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# Better Health While You Wait: A Controlled Trial of a Computer-Based Intervention for Screening and Health Promotion in the Emergency Department

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*The primary investigator on the project, Karin Rhodes, MD, is an emergency physician currently supported by the Robert Wood Johnson Foundation as a first-year fellow in the Clinical Scholars Program at the University of Chicago.*

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**Study objective:** We evaluate a computer-based intervention for screening and health promotion in the emergency department and determine its effect on patient recall of health advice.

**Methods:** This controlled clinical trial, with alternating assignment of patients to a computer intervention (prevention group) or usual care, was conducted in a university hospital ED. The study group consisted of 542 adult patients with nonurgent conditions. The study intervention was a self-administered computer survey generating individualized health information. Outcome measures were (1) patient willingness to take a computerized health risk assessment, (2) disclosure of behavioral risk factors, (3) requests for health information, and (4) remembered health advice.

**Results:** Eighty-nine percent (470/542) of eligible patients participated. Ninety percent were black. Eighty-five percent (210/248) of patients in the prevention group disclosed 1 or more major behavioral risk factors including current smoking (79/248; 32%), untreated hypertension (28/248; 13%), problem drinking (46/248; 19%), use of street drugs (33/248; 13%), major depression (87/248; 35%), unsafe sexual behavior (84/248; 33%), and several other injury-prone behaviors. Ninety-five percent of patients in the prevention group requested health information. On follow-up at 1 week, 62% (133/216) of the prevention group patients compared with 27% (48/180) of the control subjects remembered receiving advice on what they could do to improve their health (relative risk 2.3, 95% confidence interval 1.77 to 3.01).

**Conclusion:** Using a self-administered computer-based health risk assessment, the majority of patients in our urban ED disclosed important health risks and requested information. They were more likely than a control group to remember receiving advice on what they could do to improve their health. Computer methodology may enable physicians to use patient waiting time for health promotion and to target at-risk patients for specific interventions.

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## INTRODUCTION

Two common problems in the emergency department are long waiting times and a failure to identify sensitive personal and public health risks. These stem from constraints on provider time. Could patient waiting time, commonly perceived as time wasted, be used as an opportunity for screening and health promotion? We hypothesized that we might be able to address these issues with the use of a self-administered computer-based program. A review of the literature indicates that patients find computer-based health risk appraisal acceptable and are more likely to answer sensitive questions truthfully on a computer.[1-5] However, there is limited experience with integrating interactive computer systems into clinical practice.[6] We developed such a system, Prevent HealthQuiz, and evaluated its utility for nonurgent patients waiting for care in an urban ED.

The ED may constitute an advantageous venue for reaching out to people with serious health risks. There are approximately 100 million ED patient visits per year in the United States. Many ED patients are without a regular source of care.[7-9] Beyond the need for linkage to primary care and community-based resources, there is evidence that preventive services may be acceptable to ED patients[10,11] and cost-effective, particularly for vulnerable populations.[12-14] Most ED patients have acute health care problems but are not critically ill. In the ED setting, these patients are assigned to nonurgent triage categories and often spend a significant amount of time waiting to be seen by the physician. Is this waiting time a potential "teachable moment"?

We wanted to determine whether ED patients were interested in health risk assessment and health promotion. Further, we were interested in its effect on patient recall of health advice. Finally, we sought to assess the practical utility of using patient waiting time for screening and health education in a manner that would not interfere with patient flow in a busy inner-city ED.

## MATERIALS AND METHODS

We conducted a controlled clinical trial of a computer-based health risk assessment in an inner-city university teaching hospital ED with approximately 38,000 adult visits per year, 40% of which are classified as nonurgent. Health care is provided by emergency medicine and internal medicine residents who are supervised by emergency medicine faculty members. Our study focused solely on patients assigned to nonurgent triage categories. We used a quasi-randomized design based on alternating assignment of patients to the intervention (prevention) and usual care (control) groups.

With previously validated questions that had been both clinically and computer tested,[15-18] we developed a computer-based assessment of health risks, targeting those that could be modified by behavioral or life-style changes. A pilot phase included cognitive interviewing[19] with a convenience sample of 141 nonurgent ED patients and patient relatives of varying ages and educational backgrounds to ensure content and construct validity. The final form of the prevention HealthQuiz has 145 questions at a fifth-grade reading level covering 8 categories of health-related behaviors and personal health. A complete interview contains answers to approximately 80 to 100 of these questions, because of skips based on age, sex, and previous answers. Twenty-three questions ask about demographic variables or access to care and 30 others either introduce topics or ask whether the patient would like information about a topic. Average response times are 15 minutes for men and 18 minutes for women, who are asked additional cancer and contraceptive-related questions.

After completing the questionnaire, patients receive individualized computer-generated health recommendations and any additional information requested during the questionnaire. For the treating physician, the computer program generates a 1-page summary with the patient's demographic information, major health risks, and referral information.

From July 1998 through January 1999, 4 part-time research assistants recruited eligible patients from the ED waiting room after triage and registration. Study periods were between 10 AM and 10 PM on a convenience selection of weekdays and weekends. Eligible patients were English-speaking adults whose condition at triage was nonurgent who had access to a telephone and agreed to a follow-up telephone interview. Patients were excluded if they were in pain, blind, overtly psychotic, or unable to read. Not all eligible patients were enrolled because of limited computer availability. To avoid selection bias, when the computer was available the patient to be recruited was the one who most recently arrived and assigned as nonurgent at triage. After a successful recruitment to the prevention group, the next most recently arrived patient was assigned to the

control group. Patients gave verbal consent to a scripted introduction that specified that the computer questionnaire asked questions about their health and lifestyle and told them this information would be shared with the treating physician during the current visit. Prevention patients used a touch screen computer and a Web-based questionnaire. This took place in a private setting attached to the ED waiting room. Friends and family were not allowed to be present. We interrupted the questionnaire if the patient was called to the treatment room. All patients were analyzed on the basis of the group in which they were enrolled, regardless of whether they completed the questionnaire. This study complied with the human subjects' protection requirements and was approved by the university's institutional review board.

Study data were collected and entered into an Excel database (Microsoft, Redmond, WA). The research assistants kept a record of all patients who were approached and any reasons for refusal. They noted if patients started but did not complete the computer questionnaire, any need for computer assistance, and recorded all patient comments. The research nurse monitored data collection and coding quality and was available to the research assistants for questions about study procedures. All patients received a follow-up telephone call approximately 1 week after their visit. The research assistant making the telephone call was blinded as to the patient's group assignment. If the patient was not contacted on the first attempt, repeat follow-up was attempted during each subsequent study session up to a maximum of 10 attempts. If necessary, messages were left and there was a number for the patient to call back during working hours.

To evaluate patient interest and risks, we assessed behavioral risk factors and numbers of requests for health information. This information was collected from the prevention group interview database. Information about the patients' reactions to the ED visit was collected during blinded follow-up telephone calls from both groups. The telephone interview asked about visit satisfaction, follow-up with appointments, suggestions for improvement of ED care, and whether patients remembered being given any advice regarding what they could do to improve their health.

We determined proportions of eligible patients willing to take a computer-based health risk assessment and the proportions assigned to the prevention group who completed the questionnaire. From the data entered by patients taking the computer questionnaire, we looked at the numbers and percentages of behavioral risks and requested health information. We also compared the proportions of each group remembering being given advice on what they could do to improve their health. $\chi^2$ Tests were used to compare the groups regarding remembered advice. The magnitudes of effect were calculated as relative risks, with 95% confidence intervals. All data were analyzed by using Stata6 statistical software (release 6.0, 1999; StataCorp, College Station, TX).

## RESULTS

During a 6-month period, the research assistants approached 570 nonurgent patients. Twenty-eight were ineligible because of pain (n=21) or had no access to a telephone (n=7). Four hundred eighty-three (89%) of eligible patients agreed to participate, and 470 of them were enrolled into 1 of the 2 study arms. The remaining 13 patients were called for treatment before being assigned. Two hundred forty-eight patients were assigned to the prevention group and 222 patients were assigned to the control group. The difference in numbers was an artifact of the alternating assignment because each study period

**Table 1.**
*Comparison of demographic variables and reasons for visit for control and prevention group patients.**

| | Study Patients (Total=470) | |
|---|---|---|
| | **Control Group (N=222) No. (%)** | **Prevention Group (N=248) No. (%)** |
| **Disposition** | | |
| Discharged home | 157 (71) | 191 (77) |
| LWBS | 27 (12) | 20 (8) |
| Admitted | 11 (5) | 8 (3) |
| Disposition not documented | 27 (12) | 29 (12) |
| **Sex** | | |
| Men | 70 (32) | 78 (32) |
| Women | 152 (68) | 170 (68) |
| Average age (y) | 42 | 36 |
| **Race**† | | |
| White | 21 (10) | 16 (7) |
| Black | 187 (84) | 226 (91) |
| Other | 1 (1) | 6 (2) |
| Missing data | 13 (6) | |
| **Reason for visit** | | |
| Medical | 125 (56) | 124 (50) |
| Injury | 46 (21) | 68 (27) |
| Gynecologic/urinary | 32 (14) | 49 (20) |
| Other reasons/missing data | 19 (9) | 7 (3) |

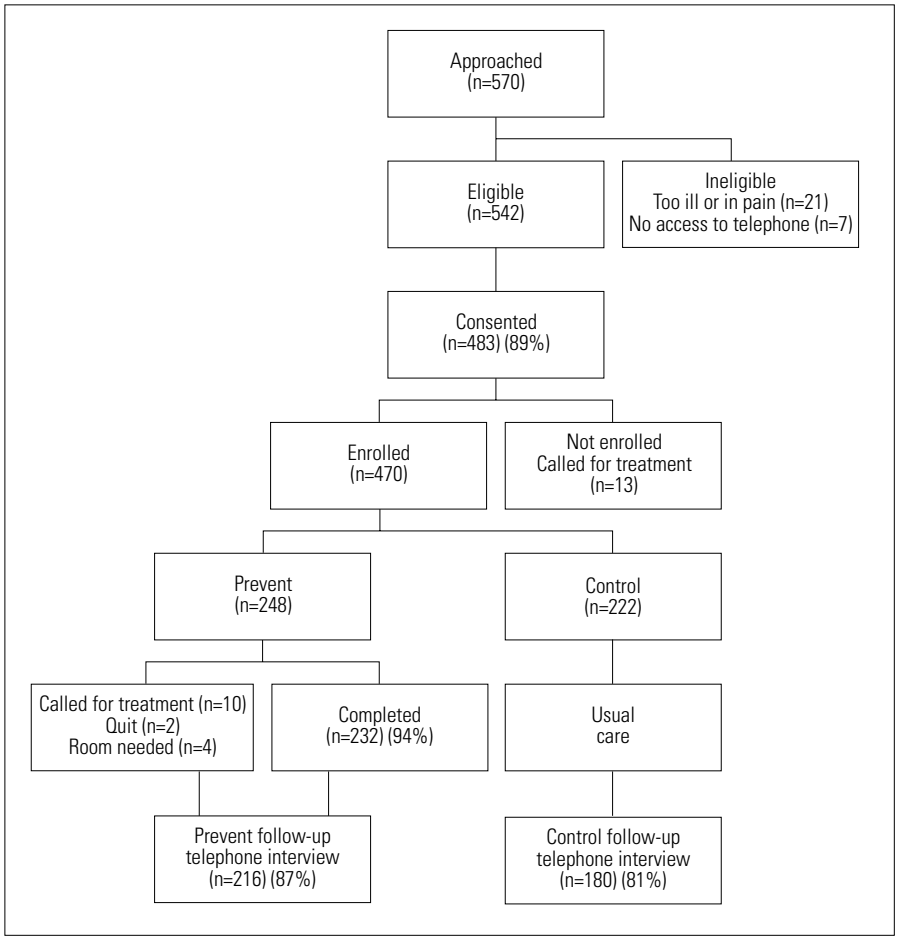
*Demographic variables and reasons for visit were collected from chart review done during the study period after the ED visit.
†For race, missing data were supplemented by patient responses on the computer questionnaire.

began with a prevention group assignment, thus approximately half of the sessions resulted in 1 more prevention than control patient. A total of 232 patients (94%) of those assigned to the prevention group completed the questionnaire before being called to the treatment room (Figure).

Our study population reflected the composition of our nonurgent ED patients who are urban and predominantly black women. The control patients were similar to the prevention patients (Table 1). There were no significant differences in race or sex. The control group was on average 6 years older and 6% more likely to have a medical than an injury-related reason for visit. Both groups had the same proportion of gynecologic-urinary complaints. During study periods, the rate of all ED patients leaving without being seen (LWBS) by a physician ranged from 3% to 20% with an average of 8% for all levels of severity; this is much higher for nonurgent patients who were the subjects of this study. Rates of LWBS were 12% for control and 8% for prevention patients. Of note, 4% of our nonurgent study patients were admitted. Additional demographic characteristics were collected as part of the computer questionnaire for the prevention group only (Table 2). An evaluation of access to care variables in this group found that 29% were privately insured, 54% were covered by Medicaid or Medicare, and 12% had no health insurance; 27% had no usual source of care outside the ED.

Eighty-five percent (210/248) of patients in the ED prevention group disclosed 1 or major behavioral risk factors including current smoking (32%), untreated hypertension (13%), problem drinking (19%), use of street drugs (13%), major depression (35%), and unsafe sexual behavior (32%) (Table 3). Other injury-prone behaviors included driving within 4 hours of having 2 or more drinks (11%), inconsistent use of seat belts (40%), not having a smoke detector that has been checked in the past year (17%), a history of witnessing knife or gun violence (31% of men, 18% of women), and having a hand-

**Figure.**
*Study flow diagram.*



gun at home or in the car (21% of men, 6% of women). Of importance, the large majority (95%) of patients who completed the computer questionnaire elected to receive additional information about specific health topics (Table 4).

We were able to contact 396 of the 470 study patients for a follow-up telephone interview, including 180 (81%) of 222 control patients and 216 (87%) of 248 in the prevention group. In the follow-up interviews, 62% (133/216) of prevention group patients contacted, compared with 27% (48/180) of the control patients, reported having received advice on what they could do to improve their health (relative risk 2.3, 95% confidence interval 1.77 to 3.01) Although patient comments about the prevention questionnaire were overwhelmingly positive, there was no difference in overall visit satisfaction (mean rating 1.7 on a 1-to-3 scale, with 1 being "very satisfied") or having called a referral number (mean, 50%) 1 week after the ED visit.

**Table 2.**
*Additional demographic and access to care variables for patients who took computer questionnaire.**

| Variable | % |
|---|---|
| **Education** | |
| <High school | 21 |
| Trade school | 7 |
| High school diploma | 38 |
| College degree | 27 |
| Graduate school | 5 |
| Doctorate/professional school | 2 |
| **Insurance** | |
| Medicaid | 37 |
| Medicare | 17 |
| Private | 29 |
| Self-pay | 12 |
| Student health/worker compensation | 5 |
| **Marital status** | |
| Married | 19 |
| Single | 60 |
| Divorced/separated | 17 |
| Widowed | 4 |
| **Usual source of care** | |
| ED | 17 |
| None | 10 |
| Health maintenance organization | 10 |
| Hospital clinic | 31 |
| Neighborhood clinic | 18 |
| Primary physician office | 14 |
| **Duration of symptoms prompting ED visit** | |
| <1 d | 21 |
| <1 wk but >1 d | 44 |
| <1 mo but >1 wk | 22 |
| <1 y but >1 mo | 7 |
| >1 y | 6 |

*Other demographic data for prevention group only (N=248) (data from computer questionnaire).

## DISCUSSION

We found it feasible to use computer survey technology for risk factor screening and health promotion in the acute care setting. ED patients were very accepting of this technology and interested in using their waiting time as an opportunity to receive health information. Of importance, patients receiving the computer intervention were more likely than the control group to remember being given health advice 1 week after the ED visit.

**Table 3.**
*Behavioral risk factors disclosed on computer questionnaire.*

| Topics and Definitions of Risk Factors | Patients Disclosing Risks on the Computer Questionnaire* (N=248) No. (%) |
|---|---|
| **Overall disclosure of at least 1 behavioral risk factor*** | **210 (85)** |
| **Use of street drugs†** | 33 (13) |
| Use of street drugs in last 4 weeks | 29 (12) |
| History of intravenous drug use | 7 (3) |
| **Problem drinking†** | 46 (19) |
| Sometimes >4 drinks/d and drinking at least 3 times/wk *(or)* | 36 (15) |
| At least 1 positive response to CAGE (test for alcoholism) | 40 (16) |
| **Cardiovascular behavioral risks†** | 92 (37) |
| Smokes cigarettes | 79 (32) |
| History of hypertension and not taking blood pressure medication | 28 (13) |
| **Major depression†** | 87 (35) |
| Depressed >2 wk in row in past 12 months | 79 (33) |
| Suicidal ideation in last 12 mo | 33 (13) |
| **High-risk sexual behavior†** | 84 (33) |
| Nonuse of condoms *and* at least 1 of the following: | 137 (55) |
| History of sexually transmitted disease in past 5 y | 58 (23) |
| Partner with sexually transmitted disease in past year | 31 (13) |
| >1 sexual partner in past year | 47 (19) |
| History of or sexual exposure to prostitution | 11 (5) |
| **Other injury-prone behaviors†** | 155 (62) |
| Driving within 4 h of drinking ≥2 alcoholic drinks | 26 (11) |
| Does not always use seat belt | 100 (40) |
| Does not have/has not checked smoke detector in past year | 42 (17) |
| Has handgun in home or car | 28 (11) |
| History of witnessing or participating in knife/gun violence | 54 (22) |

*A disclosure was defined as a response of "Yes" to the question but also included "Not sure" responses only in the areas of patient disclosure of suicidal ideation and "No" to questions about taking medication for hypertension or having a smoke detector that has been checked by someone in the past year.
†Summaries.

The US Preventive Services Task Force and Centers for Disease Control and Prevention have recommended that all physicians take advantage of acute care visits to provide screening and counseling for selected health risk behaviors.[20,21] Meeting this standard is difficult given current market constraints that require physicians to give more service in less time with less staff support. Increased emphasis on information technology may help physicians to manage the competing priorities of medical care. A recent systematic review of the major studies of computer-based clinical decision support systems for medical providers found them to be effective in enhancing preventive care.[22] A 1999 review of computer-based interactive health systems found them to be efficacious for delivering behavioral counseling, both as stand-alone interventions or as adjuncts to physician counseling.[23] Another review of survey methodology found computer-based technology improved the accuracy of data collection for survey research.[24] However, to our knowledge there are no reports evaluating the effectiveness of combining computer-based screening with interactive patient health education in an acute care setting. The fact that 95% of nonurgent ED patients taking a computer questionnaire requested health information lends support for the use of computer-based technology for screening and health promotion as an adjunct to usual acute care.

**Table 4.**
*Requests for specific health information for self or others.**

| Topics on Which ED Patients Requested Health Information | Respondents Answering "Yes" When Asked If They Would Like Information† No. (%) |
|---|---|
| **How to:** | |
| Exercise for health | 194/243 (80) |
| Prevent or control high cholesterol | 160/243 (66) |
| Control high blood pressure and prevent stroke | 171/243 (70) |
| Lower chances of having a heart attack | 192/243 (79) |
| Learn cardiopulmonary resuscitation (asked if no previous course) | 135/153 (88) |
| Get help for a drug problem* | 95/232 (41) |
| Get help for depression* | 122/242 (50) |
| Avoid unwanted pregnancies (asked of women <50 y and no surgical sterilization) | 25/84 (30) |
| Lower uterine and cervical cancer risks | 119/153 (78) |
| Detect breast cancer at early stage | 124/165 (75) |
| Quit smoking* | 121/240 (50) |
| Get help for a drinking problem* | 54/240 (22) |
| Prevent sexually transmitted disease* | 102/232 (44) |
| Prevent or be tested for HIV/AIDS* | 105/232 (45) |
| Overall no. of patients requesting health information on 1 or more topics | 235/248 (95) |

*For these topics, patients were asked whether they would like information for themselves or for someone else. The format of the question was designed to permit nondisclosure of personal risks while asking for information about the topic.
†The percentage of requests on each individual topic is calculated only for patients who were asked the question. Because of branches and skips and partial completion of some questionnaires, the denominator for people answering a question varies.

The printed health information generated by the computer program was well received by patients. It gave them something to read while in the department and to take home for review. In fact, requests for health information frequently exceeded the number of patients disclosing personal risks for that topic. We believe these increased requests represented a desire to pass on health information to friends or family members. As evidence for this, only 32% of patients said they were current smokers, but an additional 20% lived with a smoker, and 50% of the patients said they would like to get information for themselves or someone else on how to quit smoking. This would make a strong case for the extension of the potential health benefits beyond the individual patient receiving care. On the other hand, it may also represent undisclosed health risks in our patients.

Other investigations set in the ED environment have revealed significant numbers of patients with serious personal and public health risks.[25-28] Some of these behaviors have been found to be strongly related cofactors and independent predictors of poor health and adverse social outcomes.[29] For example, a single alcohol-related ED visit was found to be predictive of future arrest for alcohol-impaired driving, future ED visits for suicidal behavior or domestic violence, and increased 5-year mortality.[30] Although screening and intervention for health risk factors have not been standard practice in the ED setting,[31] emergency physicians have recently started to quantify these risks and explore potential interventions with some positive results.[32,33]

Compared with a control group, patients in our study who took the computer-based questionnaire had increased recall of having received advice about what they could do to improve their health. What factors led to this increase? One possibility is that the printed computer-generated health recommendations by themselves had an impact or perhaps patients were remembering physician reinforcement of those health recommendations, although we rarely found documentation of such counseling. Another hypothesis is that taking the health questionnaire had the effect of activating the patient in the waiting room and this resulted in enhanced physician/patient commu-

nication. This would be analogous to work by Kaplan et al[34] and Greenfield et al,[35] who demonstrated that diabetic patients prepared in the waiting room before a visit with their physician had improved blood glucose control. Our study design did not allow for direct exploration of mechanisms that contribute to motivating behavioral change.

There has been speculation as to whether the ED visit is really an opportunity for prevention, or just a chaotic and confusing time for the patient and family. Recent ED evidence suggests that preventive interventions directly related to the reason for visit can be effective. Parents trained about suicide risks during an ED visit for an adolescent behavior problem were 4 times more likely to take steps to limit their child's access to guns and prescription drugs than parents without the training.[36] Our data suggest that the ED setting is conducive to providing a teachable moment for preventive health messages, regardless of whether those messages are related to the reason for visit.

The generalizability of our results may be diminished in that our study took place in a single urban university hospital ED with a predominantly black patient population who were experiencing significant waiting times before being seen by a physician. In addition, when we alternately assigned patients by order of arrival to either the control or the prevention groups, we were randomizing by queue as opposed to a true random selection technique. Although we did not believe this would lead to a systematic selection bias, this process probably resulted in a younger population in the prevention group than in the control group. Regarding the age difference, we hypothesize that older patients were called back for treatment sooner and were therefore less likely to be waiting when the computer resources were available. Therefore, our assumption that the control group had approximately the same proportion of behavioral health risks as the intervention group may not be accurate. Finally, although we report an increase in remembered health advice, we did not, and could not, examine actual behavioral change. Although the intuition is that remembering health advice would be an important first step, this study was not designed to evaluate whether advice was related to behavioral change.

In summary, we explored the use of information technology as a method of using patient waiting time for screening and health promotion. In our study, computer health risk assessment was acceptable to patients and resulted in the majority of patients disclosing important behavioral health risks and requesting health information. Compared with a control group, the intervention group was more likely to remember receiving health advice. Computer-based interactive technology may enable EDs and other clinical settings with significant amounts of patient waiting time to use that time for health promotion and to help identify patients who might benefit from more specific interventions.

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