested removal of examiner codes from the surveys early in the data collection process. Since examiners using CompuHx had begun data collection first, examiner codes were recorded for the first 123 CompuHx patients only and for no non-CompuHx patients.)

Table 10.7. Comparison of patient satisfaction with exams conducted with and without CompuHx.

	Total sample		Examinations with CompuHx		Exams without CompuHx	
	Mean ($n = 427$)	SD	Mean ($n = 233$)	SD	Mean ($n = 194$)	SD
Global satisfaction scale	4.43	0.77	4.43	0.73	4.43	0.81
Cognitive scale	4.56	0.77	4.52	0.76	4.60	0.79
Affective scale	4.55	0.79	4.51	0.76	4.60	0.81
Behavior scale	4.54	0.84	4.51	0.82	4.59	0.88
Acceptance of advice scale	4.39	0.75	4.32	0.77	4.47	0.73
Examiner focused on chart or computer (1 item)	3.63	1.39	3.69	1.30	3.57	1.49
Examiner seemed rushed (1 item)	1.81	1.26	1.76	1.17	1.87	1.38

Scoring: 1 = strongly disagree, 3 = neutral, 5 = strongly agree.

Overall, there were weak, but statistically significant, correlations for both the global ($r = 0.17$, $p < 0.001$) and affective ($r = 0.21$, $p < 0.001$) satisfaction scales with age, that is, older patients were more satisfied as measured by these two scales. This finding is supported by literature that indicates that older patients tend to express higher satisfaction with quality of care [71].

Gender differences were also examined since there were more males in the CompuHx response group (possibly because all of the CompuHx examiners were male and patients sometimes request same gender examiners). Findings showed that, in both groups, female patients were slightly more satisfied with examiner behavior and said they were more likely to take the examiner's advice. Two-way ANOVA statistics, however, showed no CompuHx effect and no interaction between gender and the CompuHx/non-CompuHx category. Regression analyses with patient age, gender, and then the CompuHx/non-CompuHx category entered as predictors of global satisfaction indicated that only age predicted patient satisfaction, $F(3, 390) = 3.76$, $p = 0.01$.

In all groups, *patients who used computers* themselves were less satisfied with various aspects of Health Appraisal (e.g., global satisfaction for computer users mean 4.31, standard deviation 0.77, nonusers mean 4.52, standard deviation 0.77), $t = 2.64$, $p < 0.01$. This finding, however, many simply reflect patient age, rather than computer use, as a predictor of satisfaction. Patients who use computers were younger than patients who do not, and younger patients in this study and in the literature are less satisfied.

Study Limitations

Patients were not randomly assigned to CompuHx and non-CompuHx groups. Findings are based on a sample of patients who agreed to complete the survey and are not representative of all Health Appraisal patients. No data were collected on patients who did not complete the survey. Patients who did not speak English or who were confused or otherwise unable to comprehend the survey were not asked. Also, patients with less positive health outcomes or experience with the health appraisal process may not have completed surveys. The method was the same, however, for both the CompuHx and non-CompuHx patients and there should be no systematic difference between the groups that would bias the finding that patients in both groups were equally satisfied.

This was a case study of a single organization with 22 clinicians, 5 of whom had used the computer system. As with all case studies, comparisons with other reported research will be limited by any differences in the research design of the studies. Furthermore, the findings for nurse practitioners and physician assistants are not generalizable to physicians, although their daily work patterns in the consulting room are similar to those of physicians in ambulatory care and a number of parallels are pointed out in the discus-

sion below. The depth of the case study approach, however, provides details on the implementation experience that have been lacking in previous research. While the sample size is small, 100% of the 22 examiners responded to the survey and half of them were interviewed, including users and nonusers and individuals with a variety of views. Researchers designing future comparative studies on CompuHx or similar systems can enhance the generalizability of the findings by replicating appropriate aspects of the methodology used in the present research [53,55].

Discussion

Examiners

While this research focuses on nurse practitioners and physician assistants in one organization, study findings provide clear examples of possible factors behind the mixed success of healthcare computer systems. While the specific experiences of the examiners in this study are unique, comparing those experiences to others documented in the literature allows us to suggest aspects that may be generalizable to other organizations.

Does the System Make Practice Easier?

Findings from this study reinforce the view that, while clinicians are willing to use systems that will enhance their practice, to date most systems do not make practice easier [17]. The clinicians in this study were willing to use the system, but 10 of the 22 examiners were also uncertain as to whether it was "worth the time and effort required to use it" (see Figure 10.1). While they saw benefits (e.g., enforcing thoroughness), interview respondents also talked about the effort required to learn the system while still interacting appropriately with the patient. Results are also congruent with research in the United Kingdom on computer use by physicians in the consulting room and with one recent preimplementation study in the United States. Both highlight concerns over the time required to gather more explicit data and possible depersonalization of the patient encounter [7,10,25,47]. These findings also reinforce the need for an implementation plan that allows clinicians enough time and training to become comfortable with the system.

It is also important to note that age and previous computer experience did not predict attitudes toward the system as some have suggested. In fact, several interviewees noted that they had worked in Health Appraisal for many years and had no knowledge of computers, but felt the system could be valuable and were willing to learn. One of the younger examiners, on the other hand, was completely opposed to using the system. Examiners' attitudes toward the impacts of computers in general on the role of the clinician were significantly correlated with their attitudes toward this specific computer system.

The study also included a preliminary exploration of the relationship between a system that enforces thoroughness and aids in gathering information for a diagnosis and the stress clinicians may feel from the uncertainty inherent in patient care. While these cross-sectional data could not address issues of causality, the findings suggest that further research should focus on whether this type of system might contribute to higher tolerance for uncertainty on the part of clinicians.

Role of the System Champion

While computer professionals have pointed out the importance of a leader or champion in system implementation [15], the role of the champion and its implications will differ from setting to setting. In the organization under study, the champion was also the medical director of the organization, and examiner concerns that their performance would be monitored were reflected in both their survey responses and the request to remove examiner codes from the patient surveys. The issue of performance monitoring became particularly salient since the implementation process included a direct evaluation of each CompuHx user's work by the director. His evaluation went beyond system use to examine their overall skills in health appraisal, which he felt also improved as they learned the system. Respondent comments in the interviews indicated that this process was both beneficial and threatening. Comments of several examiners not yet using the system, however, indicated that many practicing health professionals may not welcome becoming students or apprentices again.

Increased Visibility of Clinician Practice

The issue of increased visibility of clinician practice has also begun to emerge in recent ethnographic studies of system implementation. Even in instances when there is no director scrutinizing practice, clinicians are conscious of the increased visibility of their work and may adjust their practice in response. Aydin and Forsythe [25], for example, observed physicians spending time composing longer clinical notes after implementation of a dictation system through which the notes were made available in the electronic medical record. Kaplan [75] focused on imaging systems and clinicians' perceptions of the benefits of making images public by including them in the patient record. In each of these diverse settings, the decisions made by clinicians in their practice are more "public" or visible to others, and consequently also more open to scrutiny.

Clinician Communication Patterns

Communication among clinicians and others can both influence decisions on whether to use a new system, as conversations with colleagues convince individuals that a system might be valuable in their practice; and also help

individuals adapt or modify a system to better meet their needs (i.e., the concept of reinvention) [76]. In this study, social network analysis indicated that nurse practitioners and physician assistants who used the system reported that they communicated more frequently with one another as well as with other staff who could assist them in performing their professional duties than did nonusers. This frequent communication can also influence consultation patterns within the organization, with potential benefits for patient care. As expected, users' interactions with the medical director of the department, who was a leader in the development of the system and acted as an important source of information and support for the users, were more frequent than those of nonusers. In addition, NPs and PAs who used the system communicated more frequently throughout Preventive Medicine in carrying out their work. While cross-sectional data does not establish causality, the examiners' own descriptions of their interactions (interview data) support the hypothesis that new communication patterns accompanied the introduction of CompuHx in the organization.

These possible increases in communication may have important implications for the longer term quality and productivity of the department. Research in other healthcare settings has shown that communication and collaboration among caregivers are associated with better patient outcomes [77,78,79,80]. Furthermore, research outside of healthcare indicates that the more co-workers an individual communicates with about a new technology, the more productive he or she is likely to be using the system [81]. The study also illustrates the ways in which communication within social networks becomes an important resource to support system use. In fact, the "heart of the diffusion process is the modeling and imitation . . . of near-peers' experience" [76, p. 304]. New interactions may also arise as individuals learn to use the system and talk to others about it [61]. Managers can facilitate the formation of these networks by designating "superusers" (the user with the highest number of interactions with other users in this setting, for example, was the designated "superuser"), allowing time and encouraging employees to talk to each other about the system.

Patients

Findings showed no difference in patient satisfaction between CompuHx and non-CompuHx groups with *any aspect* of their Health Appraisal experience. The finding that computers in the consulting room did not result in lower affective or cognitive patient satisfaction indicates that clinician use of a computer during consultation did *not depersonalize* the encounter for the patients. The fact that scores on the behavior scale (measuring perceptions of the thoroughness of the exam and confidence in the examiner) also showed no differences, however, indicates that computer use by the clinician *did not enhance* patient satisfaction with their experience either. Furthermore, although CompuHx patients agreed that they would choose an

examiner who used a computer, their scores on this item were considerably lower than their highly positive ratings on the other scales. The computer was clearly less important to patients than the other aspects of their relationship with the clinician, with which they were highly satisfied.

Conclusion

In summary, study findings indicate that (1) patients have no problem with the use of a computer in the consulting room; and (2) examiners (NPs and PAs) are willing to use a system that they perceive as having benefits for patient care (e.g., enforcing thoroughness in the exam). For systems to be enthusiastically endorsed and used by clinicians, however, they will need to go beyond the mixed benefits of systems such as CompuHx to include features that clearly make practice easier (e.g., easy retrieval of information clinicians need). Physicians in hospitals, for example, are far more likely to use computers to retrieve laboratory results needed to make clinical decisions than to enter their own orders in the computer, which requires additional work on their part. Also essential is a detailed implementation plan that includes adequate time for training and communication with other users, and addresses issues such as the role of the system champion and any performance monitoring concerns. Implementation may also be hindered by the need to identify the monetary value of the cited benefits in light of the additional time initially required to conduct exams using the system, as well as required capital expenditures. Longitudinal research should examine potential changes in clinician tolerance for uncertainty, as well as the impacts of altered communication and consultation patterns, which have been shown to improve productivity in other settings. The project also highlights the importance of research that focuses not only on system outcomes, but also examines the implementation process and includes the necessary information to evaluate factors influencing clinician usage of the system.

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