

Patient Entries in the Electronic Medical Record: An Interactive Interview Used in Primary Care

Jonathan S. Wald, M.D., M.P.H.,¹ David Rind, M.D., M.S.,² Charles Safran, M.D., M.S.,²
Hollis Kowaloff, B.S.,² Rebecca Barker, and Warner V. Slack, M.D.^{1,2}
The Center for Clinical Computing and Departments of Psychiatry¹ and Medicine,²
Beth Israel Hospital and Harvard Medical School, Boston, MA 02115

We describe the development, implementation, and use of a computer-administered patient interview, the Health History Interview, by over 300 new patients in a primary care practice at Boston's Beth Israel Hospital. The interview has been well accepted by patients and rated positively by providers. It electronically captures clinical information directly from patients for use during their initial encounter with a provider. It facilitates aggregate analysis of clinical data for quality improvement efforts, such as aiming preventive medicine interventions at identified problem areas within the clinic. Expectations management has been an important task throughout the project. Increasing use of the interview beyond the 30-40% of new patients who have taken it will require greater communication with patients, greater convenience to patients and providers, and more evidence of the clinical, administrative, and research benefits of the technique. Most important, full implementation will require fundamental changes in physician practice habits and patterns of communication between patients and the health care system, as well as clearly demonstrated cost-benefit improvements through the use of these tools.

INTRODUCTION

The importance of patient-physician dialogue in obtaining a clinical history, making decisions, monitoring illness, and planning treatment continues to grow as medical knowledge and treatments advance. Yet changes in health care delivery systems are resulting in pressures to reduce visit frequency and length, to shift many clinical encounters to non-physicians, and to provide more complex medical care in the outpatient setting. New techniques to facilitate the exchange of information between patients and their providers are emerging. Reports of telephone calls as a substitute for face-to-face visits, patient-provider e-mail, and other interactive tools such as computer-administered patient interviews are increasing.

Computer-based interactive patient interviews were first investigated almost 30 years ago.¹ When developed and implemented with care, they offer the advantages of saving time and supplementing the oral interview through structured clinical data collection,^{2,3,4,5} automated summaries,^{6,7} greater reliability than human interviewers,^{6,8,9} and better collection of sensitive or embarrassing subject matter^{10,11,12,13} than occurs with human interviewers. With new handheld devices and telecommunications tools, interactive interviews are becoming more and more convenient. They are well-accepted by patients^{10,14,15} and improve the capture of clinical and other data for use in various aspects of patient care.^{16,17} They have not replaced the human interviewer or eliminated the need for a physician-generated encounter note,^{18,19} and most people who are familiar with these tools view the provider's role as strengthened by their use.

To gain experience with the routine use of a computer interview in a primary care setting, we developed and implemented a *Health History Interview* in a general medicine clinic for use by new patients. Prior to meeting their physician, patients sit at a computer terminal located in the clinic waiting room, where they take the interview. Questions are displayed one at a time.

The interview was designed to obtain a broad clinical snapshot of the patient in a reasonable period (30 minutes) by gathering and summarizing information relevant to the medical review of systems, psychiatric symptoms, preventive health, habits, and other areas. To minimize user fatigue and time requirements, we have not included *all* questions that might be asked in a comprehensive initial interview. Responses are stored as part of the electronic medical record and printed (or displayed) in summarized format for the physician and patient.

The interview was implemented in a large multidisciplinary academic general medicine practice at Boston's Beth Israel Hospital, where the

hospital-wide clinical information system developed by the Center for Clinical Computing (CCC) is heavily used in virtually all aspects of care. The interview is part of a mature electronic medical record that allows providers (both generalists and specialists) to record and retrieve patient information during or after a patient visit, to gain access to decision support, and to communicate with others who may be caring for the same patient.

METHODS

The interview content was developed by one of us (JSW) with help from many others, especially patients. The questions were derived from prior computerized histories done at our center, written checklists used in the clinic, and published history-taking forms. In some cases, standardized instruments were incorporated, such as the Alcohol Use Disorders Identification Test.²⁰

The interview consists of (1) a teaching section to familiarize users with the keyboard and interview commands, (2) a "sign-in" procedure to verify the patient's identity, (3) the clinical questions, and (4) a survey at the conclusion of the interview to measure patients' opinions and the reliability of the questions. The user is permitted to interrupt and resume the interview if necessary.

The interview was programmed using Converse,²¹ an application for creating and administering interactive interviews originally developed in 1978 and still in use today. The software translates user-defined screens into executable code that runs on the hospital's Data General minicomputer in a Meditech MUMPS environment. The interview is text-based with a command-line interface, and permits structured responses to questions (e.g., yes/no, multiple choice) as well as entry of free text. Responses are coded and stored in fields in a central clinical data repository. The software uses programmable branching logic to select the questions that should be presented to the user. The logical rules can incorporate any clinical information residing in the central database of the CCC system, as well as answers to previous questions. Converse performs contextual error-checking, displays help messages if invalid responses are made, and manages the interactive session with the patient. Additional programming was done

to make data storage and report generation more compatible with the electronic medical record. A report dictionary was constructed to translate coded responses into a written summary. The written summary could be displayed on the computer screen or printed.

An implementation plan was devised through meetings of the medical and administrative clinic staff. Patients scheduled for a new visit were informed in advance by telephone or letter that they would be asked to take an interview. Upon arrival at the reception desk they were directed to a terminal in the waiting room, asked to press the <Enter> key, and prompted to follow instructions shown on the screen.

Two printed summaries were generated when the interview was finished (or interrupted): one for the patient and one for the provider. Receptionists and health assistants had on-line options for checking the progress a patient was making towards completion of the interview, and were encouraged to avoid interrupting a session that was almost complete.

Use of the interview was monitored in detail. Scheduling information from the hospital's on-line scheduling system was obtained for part of the data analysis. Patients were offered an electronic satisfaction survey upon completion of the interview. Test-retest reliability data were obtained by re-displaying some of the clinical questions to patients after the survey. Providers were given a written survey and asked to record their opinions of the use of the interview in clinical practice.

RESULTS

Interview use and patient demographics

Over a nine-month period from July 1994 through March 1995, 316 interviews were started and 172 (55%) of those were completed. Patients were 66% female, were 17 to 88 years of age, and had a mean age of 37 years. On average, a completed interview took 27 minutes, required 207 responses (for a 7.8 second response time), and stored 268 data elements. Men were asked fewer questions (187 vs. 217 mean responses) and spent less time at the computer (25 minutes) than women (28 minutes). Mean response times were similar for men (7.9 seconds) and women (7.8 seconds).

Advancing age was associated with differences in keyboard experience, total interview time, interview teaching time, and response time (see Table 1). Comparing patients in the youngest and oldest age groups who completed interviews (<30 vs. ≥60 years), 42% of the older subjects had no keyboard experience, whereas 3% of the younger subjects had no keyboard experience. The mean total interview time was 25 minutes for the younger patients and 37 minutes for the older ones. The mean teaching time was doubled for older patients, and the average response time was almost 50% higher for older patients than for younger ones.

Table 1. Interview Performance, with Patients Grouped by Age

Age	N	Keyboard use (%)			Interview time (min)		
		None	Little	Lots	Total	Teach	RT*
<30	70	3	21	76	25	3	7
30-44	62	10	25	65	26	4	8
45-59	28	11	43	46	29	4	8
60+	12	42	25	33	37	7	10

*RT=Response Time (seconds/response)

Between 30% and 40% of patients seen for “new” visits during the 9-month observation period started an interview (inaccuracies in the scheduling system make exact determination of this percentage difficult). From anecdotal reports by the receptionists in the practice, it appears that some patients did not start the interview because they did not have time, or because they had difficulty reading English, had visual impairment, or had other handicaps (medical or psychiatric) that would make it difficult for them to read, understand, or respond to questions printed on paper or displayed on a screen.

Patient survey

The patients surveyed were positive about their interview experience; 96% felt their responses were important to their care and 97% felt their answers would be valuable to their provider. Most found the experience to be “interesting” (93%), with the length of the interview “about right” (81%). Sixty-five percent preferred a computer-administered interview, 3% preferred the use of paper and pencil, and 15% preferred having a person give the interview. Sixteen percent had no preference.

Question reproducibility was measured by randomly presenting previously seen questions at

the end of the interview (after the survey). Responses for 20 different questions were pooled for the analysis and yielded a *kappa* statistic of 0.71 ($p < 0.001$), indicating good reproducibility. The validity of the interview questions was measured indirectly in the provider survey, described below.

Provider survey

The provider survey was returned by 64% (18/28) of physicians (8/8 attending and 10/20 resident physicians) whose patients were interviewed. All felt that the interview summary added to the “quality or amount of clinically relevant information,” and 83% said they would “recommend that patients complete the interview before meeting [with me].” This is consistent with the providers’ preference for using the summary either before meeting with the patient (67%) or in the first few minutes of the visit (27%). One third felt that having the computer summary made it easier to discuss sensitive subjects with patients, and two thirds thought patients should receive their own copy of the summary.

The clinical questions thought to offer the most “added value” to providers in terms of quality or amount of information were psychiatric (100%), alternative care (93%), and medical review of systems (80%) items. Also highly rated by providers were questions about caffeine (77%), occupational exposures (67%), alcohol use (64%), and preventive health practices (60%). Physicians indicated that they would like to repeat, at least annually, the questions about psychiatric symptoms (73%), prevention (73%), alternative care (67%), occupational exposure (64%), and medical review of systems (63%).

Thirty-five percent of physicians felt there was no change in their visit length when using the computer summary, while the remainder felt it was lengthened (30%) or were unsure (35%). Twelve percent of providers felt that visit efficiency decreased, while the majority said it was not affected (50%) or they were unsure (38%).

Aggregate patient information

As a consequence of the electronic capture of clinical histories, aggregate information about new patients was available for individual clinical questions. For example, 13% of patients (16 females and 6 males) reported the risk of poten-

tially serious violence or injury to themselves in the previous 12 months. Sixteen percent (24 females and 9 males) reported suicidal thoughts. Forty-one percent of women reported that they did not do monthly breast self-exams, and 56% of men under age 50 did not regularly check their testicles for lumps.

DISCUSSION

The results of our study confirmed findings reported in many earlier studies about the acceptability to patients, the typical response times (8 seconds), good reproducibility, and the association of advanced age with slower performance. Our indirect indicators of content validity (survey results from providers) suggest that there was satisfaction with what was obtained in the computer interview versus the face-to-face encounter. False positive findings, which are more likely when a general instrument is used in an unselected population, were reported anecdotally by one provider.

The provider survey results showed strong endorsement of the interview for collecting clinically relevant information and a strong wish to repeat many of the questions yearly or more often. Providers indicated that in order to be useful, interviews should be complete, should be available at the start of a visit, should be printed on paper, and should include the areas listed above for new patients. Providers varied as to whether they repeated the interview questions during their own interviews. While the printed summary was a convenience to physicians during their meeting with patients, the on-line summary was used later to check certain responses or to review interview responses completed by the patient after the visit.

Aggregate data that become available because of computer interviews may identify medical or psychiatric conditions for screening or prevention. Educational efforts and follow-up interviews could be used to monitor whether the women who do not do breast exams, and the men who do not practice routine testicular exams, change their behavior.

Within our clinic, support staff continued to direct patients to use the Health History Interview even after a research assistant was no longer available. This reflects the commitment of the

practice to implementation and their perception of benefits to patients and providers. Once begun, continued interview use by patients is fairly inexpensive. However, a substantial effort was required for content development, customized programming, and "marketing" to physicians and administrative staff prior to initial use of the Health History Interview.

To increase the interview starting rate beyond 40% and the completion rate beyond 50%, we plan to use laptop computers. These would permit patients to continue an interview while waiting in the examining room, where typically 10-15 minutes are spent before a visit. A PC-based platform would also permit us to use character sets for languages that are common among our patients; for example, approximately 10% of them speak only Russian.

Well-designed health care information systems can maintain a patient record, report the results of diagnostic tests, and provide decision support for health care providers, improving the quality of patient care. Information systems must also provide, or link with, systems used by other employees of the health care organization for administrative, research, and fiscal tasks. While there is great emphasis (ideally) on the patient as a recipient of care, there has been little consideration of the patient as an end-user, despite the fact that patients have information needs that could be met by a computing system.

Interactive interviews that extend the use of health care information systems to patients can provide a link between provider-oriented and consumer-oriented systems. As patients interact directly with the terminal and the keyboard, the information system becomes a virtual meeting place for the clinical encounter, allowing for the interchange of information between the patient, provider, and information system.

Acknowledgments: Supported in part under a grant from the Center for Clinical Computing, Harvard Medical School, Boston; a grant from the Agency for Health Care Policy and Research (HS06288-03); and a cooperative agreement with the Agency for Health Care Policy and Research and the National Library of Medicine

(HS08749-01). The authors wish to thank Ms. Emily Boro for her superb editorial assistance.

REFERENCES

1. Slack WV, Hicks GP, Reed CE, Van Cura LJ. A computer-based medical-history system. *N Engl J Med* 1966; 274:194-198.
2. Maultsby MC, Jr., Slack WV. A computer-based psychiatry history system. *Arch Gen Psychiatry* 1971; 25:570-572.
3. Chun RW, Van Cura LJ, Spencer M, Slack WV. Computer interviewing of patients with epilepsy. *Epilepsia* 1976; 17:371-375.
4. Legler JD, Oates R. Patients' reactions to physician use of a computerized medical record system during clinical encounters. *J Fam Pract* 1993; 37:241-244.
5. Pecoraro RE, Inui TS, Chen MS, Plorde DK, Heller JL. Validity and reliability of a self-administered health history questionnaire. *Public Health Rep* 1979; 94:231-238.
6. Schuman SH, Curry HB, Braunstein ML, et al. A computer-administered interview on life events: improving patient- doctor communication. *J Fam Pract* 1975; 2:263-269.
7. Bingham P, Lilford RJ, Chard T. Strengths and weaknesses of direct patient interviewing by a microcomputer system in specialist gynaecological practice. *Eur J Obstet Gynecol Reprod Biol* 1984; 18:43-56.
8. Slack WV, Slack CW. Patient-computer dialogue. *N Engl J Med* 1972; 286:1304-1309.
9. Carr AC, Ghosh A, Ancill RJ. Can a computer take a psychiatric history?. *Psychol Med* 1983; 13:151-158.
10. Locke SE, Kowaloff HB, Hoff RG, et al. Computer-based interview for screening blood donors for risk of HIV transmission [see comments]. *JAMA* 1992; 268:1301-1305.
11. Lucas RW, Mullin PJ, Luna CB, McNroy DC. Psychiatrists and a computer as interrogators of patients with alcohol-related illnesses: a comparison. *Br J Psychiatry* 1977; 131:160-167.
12. Millstein SG, Irwin CE, Jr. Acceptability of computer-acquired sexual histories in adolescent girls. *J Pediatr* 1983; 103:815-819.
13. Slack WV, Leviton A, Bennett SE, Fleischmann KH, Lawrence RS. Relation between Age, Education, and Time to Respond to Questions in a Computer-Based Medical Interview. *Comput Biomed Res* 1988; 21:78-84.
14. Carr AC, Ghosh A. Response of phobic patients to direct computer assessment. *Br J Psychiatry* 1983; 142:60-65.
15. Quaak MJ, Westerman RF, Schouten JA, Hasman A, van Bommel JH. Patient appreciations of computerized medical interviews. *Med Inf (Lond)* 1986; 11:339-350.
16. Slack WV, Safran C, Kowaloff HB, Pearce J, Delbanco TL. Be Well!: A computer-based health care interview for hospital personnel. *Proc Annu Symp Comp Appl Med Care* 1993; 12-16.
17. Bana DS, Leviton A, Swidler C, Slack W, Graham JR. A computer-based headache interview: acceptance by patients and physicians. *Headache* 1980; 20:85-89.
18. Quaak MJ, Westerman RF, van Bommel JH. Comparisons between written and computerised patient histories. *Br Med J (Clin Res Ed)* 1987; 295:184-190.
19. Mathisen KS, Evans FJ, Meyers K. Evaluation of a computerized version of the Diagnostic Interview Schedule. *Hosp Community Psychiatry* 1987; 38:1311-1315.
20. Barry KL, Fleming MF. The Alcohol Use Disorders Identification Test (AUDIT) and the SMAST-13: predictive validity in a rural primary care sample. *Alcohol Alcohol* 1993; 28:33-42.
21. Bloom SM, White RJ, Beckley RF, Slack WV. Converse: a means to write, edit, administer, and summarize computer-based dialogue. *Comput Biomed Res* 1978; 11:167-175.