Journal of Medical Internet Research

Contents

CATCH-IT Reports

Correction

Corrected and Republished Paper

Editorial

Introduction to CATCH-IT Reports: Critically Appraised Topics in Communication, Health Informatics, and Technology

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Related Articles:

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Comment in: Feil EG. Response to CATCH-IT Report by Cameron Norman: Evaluation of an Internet-Based Smoking Cessation Program. J Med Internet Res. 2004;6(4) p. e48 http://www.jmir.org/2004/4/e48/

Abstract

EHealth has developed largely from an interdisciplinary framework and, as such, does not have a "home" discipline. The absence of this home discipline has allowed eHealth research to be published widely in journals ranging from the medical sciences, to engineering, to social science or to business and policy studies. The result of this fragmented, decentralized literature base is that researchers are not always aware of important papers published in other areas and journals. With this issue the Journal of Medical Internet Research is inaugurating a new article category which we call "CATCH-IT Reports" (Critically Appraised Topics in Communication, Health Informatics, and Technology). We hope these reports will draw attention to important work published in other (sometimes obscure) journals, provide a platform for discussion around results and methodological issues in eHealth research, and help to develop a framework for evidence-based eHealth. CATCH-IT Reports arise from "journal club" - like sessions founded in February 2003 at the Centre for Global eHealth Innovation. We invite other research institutions to create similar journal clubs and to write up and submit to this journal critiques in the form of CATCH-IT Reports.

Introduction: Information Scatter in eHealth Research

While health informatics is widely seen as a discipline with the potential for making health care more effective by advancing the introduction of medical evidence into clinical practice, information professionals are not always known for their optimal utilization of research findings in their own area of specialization. One of the barriers for keeping on top of research findings in health informatics is that even for information professionals trained in retrieving, organizing, and filtering information, it is difficult to keep pace with the scattered literature in this rapidly expanding field. With information technology having penetrated virtually every field of medicine, pertinent papers appear scattered in many different journals. in particular if we consider the broad definition of medical informatics as "the field that deals with the storage, retrieval, and optimal use of biomedical information, data, and knowledge for problem solving and decision making or in information delivery" [1], or the even broader definition of "eHealth", which would also include for example papers dealing with the role of

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the Internet for information dissemination, data collection, and decision making for health professionals and consumers, and impact of the Internet on health behavior and well-being of people with a public health focus [2, 3]. In a search conducted on December 30, 2004 for journal articles published in 2003/2004 with "Internet" as a major MeSH keyword, we identified 1702 papers. (Note that at this time not all 2004 articles are yet Medline-indexed; thus this data contains only a subset of the papers published in 2004. We also excluded 70 articles published in *Internet Healthcare Strategies* as this journal does not publish original papers).

The 1702 papers were scattered across 685 different journals (Table 1 lists the top 20 journals publishing most of the papers). Reading the top two journals in this field (*Journal of Medical Internet Research* and *Cyberpsychology & Behavior: the Impact of the Internet, Multimedia and Virtual Reality on Behavior and Society*) as well as the two proceedings volumes from major medical informatics conferences (the proceedings of the American Medical Informatics Association fall conferences,

and the conference proceedings of the European Federation of Medical Informatics *Studies in Health Technology and Informatics*) would keep readers informed of approximately 10% of the work published in this area. One would have to read papers in 36 different journals to cover 33% of the articles, 92 different journals to cover 50%, 190 journals to cover 66%, and 344 journals to cover 80% of all articles (Figure 1). While such a distribution, where a small group of core journals would provide 1/3 of the articles on that subject, a medium number of less-core journals would provide another 1/3 of the articles on that subject, and a large number peripheral journals would provide the final 1/3 of the articles on that subject, is typical (known as "Law of Scatter" or "Bradford's Distribution"), the extent of scatter in the field of eHealth is extreme, with a very long tail. While the *Journal of Medical Internet Research* ranks as the top journal which published more papers related to the Internet in medicine than any other journal, it still "only" publishes about 3% of the total number of papers in this field (which, by the way, we hope are the best 3%, and which is a proportion we hope to increase significantly over the next years).

Table 1. Distribution of articles published 2003/2004 and Medline-indexed with the keyword "Internet" as major MeSH (Medical Subject Heading) among the top 20 journals (a total of N=1702 papers were scattered in 685 different journals, not all shown here)

Rank	Journal Title	Number of Articles Published 2003/2004 with "Internet" as Major MeSH Keyword	Percentage of Total Articles (N=1702)	Cumulative Percentage
1	J Med Internet Res	47	2.76%	2.76%
2	AMIA Annu Symp Proc	44	2.59%	5.35%
3	Stud Health Technol Inform	39	2.29%	7.64%
4	Cyberpsychol Behav	39	2.29%	9.93%
5	Bioinformatics	31	1.82%	11.75%
6	Int J Med Inform	21	1.23%	12.98%
7	Health Manag Technol	20	1.18%	14.16%
8	J Telemed Telecare	19	1.12%	15.28%
9	Comput Inform Nurs	18	1.06%	16.33%
10	Health Data Manag	18	1.06%	17.39%
11	Health Info Libr J	16	0.94%	18.33%
12	Behav Res Methods Instrum Comput	16	0.94%	19.27%
13	BMJ	15	0.88%	20.15%
14	Med Ref Serv Q	15	0.88%	21.03%
15	Profiles Healthc Mark	13	0.76%	21.80%
16	J Med Syst	12	0.71%	22.50%
17	Nurse Educ	11	0.65%	23.15%
18	J Nurs Educ	11	0.65%	23.80%
19	Med Econ	11	0.65%	24.44%
20	Health Serv J	10	0.59%	25.03%

Figure 1. Information scatter in eHealth: Distribution of "Internet"-related papers published in 2003/2004 by journal (with some prominent journals highlighted). While the *Journal of Medical Internet Research* attracts more pertinent papers in this field than any other journal, the majority of the literature remains scattered (this figure does not even take into account non-Medline indexed journals e.g. from engineering or the social sciences).

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It becomes clear that one has to monitor a large number and broad spectrum of journals in order to stay abreast of the most important developments in the evolving field of eHealth. EHealth is in a unique position in that it has developed largely from an interdisciplinary framework and, as such, does not have a "home" discipline (even "medical informatics" is only a part of the broader eHealth scene). The absence of this home discipline has allowed eHealth research to be published widely in journals ranging from the medical sciences to engineering, to social sciences and to business and policy studies. The aforementioned analysis does not even take into account articles published in journals which are not indexed in Medline. The result of this fragmented, decentralized literature base is that researchers are not always aware of important papers published in other disciplines and journals.

eHealth Journal Club and CATCH-IT Reports

With this issue, the *Journal of Medical Internet Research* is inaugurating a new article category which we call "CATCH-IT Reports" (Critically Appraised Topics in Communication, Health Informatics, and Technology). With this new article series we hope to draw attention to important work published in other (sometimes obscure) journals, and provide a platform for discussion around methodological issues in eHealth research.

The reports arise from "journal club" - like CATCH-IT sessions founded in February 2003 at the Centre for Global eHealth Innovation by Gunther Eysenbach with the goal of bringing together researchers, students, faculty, researchers, and health professionals interested in furthering understanding of eHealth through the process of critically appraising and discussing current eHealth research. The objectives of these bi-weekly sessions and the CATCH-IT Reports are

- To train researchers, students, and faculty in critical appraisal skills and to encourage an evidence-based approach to the medical informatics literature
- To bring to the attention of the eHealth community important and timely issues and publications concerning evidence and issues in the field
- To provide, in a systematic fashion, critical analyses of publications and eHealth trials
- To identify pressing research issues and to stimulate thinking about methodological issues in eHealth.

The CATCH-IT review group at the Centre for Global eHealth Innovation comprises individuals who all have experience in developing, deploying and evaluating eHealth interventions. What we lack in terms of length of experience (as we all do in this new field) we make up for in breadth of experience. Our group consists of researchers and practitioners from many different disciplines, cultures, ages, and roles. We are scientists, practitioners, professors, and students. All of us are consumers. Some of us are new to the process of critical appraisal of research while others have been at the forefront of developing methods for evidence-based medicine since the term was first coined. In short, we represent a diverse cross section of eHealth consumers.

Each session is prepared by one of the participants taking on the role of facilitator. The facilitator selects a recent paper from the current body of literature (as a guideline it should not be older than 6 months, in exceptional cases up to 12 months) and circulates the paper to all participants at least 1 week before the CATCH-IT session.

Selection criteria for papers discussed in a CATCH-IT report include one or more of the following:

- High quality papers with great potential impact on one or more groups of decision makers in the health system *or*
- Papers illustrating methodological flaws worth discussing (seeking to prevent them in future studies)
- Papers providing an elegant solution to a (methodological) problem or otherwise addressing timely methodological issues or problems
- Illustration of new ideas or concepts that could represent food for reflection and discussion
- Direct impact on ongoing research (of the facilitator or elsewhere).

At the session, the facilitator first presents the paper, which is then critically discussed in the group under aspects such as validity and importance of the paper. Often, new research ideas are generated in the process, or methodological problems are unearthed. Almost always questions remain open as articles are often incompletely reported. We often ask ourselves the question, "How could the peer reviewer/editor miss this?"

Minutes of the discussions are kept, and the facilitator writes up a short report, typically 1000 to 1500 words in length. In the future, we will publish the best of these reports in this journal. The reports will be sent to the author of the original paper and he will be invited to respond to the report. A general template for CATCH-IT Reports will be developed during the project, but generally each published CATCH-IT Report will address the following questions:

- Why is the paper interesting, why was it picked?
- For whom is this paper interesting, and why?
- What were the intervention, setting, outcome measures, results, and conclusions of the authors?
- Background information – what's not written in the paper is…
- What are the methodological issues, and is the result valid?
- What can health professionals learn from this study?
- What can consumers learn from this study?
- What can policy makers learn from this study?
- What can researchers learn from this study?
- What further research is required?
- What questions for the author arise?

One of our goals is to produce reports based on our discussions and reviews in order to promote better research and to foster further debate and discussion on ways to create the best evidence for the use of eHealth. The focus of the first report, published in this issue [4], is on the article's contribution to our understanding of eHealth - it's efficacy, effectiveness or potential use in research. We also hope that from this work we will be able to compile some guidelines for specific eHealth methodologies and approaches to development and evaluation

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of eHealth innovations. This is not to suggest that guidelines for evaluating eHealth research do not exist. The CONSORT statement [5], the guidelines for interactive health communication from SciPICH3 [6], and many discipline-specific research guidelines all offer us some clues on what to look for when evaluating these articles. It is our hope that, over time, we can further refine such guidelines to meet the changing climate of eHealth, and perhaps work on specific guidelines for

particular problems, such as the CHERRIES statement for Web-based survey research [7].

While forthcoming CATCH-IT papers will be primarily produced by graduate students and faculty at the Centre for Global eHealth Innovation, we invite other research institutions to create similar journal clubs and to write up and submit critiques and discussion pieces of the current eHealth literature in the form of CATCH-IT Reports.

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Review

The Effectiveness of Web-Based vs. Non-Web-Based Interventions: A Meta-Analysis of Behavioral Change Outcomes

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Abstract

Background: A primary focus of self-care interventions for chronic illness is the encouragement of an individual's behavior change necessitating knowledge sharing, education, and understanding of the condition. The use of the Internet to deliver Web-based interventions to patients is increasing rapidly. In a 7-year period (1996 to 2003), there was a 12-fold increase in MEDLINE citations for "Web-based therapies." The use and effectiveness of Web-based interventions to encourage an individual's change in behavior compared to non-Web-based interventions have not been substantially reviewed.

Objective: This meta-analysis was undertaken to provide further information on patient/client knowledge and behavioral change outcomes after Web-based interventions as compared to outcomes seen after implementation of non-Web-based interventions.

Methods: The MEDLINE, CINAHL, Cochrane Library, EMBASE, ERIC, and PSYCHInfo databases were searched for relevant citations between the years 1996 and 2003. Identified articles were retrieved, reviewed, and assessed according to established criteria for quality and inclusion/exclusion in the study. Twenty-two articles were deemed appropriate for the study and selected for analysis. Effect sizes were calculated to ascertain a standardized difference between the intervention (Web-based) and control (non-Web-based) groups by applying the appropriate meta-analytic technique. Homogeneity analysis, forest plot review, and sensitivity analyses were performed to ascertain the comparability of the studies.

Results: Aggregation of participant data revealed a total of 11,754 participants (5,841 women and 5,729 men). The average age of participants was 41.5 years. In those studies reporting attrition rates, the average drop out rate was 21% for both the intervention and control groups. For the five Web-based studies that reported usage statistics, time spent/session/person ranged from 4.5 to 45 minutes. Session logons/person/week ranged from 2.6 logons/person over 32 weeks to 1008 logons/person over 36 weeks. The intervention designs included one-time Web-participant health outcome studies compared to non-Web participant health outcomes, self-paced interventions, and longitudinal, repeated measure intervention studies. Longitudinal studies ranged from 3 weeks to 78 weeks in duration. The effect sizes for the studied outcomes ranged from -.01 to .75. Broad variability in the focus of the studied outcomes precluded the calculation of an overall effect size for the compared outcome variables in the Web-based compared to the non-Web-based interventions. Homogeneity statistic estimation also revealed widely differing study parameters ($Q_{w16} = 49.993$, $P \le .001$). There was no significant difference between study length and effect size. Sixteen of the 17 studied effect outcomes revealed improved knowledge and/or improved behavioral outcomes for participants using the Web-based interventions. Five studies provided group information to compare the validity of Web-based vs. non-Web-based instruments using one-time cross-sectional studies. These studies revealed effect sizes ranging from -.25 to +.29. Homogeneity statistic estimation again revealed widely differing study parameters ($Q_{w4} = 18.238$, $P \le .001$).

Conclusions: The effect size comparisons in the use of Web-based interventions compared to non-Web-based interventions showed an improvement in outcomes for individuals using Web-based interventions to achieve the specified knowledge and/or

behavior change for the studied outcome variables. These outcomes included increased exercise time, increased knowledge of nutritional status, increased knowledge of asthma treatment, increased participation in healthcare, slower health decline, improved body shape perception, and 18-month weight loss maintenance.

Introduction

A primary focus of self-care and self-management interventions is the encouragement of an individual's behavior change in the presence of a chronic illness or condition necessitating knowledge sharing, education, and understanding of the condition. There has been limited research comparing the use and effectiveness of Web-based interventions to non-Web-based interventions such as traditional face-to-face interactions and paper and pencil assessments. The introduction of the Internet into clinical practice as an information-sharing medium has brought about many opportunities for innovative interventions for individuals with chronic illnesses and their care providers. These interventions are often designed to address deficiencies in patient knowledge and chronic illness self-management skills. Improvements in these areas have been shown to lead to improved health outcomes. However, the extent of the benefits gained through the implementation of Web-based self-regulatory and behavior change interventions compared to non-Web-based interventions has not been fully ascertained. This meta-analysis was undertaken to establish any potential effect size differences between Web-based and non-Web-based interventions on selected patient behavior change outcomes.

In recent years, there has been an increase in the use of the Internet to gather, transform, and disseminate information that, in earlier years, was primarily done through the use of paper, in the form of books, pamphlets, instruction materials and so on. Internet users are seeking health information and healthcare services; 80%, or about 93 million Americans have searched for at least one of 16 major health topics online [1]. The Robert Wood Johnson Foundation (RWJF) has noted the increased use of Internet-based devices, cellular phones, and personal digital assistants (PDAs) creating opportunities for both patients and providers to benefit from access to e-Health applications. The RWJF has supported this trend by providing funding to study health behavior modification and chronic disease management in nontraditional settings through the use of e-Health technologies [2]. The use of computers to directly collect health assessment data from patients is a well-established technology that has been shown to produce reliable responses when administered over the World Wide Web [3]. In some circumstances, computer surveys have been shown to have advantages over face-to-face interviews. In one study, computer-based screening elicited more HIV-related factors in the health histories of blood donors than did standard questionnaire and interviewing methods [4]. Participant disclosure of high-risk sexual encounters has also been improved given the semblance of the more anonymous, Web-based data collection methodologies [5].

Computerized health behavior interventions are beneficial to patients/clients and healthcare providers. This is evidenced by structured reviews on the effectiveness devices such as kiosk-based computer assisted self-interviewing, interactive video, Internet applications, computer aided instruction, and the like in a variety of patient care settings. Balas and colleagues found that interactive patient instruction, education, and therapeutic programs helped individuals improve their health; at the same time, healthcare delivery processes were also improved [6]. Research studies suggest that education and knowledge sharing benefits can be achieved through computer-based education methodologies [6,7].

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Figure 1. Search terms "Web-based Therapy" trended by year of publication
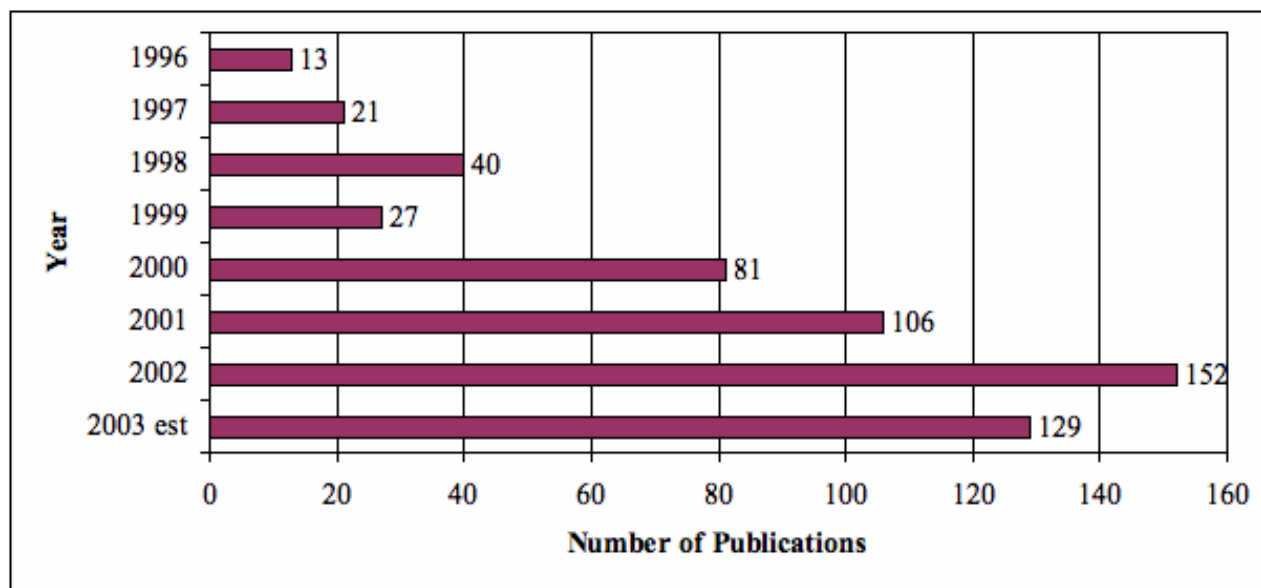
Interest in use of the Internet and Web-based interventions is increasing rapidly. In the 7-year period from 1996 to 2003, a total of 569 citations demonstrated a twelve-fold increase in MEDLINE publication citations for "Web-based therapies," from 13 citations in 1996 to 152 citations in 2002. There has also been a steady increase in the number of citations in MEDLINE for the term "Web-based intervention," further indicating interest in this research area for Web-based treatments. In addition to completed patient-focused, Web-based intervention studies, a large number of the publications are simply proposed or newly implemented studies. Many studies are based on therapeutic interventions that are provider focused and part of an implemented system incorporating the use of computerized medical records. Others include telehealth technologies that include highly technically interfaced lab values recorded within a case managed setting. Others discuss the variety and integrity of health-related Web sites (Figure 1).

Methods

Data Sources/Systematic Review

For identification of the relevant literature, a specific search strategy was performed using explicit inclusion criteria to avoid selection bias. A MEDLINE, CINAHL, EMBASE, ERIC, and PSYCHInfo search between the years 1996 and 2003 was conducted using keyword search terms of "computerized intervention," "Internet intervention," "Web-based therapy," and "Web-based intervention." The Cochrane Library collection was also accessed using keyword searches for "Web-based intervention" and "Internet intervention." Searches in additional databases were done but revealed no new comparative Web-based published articles. A manual review of the reference lists of these articles was done to identify additional articles for possible inclusion. When an article was identified, it was compared against established inclusion/exclusion criteria to determine its suitability for the meta-analysis. The inclusion/exclusion criteria are presented in Table 1.

Table 1. Inclusion and exclusion criteria for the meta-analysis

Inclusion Criteria:

- Publication date: January 1996 to December 2003.
- Comparison of a Web-based behavior or educational intervention, intended to influence behavioral change and/or self-efficacy health outcomes of participants compared to a non-Web-based method.
- Either randomized and controlled clinical trials or convenience samples
- Descriptive studies using a baseline and post study score(s)
- Clinic and clinic/home based studies
- Score of 12 or more on the Quality Rating Scale for the study (see Table 2).

Exclusion Criteria:

- Publication date: prior to January 1996
- Excluded studies:
    - Non-Web-based Computer Assisted Instruction (CAI) studies
    - Procedural methods citations (methods papers, non-implemented studies)
    - Prospective non-implemented studies/citations
    - Provider focused studies, no client participation
    - Web site access only studies
    - Professional practice studies
    - Telephone based interventions
    - Remote monitoring studies
    - Interventions incorporating synchronous video communication
    - Web-based intervention compared to another Web-based intervention
    - Classroom or non-clinic/non-home location
- Score less than 12 on the Quality Rating Scale for the study (see Table 2).

Quality Documentation of the Studies

The quality assessment of the included studies was based on the method used by Haynes and colleagues [8], with modifications to address the focus of this study on Web-based interventions. The compliance to standards for the studies is based on five criteria: (1) study design; (2) selection and specification of the study sample; (3) specification of the illness/condition; (4) reproducibility of the study; and (5) outcomes specification and the measurement instruments used/validity and reliability documentation of instruments. The sum of the variables result in a total score ranging from 0 to 18 (Table 2). Only studies with a quality documentation score of 12 or greater were retained for the meta-analysis.

Table 2. Quality evaluation of selected investigations (adapted from Haynes et al [8])

Study Characteristic	Evaluation Criteria	Scoring*
Study Design	1. Randomized trial	3 points
	2. Non-randomized trial with control group	2 points
	3. Descriptive/cohort study	1 point
Selection and specification of the study sample	1. Random selection with description of 4 to 5 demographic variables	3 points
	2. Random sampling without sufficient description of the demographic variables	2 points
	3. Convenience sampling with sufficient background information	1 point
	4. Bonus point for a description of how many patients were excluded and reasons for exclusion.	+ 1 point
Specification of the illness/condition	1. Illness specified with reproducible inclusion/exclusion criteria.	3 points
	2. Diagnostic criteria only were provided	2 points
	3. Diagnosis only	1 point
	4. Bonus point if all prior criteria were met and co-morbidities were described.	+1 point
Reproducibility of the study	1. Description permits the reader to replicate the study	1 point
	2. Results provided a standard for computing effect size (i.e., variable means, standard error, or standard deviation correctly stated).	Yes: 3 points No: 0 points
Outcomes specification and measurement	1. Outcome measure is described and valid instrument use was clearly provided	3 points
	2. Outcomes were not measured using valid and reliable instruments	2 points
	3. Results did not match the described outcomes to be measured in the study	-1 point
Maximum score		18 points

* Only studies that scored 12 or higher were retained for meta-analysis

Instrument Reliability and Validity

It is important to compare Web-based study instruments to their counterpart paper-based study instruments. Structured assessment instruments can be used to reliably measure a broad range of attributes of patient health and status. For comparative purposes in a meta-analysis, it is important to know the reliability of the measurement instruments with the reliability of the item measures reported in the publication. The validity and reliability of a Web-based measurement approach itself has not yet been adequately addressed. It cannot be assumed that the validity of an instrument based on its paper format and use in a specific research situation is transferable to the instrument's use in a Web-based format. Some instruments may be modified in ways that could change their meaning and accuracy, such that it might be inappropriate to compare data collected from different versions of the instruments (for example, provider administered assessments vs. self assessment). The ordering of the questions within an instrument can affect reliability and validity. In a Web-based format, the expected ordering may change and the ability to go back and review/change answers may need to be considered. The format of text can affect how the questions and instructions are interpreted. The use of bolding, italics, colors, fonts, and capitalization can affect the readability of items and change their phrasing. These can also draw attention to or from key parts of the instructions [9].

Effect Size Calculation

A number of studies have been conducted having a measure that can be compared for its effect size in both a Web-based intervention vs. a non-Web-based intervention. Although the studies vary in the use of different outcomes that are used as measures for knowledge and/or behavior change, the construct of such change may be validly measured using meta-analytic techniques [10]. Although most studies had multiple outcomes from which to measure knowledge and/or behavior change, using several effect size calculations to represent results from each study outcome violates the rule of independence for statistical analysis, as these outcomes were obtained from the same sample of participants and were obtained in a similar setting. Multiple outcome effect sizes will also give disproportionate weight to studies with multiple groups and multiple scales compared to studies using fewer outcome measures.

Effect size was used to quantify the effectiveness of the Web-based intervention, relative to a non-Web-based comparison intervention. Effect size analysis was done to ascertain a standardized difference between the Web-based and non-Web-based groups, regardless of how the outcome was measured, by applying the appropriate meta-analytic technique. This analysis makes the assumption that individual studies are estimating different treatment effects and will observe the resulting effect size values and confidence intervals for distribution and variability. This check is done to evaluate if the effects found in the individual studies are similar enough that the combined effect size estimate is meaningful.

Hedges' d, a bias corrected modification of Cohen's d, was calculated to determine the magnitude of the difference between the mean of an intervention group and the mean of the control

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group, divided by a pooled standard deviation [10]. The calculations were based on the reported data in each of the studies that provided sample sizes, means, and standard deviations for each of the Web-based and non-Web-based intervention groups for the relevant effect (outcome) variables. A homogeneity statistic, Q_w, was also calculated to determine whether the values of d used to calculate a mean effect size were consistent within the set of the reviewed studies. Heterogeneity is indicated when the Q_w statistic has a large, statistically significant value, suggesting that one or more features that were present in some studies and absent in others were affecting the magnitude of the effect sizes.

In controlled, repeated-measures studies, the effect size was calculated using the earliest time period for controls (non-Web-based intervention) and the final time period for controls then repeated for the intervention (Web-based intervention) groups, achieving one effect size for each group. The Web-based and non-Web-based group effect sizes were integrated to achieve one effect size for each study variable reviewed. In studies where standard deviations were not reported, but *P* values and/or z scores were provided, the Stouffer method for effect size calculation was used [11]. In studies having frequency or proportion data, the Mantel-Haenszel-Peto method was used to calculate the effect size between the Web-based and non-Web-based intervention groups [10]. For those studies that had multiple methodologies (i.e., multiple Web-based intervention groups compared to one paper-based group) or for those studies that used multiple paper-based methodologies (i.e., self-completion of a paper assessment and provider interview), the multiple group means were combined, the standard deviations were pooled, and effect size calculated. In those studies using a case/control, repeated measures design, the calculations for effect size and analysis of the effect sizes were performed using D-Stat Version 1.0 (Lawrence Earlbaum Associates, Inc., Hillsdale, NJ). Graphing was done using SPSS version 11.5 (SPSS Inc., Chicago, IL). Drop-line charts for individual groups using the variables for effect size and the low and high confidence interval values were graphed to provide visual representation effect sizes and associated confidence intervals.

Descriptive statistics were used to ascertain means and standard deviations as needed for aggregating the study data. Participant attrition rates in the longitudinal studies were calculated from the group N at the time of enrollment into the study until the time of the final reported follow-up period.

Results

Citation Searches

MEDLINE, CINAHL, EMBASE, PSYCHInfo, ERIC, and Cochrane Library, keyword searches resulted in 1518 citations. After reviewing for database redundancies in the citations, individual examination of the reference lists, and reviews of dissertations, a final review against the inclusion/exclusion criteria and quality documentation resulted in 20 studies selected for the instrument format analysis and the intervention-focused meta-analysis for behavior change outcomes. The selected studies were performed in the United States, France, Japan, Italy, Spain, Netherlands, Sweden, and Germany.

Exemplar studies, not selected for analysis, are summarized as follows: Studies that were Web-based to Web-based intervention comparisons [12-15]; 2) Studies that were descriptive of the functionality of a Web site [16,17]; 3) Studies that were provider focused [18]; 4) Pre/post intervention studies that only assessed the Web-based intervention [19-24]; 5) Studies that did not provide adequate information regarding either a change in outcomes or the comparative utility/validity/reliability of the Web-based tool [25-27]; and 6) Computer-assisted instruction (CAI) studies [28-30].

Characteristics of the Reviewed Studies

Review of the selected articles revealed variation in design of the Web-based intervention studies. Because of the variation in the framework for these studies, two separate analyses were performed that: (1) evaluated studies that focused on a one-time, cross-sectional survey comparison of assessment instruments/methods when administered to Web-based and non-Web-based groups [3,31-34]; and (2) evaluated outcomes variables of intervention that best indicated knowledge and/or behavior change resulting from a Web-based intervention [35-51]. A summary of each study is shown in Table 3.

Aggregation of data from the 22 selected studies showed a total of 11,754 participants in both the Web-based and non-Web-based interventions at the time of inclusion into their respective studies. Of this total, 5,841 were women and 5,729 were men. The average age of participants was 41.5 years. For longitudinal studies, the average intervention duration was 27 weeks with a range from 3 weeks to 78 weeks. Attrition rates for the longitudinal studies revealed that both the intervention and control groups lost an average of 21% of the study participants over the duration of the studied interventions. (Table 4).

Table 3. Summary of reviewed studies**

Author(s) and date	Intervention Focus	N and Study Characteristics	Conceptual Framework	Design	Variables/Behavior Change Variable	Study Findings	Reliability of Effect Variable Instrument
Clarke G, Reid E, Eubanks D, O'Connor E, DeBar LL, Kelleher C, Lynch F Nunley S, 2002 [38]	Depression	N = 299 (I = 144, C = 155) 32-week study evaluating the effectiveness of a Web-based psycho educational tutorial intervention to reduce depression	Cognitive restructuring techniques	Longitudinal, Randomized study Repeated measures	IV = Intervention using tailored self-management or peer support therapy using cognitive therapeutic techniques DV = CES-D depression score change	No significant differences for the Internet program across the entire sample. Post-hoc, analyses revealed a modest effect among persons reporting low levels of depression at intake.	Center for Epidemiological Studies-Depression (CES-D) 20-statement scale. Internal consistency from 0.85 to .90. Concurrent validity with Beck depression inventory, brief screen for depression.
Krishna S, Francisco BD, Balas A, Konig P, Graff GR, Madsen RW, 2003 [44]	Asthma Education	N = 228 (I = 121, C = 107) 52-week intervention comparing the use of IMPACT, an Internet enabled interactive asthma education program, to printed and verbal asthma education in a pediatric population, 18 years or younger.	Knowledge change leading to behavior change	Longitudinal, Randomized study Repeated measures	IV = Use of IMPACT, Web-based intervention DV = Childrens asthma knowledge, Caregivers asthma knowledge, days of asthma symptoms, medication use, ER /urgent care visits, missed school days, hospitalizations	Knowledge change was a primary indicator for program use and effectiveness. Multimedia education is a feasible adjunct that can be incorporated into a clinic visit. Increased asthma knowledge, decreased morbidity, and reduced use of ER services in IMPACT participants.	50-item asthma knowledge survey, 10 item asthma scenario survey. No validity or reliability documentation.
Celio AA, Winzelberg AJ, Wilfley D, Eppstein-Herald D, Springer EA, Dev P, Barr-Taylor C, 2000 [36]	Eating Disorders	N = 76 (Internet-student bodies (SB) = 27, class-based Body Traps (BT) = 25, wait-list/control (WLC) = 24) 8-week intervention and four-month follow up. Comparison of Web-based and classroom based psycho educational interventions to reduce body dissatisfaction and eating disorders/behaviors/attitudes.	Behavior change	Longitudinal, randomized study Repeated measures	IV = Web-based intervention, Class room intervention DV = Change in body satisfaction questionnaire scores, Eating disorder examination questionnaire, Eating Disorders Inventory (EDI)-Drive for thinness scale.	Internet intervention had a significant impact on reducing risk factors for eating disorders. No significant effects were found between the BT and WLC conditions	Body satisfaction questionnaire (BSQ) has internal consistency of .97, test-retest validity = 0.88, and concurrent validity coefficient = .66. At baseline measures, the EDE and BSQ showed spearman correlation = .86.
Harvey-Berino J, Pintauro S, Buzzell P, DiGiulio M, Casey-Gold B, Moldovan C, Ramirez E, 2002 [41]	Weight Control	N = 46 (Internet Support IS = 15, Traditional Support TS = 14, Control = 15) Web-based study, investigating the effectiveness of a weight maintenance program conducted over the Internet compared to in-person sessions. A 6-month clinical behavioral weight loss trial with in-person behavioral obesity treatment followed by a 12-month maintenance program conducted both in-person (frequent in-person support; F-IPS, minimal in-person support; M-IPS) and over the Internet.	Not discussed	Longitudinal, Randomized, 12 month maintenance program study	IV = use of Internet support method DV = body weight, dietary intake, energy expended in physical activity, attendance, self-monitoring, comfort with technology Behavior change exhibited by attendance in weight loss meetings	Attendance was lower in the Internet condition over the 12 months of maintenance than in the F-IPS condition. After 6 months, many in the IS want to meet face-to-face. The IS condition gained significantly more weight than the F-IPS group during the first six months of weight maintenance	No validity or reliability of assessment instruments was documented.

Author(s) and date	Intervention Focus	N and Study Characteristics	Conceptual Framework	Design	Variables/Behavior Change Variable	Study Findings	Reliability of Effect Variable Instrument
Oenema A, Brug J, Lechner L, 2001 [47]	Nutrition	N = 198, (I = 96, C = 102) Web-based tailored nutrition education program.	Weinsteins Precaution Adoption Process	Randomized trial Repeated measures (pre-post)	IV = Use of Web-based tailored nutrition education program DV = Validated food frequency questionnaire Behavior change exhibited by self report of awareness of personal dietary intake levels	Significant differences in awareness and intention to change were found between the intervention and control group at post-test. Tailored intervention was appreciated better, rated as more personally relevant, had more subjective impact on opinion and intentions to change than the general nutrition information.	Pearson correlations of about 0.7 for adults and 0.6 for adolescents were observed between fat scores derived from the Fat list and total and saturated fat intake in grams estimated by the 7-day diet records.
Harvey-Berino J, Pintauro SJ, Buzzell P, DiGiulio M, Gold BC, Moldovan C, Ramirez E, 2002 [42]	Weight Loss Maintenance	N = 122 (Internet = 40, Minimal in- person support = 41, Frequent in person support = 41) Sustained contact following a weight loss program	Not discussed	Longitudinal 18 month weight maintenance program	IV = Use of Internet support method DV = body weight, dietary intake, energy expended in physical activity, attendance, self-monitoring, comfort with technology Behavior change exhibited by 18 mos. weight loss maintenance.	Internet group reported increased peer support. Internet support not as effective as minimal or frequent intensive in-person therapist support for facilitating the long-term maintenance of weight loss.. Weight loss did not differ by condition during treatment The IS condition gained more weight than the F-IPS group during the first 6 months of weight maintenance and sustained lesser weight loss than control.	No validity or reliability of assessment instruments was documented.
Chou FY, 2003 [32]	HIV/AIDS	N = 359 (I = 122, C = 237) Self Care Symptom Management in individuals living with HIV/AIDS (SSC-HIVrev.)	Behavior Change	Convenience sample (Web version)	IV = Use of Web-based version of symptom reporting tool DV = Help seeking strategies, personal network, information resources, Use of medications	Dissertation, participants in Web group reported decreased help seeking strategies, decreased spiritual strategies, and decreased personal networks compared to non-Web-based responders.	SSC-HIVrev. Part 1-45 HIV-related symptoms cluster into 11 factor scores. Reliability .76 - .91; Part 2- 19 HIV-related symptoms that do not cluster into factor scores but may be of interest from a clinical perspective; Part 3- 8 items related to gyn symptoms for women. Cronbachs alpha = .94.

Author(s) and date	Intervention Focus	N and Study Characteristics	Conceptual Framework	Design	Variables/Behavior Change Variable	Study Findings	Reliability of Effect Variable Instrument
Marshall AL, Leslie ER, Bauman AE, Marcus BH, Owen N, 2003 [46]	Physical Activity Promotion	N = 655 (I = 327, C = 328) Eight week mediated physical activity Web-based intervention vs. eight week print based intervention	Trans-theoretical (stages of Change) Model	Longitudinal Randomized study	IV = Use of Web-based mediated physical activity (Active Living) intervention DV = Change in physical activity measured by the International Physical Activity Questionnaire (IPAQ) Short Past 7-day instrument.	Increase in total physical activity in the Print participants who were inactive at baseline. Decrease in average time spent sitting on a weekday in the Web group. No difference between Print and Web program effects on reported physical activity. The Print group showed slightly larger effects and a higher level of recognition of program materials.	No documentation of data supporting validity or reliability.
Gustafson DH, Hawkins RP, Boberg E, Pingree S, Serlin RE, Grazino F, Chan CL, 1999 [40]	HIV/AIDS	N = 204,(I =107 overall, C = 97) The Comprehensive Health Enhancement Support System (CHESS) developed for HIV/AIDS) Received system for 3 or 6 months; controls received no intervention of the CHESS system.	Behavior change	Longitudinal Randomized trial, Repeated measures Pre, intra, and post	IV = Use of CHESS system DV = QOL variables Medical outcomes study (MOS) short form Hospital resource utilization Behavior change exhibited by level of participation in healthcare	Intervention group had shorter ambulatory .care visits, more phone calls to providers, fewer & shorter hospitalizations compared to control during the computer implementation period. Post-implementation no difference in number and length of hospitalizations. Use of non emergency/ emergency were not significantly different between groups	Four subscales from the MOS 36, Physical function (α=0.87), cognitive function (α=.91), energy (α=0.85), depression (α=0.90)
Christensen H, Griffiths KM, Korten A, 2002 [37]	Cognitive Behavioral Therapy	Web-based sample of 1096 completed the Goldberg depression scale. Subanalysis also includes 49 students enrolled in an Abnormal Psychology course and local population survey of 2385 20-24 year olds Free access to MoodGYM Web intervention	Cognitive behavioral change	Descriptive Study	IV = Use of MoodGYM DV = Changes in depression and anxiety symptoms	20% of sessions lasted > 16 mins. Those who completed at least 1 assessment reported initial symptoms of depression and anxiety that exceeded those found in population-based surveys and those characterizing a sample of University students. Both anxiety and depression scores decreased significantly as individuals progressed through the modules	Goldberg Depression and anxiety Scales The full set of nine questions need to be administered only if there are positive answers to the first 4. When assessed against the full set of 60 questions contained in the psychiatric assessment they have a specificity of 91% and a sensitivity of 86%

Author(s) and date	Intervention Focus	N and Study Characteristics	Conceptual Framework	Design	Variables/Behavior Change Variable	Study Findings	Reliability of Effect Variable Instrument
Ritterband LM Cox DJ Kovatchev B McKnight L Walker LS Patel K Borowitz SM Sutphen J, 2003 [48]	Pediatric Encopresis	N = 24 (I = 12, C = 12) 3-week intervention for pediatric bowel training (Enhanced Toilet Training-ETT) to reduce defecation accidents called U-CAN-POOP-TOO. Evaluate the Internet version to overcome barriers of healthcare professional implementation of therapy alone.	Behavior change	Longitudinal study	IV = Use of Web-based U-CAN-POOP-TOO intervention for ETT DV = Reduction in number of defecation accidents, bathroom use change, encopresis knowledge questionnaire (EKQ), Virginia encopresis /constipation appreciation test (VE-CAT)	The Web participants showed improvement in reduced fecal soiling, increased toilet use, increased unprompted trips to the toilet. Both groups showed improvements in knowledge and toileting behaviors. Internet interventions may be an effective way of delivering sophisticated behavioral interventions to a large and dispersed population in a convenient format.	VECAT- consists of 18 pairs of drawings (9 pairs of bowel-specific and 9 parallel generic events), the child selects the picture in each pair that best describes him/herself. Authors state the VECAT has good internal consistency and testretest reliability.
Winzelberg AJ Eppstein D Eldredge KL Wilfley D Dasmahapatra R Dev P Barr-Taylor C, 2000 [51]	Eating Disorders	N = 60 (I = 31, C = 29) 8-week intervention and three-month follow up. Comparison of Web-based and classroom based psychoeducational interventions to reduce body dissatisfaction and eating disorders/behaviors/attitudes.	Behavior change	Longitudinal randomized study	IV = Web-based intervention, Class room intervention DV = Change in body satisfaction questionnaire scores, Eating disorder examination questionnaire, EDI-Drive for thinness scale	Evidence of feasibility for an Internet intervention to provide education via the Internet. At follow up, the intervention group showed improvement in body image and a decrease in the drive for thinness measures compared to controls.	Body satisfaction questionnaire (BSQ) has internal consistency of .97, test-retest validity =0.88, and concurrent validity coefficient = .66. EDI drive for thinness subscales have cronbachs alpha between .65 and .90.
Andersson G Stromgren T Strom L Lyttkens L, 2002 [35]	Tinnitus	N = 117 (I = 53, C = 64) Web-based cognitive behavioral therapy (CBT) to decrease distress caused by tinnitus.	Cognitive Behavioral Therapy	Longitudinal, randomized, Crossover design 6 month intervention, six month control	IV = Use of Web-based structured interview, treatment interactions, self-help program and weekly diaries DV = CBT Treatment efficacy evidenced by change in tinnitus reaction questionnaire, annoyance, anxiety sensitivity, depression scores	Reductions of tinnitus-related annoyance and anxious and depressive mood.	Tinnitus Reaction Questionnaire (TRQ) 26-item scale internal consistency of .96, test-retest correlation r=.88, Swedish version reported α = .97. Hospital anxiety and depression scales (HADS) show α=.82, α-.90 respectively.
Soetikno, RM. Mrad, R. Pao, V. Lenert, L., 1997 [33]	Ulcerative colitis (UC) and Quality of Life	N = 100 (I = 53, C = 47) Compared self-administered Internet based SF 36 and Irritable bowel QOL specific questionnaires (IBDQ) to paper-based administration.	Not discussed	Randomized Trial	IV = Use of Web-based assessment tool DV = Response demonstrating Validity of MOS 36 and IBD assessment surveys	Web-based scores on the IBPD tool were statistically different. Web participants had a wider range of scores and lower mean scores than clinic cases.	MOS-SF 36 Reliability cronbachs alpha: Phys. function .88-.93; Phys. role limits 84-.96; Pain .80-.90, social function .68-.85; Mental health .82-.95; Emot. role limits 80-.96; Vitality .85-.96; Gen. health .78-.95.

Author(s) and date	Intervention Focus	N and Study Characteristics	Conceptual Framework	Design	Variables/Behavior Change Variable	Study Findings	Reliability of Effect Variable Instrument
Homer C, Susskind O, Alpert HR, Owusu M, Schneider L, Rappaport LA, Rubin DH, 2000 [43]	Asthma	N = 137, (I = 76,C = 61) children ages 3-12, 12-month study Effectiveness of interactive multimedia educational software program about asthma vs. control who reviewed printed educational materials with a research assistant.	Self efficacy theory	Longitudinal Randomized study	IV = Use of Interactive tool DV = Acute care use emergency department (ED), outpatient clinic (OP) clinic, reports of asthma severity. Parent/child knowledge of asthma.	No differences were demonstrated between the 2 groups in primary or secondary outcome measures. Both groups showed improvement in all outcomes. Increased knowledge after use of the computer program. Children reported having enjoyed using the program.	Child Health Questionnaire (CHQ-PF50) assessed functional status. 11 multi-item scales covering the physical, emotional and social well-being of children. Internal consistency alphas of .39-.96 (mean.72)
Lange A, Rietdijk D, Hudcovicova M, van de Ven JP, Schrieken B, Emmelkamp PM, 2003 [45]	Posttraumatic Stress Disorder	N = 184 (I = 122, C = 62) 5-week study consisting of two, 45 minute writing session per week consisting of self confrontation, cognitive reappraisal, and social sharing.	Behavior change	Longitudinal Randomized study	IV = Use of Web-based intervention DV = Change in Impact of Event (IES) scale, symptom checklist-90 scale	On most subscales, more than 50% of the treated participants showed reliable change and clinically significant improvement, The highest percentage change was found for depression and avoidance.	The IES *(Dutch version by Kleber & Brom, 1986*). Uses* a 5-point Likert scale on experiences for a given symptom during the past week. Cronbachs alpha .66 -.78 for the Avoidance subscale and .72 -.81 for the Intrusions subscale.
Strom L, Pettersson R, Andersson G, 2000 [50]	Recurrent Headache	N = 102 (I = 20, C = 25, dropout = 57) 6-week intervention of applied relaxation and problem solving to treat recurrent headaches while minimizing therapist contact.	Self-help	Longitudinal Randomized controlled study	IV = Use of the Web-based training program for headache relaxation techniques and headache problem solving DV = Headache index measure, # headaches, intensity, Becks Depression Inventory, Headache Disability Inventory	The Internet has the potential to serve as a complement in the treatment of recurrent headache. A significant reduction in the number of headaches for the treated participants.	No validity or reliability discussion.
Southard BH Southard DR Nuckolls J, 2003 [49]	2^0 prevention heart disease	N = 106 (I = 53, C = 53) 6-month study comparing an Internet based program (SI) for nurse case managers to provide support, monitoring and education to patients with CVD. Tailored interactive home based system. Use was once a week for 30 minutes.	Not discussed	Longitudinal Randomized case control pre post study	IV = Use of Heartlinks DV = physiologic measure change, Minutes of exercise; MEDFICTS fat score; Depression score; Costs of care	Fewer CV events occurred in intervention (SI) than in control. Increased weight loss in SI group to control. Depression scores increased in both groups Minutes of exercise increased	Dartmouth (COOP) QOL assessment 8 factors and health status change score Becks Depression Inventory 21 items, Internal consistencies from .73 to .95.
Bell DS, Kahn CE Jr, 1996 [3]	Validity and Reliability assessment of Web-based MOS SF 36.	N = 4876 Web versions, 2471 MOS study Compared MOS SF 36 validity and reliability data of paper based documentation to Web-based version.	Not discussed	Convenience sample	IV = Use of Web-based SF 36 DV = Completion and Results of QOL subscales	97% of users completed the survey in < 10 minutes. Older participants required more time to complete the survey. Web participants had overall worse QOL subscale values	Subscale scores range from 0.76 to 0.90, similar to those of the MOS paper based reliability values.

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Author(s) and date	Intervention Focus	N and Study Characteristics	Conceptual Framework	Design	Variables/Behavior Change Variable	Study Findings	Reliability of Effect Variable Instrument
Flatley-Brennan P, 1998 [39]	HIV/AIDS	N = 57 (I = 37, C = 20) 25-week study demonstrating the use and effects of a specialized computer network among persons living with AIDS,	Rogers Diffusion of Innovation Theory	Longitudinal Randomized, Repeated measures study	IV = Home-based computer network use DV = Reduce social isolation improve confidence skills in decision-making no differential decline in health status among PLWA.	No significant difference between experimental and control groups Use of the system did reduce social isolation once participants levels of depression were controlled and that decision-making confidence improved as a function of number of accesses	Decision making confidence used a modified Saunders and Courtney 15 item - 22-item scale. (α=.80). Social isolation used Lins expressive social support scale (α=.88). Health status used 7 item Activities of Daily Living sub-scale (α=.76)
Wu AW, Yu-Isenberg K, McGrath M, Jacobson D, Gilchrist K, 2000 [34]	HIV/AIDS	N = 164 Touch-screen PC (n = 63,) Interview (n = 50), or self-administration (n = 51).	Not discussed	Randomized trial	IV = Use of touch screen in clinic kiosk PC to complete assessment tools DV = Reported measures from MOS-HIV, AIDS Clinical Trials Group (ACTG), Baseline Adherence and ACTG Symptom Distress	The reliability was noted to be comparable to face-to-face interview and self administration of the paper based tool.	Reliability of MOS_HIV α=0.69-0.94 for all subscales. Interclass correlations range between 0.54-0.88 for each subscale.
Bangsberg DR, Bronstone A, Hofmann R, 2002 [31]	HIV/AIDS	N = 110 Computer-assisted patient self report vs. provider estimate of HIV medication Adherence.	Not discussed	Convenience sample	IV = Use of Computer assisted, self-administered interviews (CASI) kiosk PC to complete survey tools. DV = Patient self report and provider medication adherence estimate, errors taking medication	54% of patients made at least one error in reporting their medication regimen. Providers tended to overestimate their patients' adherence and correctly classified only 24% of nonadherent patients at the 80% adherence level.	Validation of patient HIV medication self report done using the Aids Clinical trias Groups (ACTG) reasons for missing medications survey, viral load and CD4 lab values to assess detectable and non-detectable levels.

** Intervention = I; Control = C; IV = Independent variable; DV = Dependent variable; PLWA = People living with AIDS;

* Kleber RJ, Brom D. Traumatische ervaringen, gevolgen en verwerking (Traumatic events, consequences and processing). Lisse, The Netherlands: Swets & Zeitlinger; 1986

Table 4. Demographic characteristics of the cumulative studies

Author	Total N*	Attrition % From Enrollment To Final Follow Up			Mean Age in years (Range)	Gender	
		Intervention	Control	Study Duration		Males	Females
Andersson et al [35]	117	13%	7%	6 weeks	47.8	62	55
Bangsberg et al [31]	110	NA	NA	NA	46	96	14
Bell & Kahn [3]	4876	NA	NA	NA	38.2	2455	2421
Celio et al [36]	76	12%	31%	26 weeks	19.6 (18-36)	0	76
Christensen et al [37]	3530	48% reported combined		self paced	35.5	1567	1963
Chou [32]	359	NA	NA	NA	42.7	280	79
Clarke et al [38]	299	41% reported combined		32 weeks	43.7	73	226
Flatley-Brennan [39]	57	20%	12%	26 weeks	33.2	53	4
Gustafson et al [40]	204	12%	8%	26 weeks	34.6	184	20
Harvey-Berino et al [41]	46	4% reported combined		37 weeks	46.3 (31-60)	9	37
Harvey-Berino et al [42]	122	18% reported combined		78 weeks	48.4	18	104
Homer et al [43]	137	25%	20%	40 weeks	7.4 (3-12)	95	42
Krishna et al [44]	228	53%	58%	52 weeks	Not Specified	148	80
Lange et al [45]	184	53%	48%	5 weeks	47.8	Not Specified	
Marshall et al [46]	655	14%	19%	10 weeks	43	321	334
Oenema et al [47]	198	NA	NA	NA	44	75	123
Ritterband et al [48]	24	0%	0%	3 weeks	8.4	5	19
Soetikno et al [33]	100	NA	NA	NA	44.5 (midpoint) (35-54)	55	45
Southard et al [49]	106	4%	0%	52 weeks	62 (37-86)	80	26
Strom et al [50]	102	44% reported combined		6 weeks	36.7 (19-62)	33	69
Winzelberg et al [51]	60	23%	31%	20 weeks	20 (18-33)	0	60
Wu et al [34]	164	NA	NA	NA	41.5	120	44
Combined**	11754	21%	21%		41.5	5,729	5,841

* Sample size (N) was derived from the number of cases newly enrolled into each study

** Combined average age excluded: (1) Homer et al [43]; Ritterband et al [48]; Krishna et al [44]: subjects were all children 17 years of age or less. (2) Christensen et al [37], only those who participated in the completion of the Goldberg Depression Scale portion of the study. (3) Soetikno et al [33], only age range and midpoint were reported. Gender data were not reported by Lange et al [45]. Attrition rates were combined only for those specifying intervention/control.

NA=Non-longitudinal Study

Knowledge and Behavioral Change Outcomes

Sixteen of the 17 studied effect outcomes revealed improved knowledge and/or improved behavioral outcomes for participants using the Web-based interventions. The individual effect sizes for each of the reviewed study variables for knowledge change and/or behavioral change showed effect sizes ranging from small (±.01 to .19) [36-38,41,44,46]; to moderate (±.20 to .47) [39,45,47,50,51]; to moderately large (.54 to .75) [40,42,43,49]. Of the 17 studied outcome variables, six showed that the positive effect sizes were statistically significant as seen by the confidence intervals being greater than zero [42-45,47,49]

(Box 1). The one study favoring non-Web-based interventions did not show statistical significance [46]. There was no significant difference between the length of an intervention and effect size for the studied outcome.

Review of the forest plot graphical output figures showed a high degree of heterogeneity indicated by the confidence interval overlap (Box 1). Estimation of the homogeneity statistic was calculated and was statistically significant indicating variation between the 17 studies (Q_{w16} = 49.993, $P \leq .001$). Sensitivity analysis to ascertain the studies with the greatest heterogeneity, revealed three standout studies [37,46,49].

Textbox 1. Effect size (ES) for outcome variables in the analyzed Web-based interventions compared to paper-based interventions (N = 17 Studies)

Study #, Primary Author, Study Focus-Effect Variable	ES
1. Andersson et al. Pre-post-follow up tinnitus reaction questionnaire [35]	.16
2. Celio et al. Change in Body Shape Questionnaire [36]	.04
3. Christensen et al. Goldberg Depression Scale-Mean Module 1 scores, gender combined [37]	.07
4. Clarke et al. Depression (CES-D) score change [38]	.09
5. Flatley-Brennan, HIV Use of ComputerLink networking -Slower health decline [39]	.25
6. Gustafson et al. CHESS-HIV Change in participation in healthcare [40]	.54
7. Harvey-Berino et al. Weight Loss Maintenance – pounds lost [41]	.15
8. Harvey-Berino et al. 18-month weight loss maintenance [42]	.64
9. Homer et al. Change in knowledge of asthma-treatment [43]	.57
10. Krishna et al. Change in asthma knowledge scores in children [44]	.40
11. Lange et al. Change in impact of event intrusion and avoidance combined score [45]	.75
12. Marshall et al. Change in physical activity [46]	-.01
13. Oenema et al. Tailored Nutrition Education – Intention to change diet [47]	.47
14. Ritterband et al. Pediatric encopresis behavior change in bowel habit accidents [48]	.57
15. Southard et al. Minutes of exercise [49]	.74
16. Strom et al. Change in Headache Disability Inventory [50]	.19
17. Winzelberg et al. Reducing risk factors for eating disorders - change in body shape questionnaire scores [51]	.03

Assessment Instrument/Methods Comparison

The five studies comparing assessment instruments/methods when administered to Web-based and non-Web-based groups revealed two studies showing moderate negative effect sizes (Wu -.24; and Soetikno -.22)[33,34] favoring the paper-based/traditional format. The remaining three instrument/method comparison studies showed small to moderate positive effect sizes ranging from .17 to .44. One of the five studies [31], showed a statistically significant effect size, indicated by zero being included in the confidence interval, the remaining four studies showed no statistically significant effect size comparison indicating little variability between the format of the instrument/method being either Web- or non-Web-based (Box 2). Analysis of homogeneity of these five studies revealed a statistically significant Q value ($Q_{w4} = 18.238$, $P \le .001$).

Textbox 2. Effect size (ES) evaluation of studies assessing instruments/methods when administered to Web-based and non-Web-based groups (N = 5 Studies)

Study #, Primary Author, Study Focus-Effect Variable	ES	
1. Bangsberg et al.– CASI Self Report HIV Medication Adherence [31]	.44	
2. Bell et al. SF 36 QOL All Subscales [3]	.29	
3. Chou. HIV symptom self care –Taking medications, prescription, OTC medications [32]	.16	
4. Soetikno et al. SF-36 QOL-All scales [33]	-.23	
5. Wu et al. MOS-HIV QOL Survey-All scales [34]	-.24	

Discussion

Advantages for the Use of Web-based Interventions

The management of any chronic disease should be personalized to an individual, as the person is ultimately responsible for the success of the intervention. Self-management of a chronic condition and contribution to disease management has demonstrated improved results and adherence to treatment regimens [52]. Consequently, Web-based interventions should be designed to allow individuals to tailor the intervention to their specific needs. With the advent of high-level Web programming languages, intended to provide effective data and information provision and retrieval, the flexibility to provide interactive and responsive programs for use on the Internet is increasing. This is conducive to the incorporation of interactive and continuous self-monitoring, feedback and information exchange that is certain to play an increasingly important role for this patient care need.

Comparative Intervention Studies

Although the studies vary across many clinical areas of interest, there is a consistency of the selected outcome variables being targeted to require either or both an individual's knowledge and behavior change to achieve the outcome. The review of the individual study effect size comparisons in the use of Web-based compared to non-Web-based interventions showed an improvement in individuals using Web-based interventions to achieve behavior change for the studied outcome effect variables. The broad variability in the focus of the studied outcomes precluded the calculation of an overall effect size for the compared outcome variables in the Web-based when compared to the non-Web-based interventions. Additionally, a homogeneity statistic estimation also revealed widely differing study parameters ($Q_{w16} = 49.993$, $P \le .001$). Sensitivity analysis ascertained three studies with the greatest heterogeneity [37,46,49], these studies were not excluded from the analysis as their contribution to the research using Web-based and non-Web-based interventions showed significant findings. There was no significant difference between study length and effect size in the longitudinal studies.

Assessment Instrument/Method Comparison Studies

A comparison of the five Web-based instruments and the non-Web-based instruments shows the variability between the formats of the instrument to be moderate to small. The effect size analysis confirms the respective authors' findings in each of their studies. For the studied instruments, the Web-based instruments produced valid and reliable results. These studies revealed effect sizes to range from -.25 to +.29, only one of which was statistically significant, favoring Web-based interventions. In the studies that measured the use of quality of life (QOL) instruments such as the MOS-HIV and the SF-36, it should be noted that in the Bell and Kahn study [3], there was no specification of any predisposing illness in the Web-based intervention group. In the non-Web-based population, the scores reported by the authors of the comparative study [53], were combined from studies with participants having varying illnesses, which may account for this comparison group having worse SF-36 scores than the anonymous comparison group. Further, these QOL instruments may not be sensitive enough to capture the illness severity of the subscales for Web-based clients. Floor effects have been reported for the SF-36 for those with severe illness related impairment [54]. Conversely, ceiling effects may be present if the Web-user is doing well and not experiencing levels of debilitation due to symptoms. The MOS-HIV and SF-36 may not possess sufficient sensitivity to change to adequately reflect the symptom experience and management of symptoms in ongoing tailored interventions requiring daily or weekly input.

Demographic Characteristics

Most of the studies explained the possibility of demographic differences (i.e., culture, age, gender, ethnicity, and/or income) in their study intervention populations. Some studies controlled for the possibility of these differences [40], while others provided training to the Web-based intervention participants [34,43,47]. In the reviewed studies, the average age of the study participants was 41.2 years, which is relatively young. It is likely that this is not the same population who are living with many chronic illnesses. Most of the studies did not discuss issues such as ethnicity, income level, or homelessness, which are important when considering the use of a Web-based technology to deliver an outpatient intervention. All but one of the studies [45] did report gender, but overall, the differences between participation

of men and women were not large in the studies. Two studies looked at HIV interventions and had a preponderance of men (N = 237) with an average age of 37.5 years [34,40]. The studies by Bell et al and Christensen et al [3,37] were open access Web sites and had lower average ages compared to their non-Web-based control groups.

Dose of an Intervention

There are tools available that ascertain use of a Web site, visits to a various pages on the site, and paths to trace links and usage patterns by the user. These are useful to determine the dose of the Web-based intervention. Based on the individual's response, how much intervention that is needed by an individual can be

tailored and varied. In the reviewed studies that discussed their Web site use statistics, (see Table 4) there was large variability in the average intervention time and the number of logons to the sites. The average session site time of 19.3 minutes should be considered in context of the attributes of the individual using the Web site and the burden the intervention may place on the individual to complete the items and contribute any necessary interactive responses. The burden to complete the needed information throughout the site may be relieved by increased interactivity to create and maintain interest in the site. Interactivity may help reduce attrition of Web users and provide benefits in producing positive behavioral change.

Table 7. Web site usage statistics

Author	Focus/Intervention	Average Intervention Time/ site session (in minutes/person)	Web Site session logon average (/person)/ study duration (weeks)
Andersson et al [35]	Tinnitus	Not discussed	Not discussed
Bangsberg et al [31]	Computer Assisted Self-Reported Medication Adherence	Not discussed	Not discussed
Bell and Kahn [3]	Quality of life using the SF-36	4.5 min/p	Not discussed
Celio et al [36]	Eating Disorders	Not discussed	Not discussed
Christensen et al [37]	Depression and Anxiety Prevention in the General Public	9.47 min/p	280 person/6 wks
Chou [32]	HIV Self Care Symptom Management - Medication Taking	Not discussed	Not discussed
Clarke et al [38]	Depression	Not discussed	2.6 person/32 wks
Flatley-Brennan [39]	Use of ComputerLink Networking in Persons with HIV	12.5 min/p	188 person/26 wks
Gustafson et al [40]	CHESS - In Persons With HIV	Not discussed	1008 person/36 wks
Harvey-Berino et al [41]	Weight Loss Maintenance	Not discussed	Not discussed
Harvey-Berino et al [42]	Weight Loss Maintenance	Not discussed	Not discussed
Homer et al [43]	Asthma Education Program	Not discussed	Not discussed
Krishna et al [44]	Asthma Education Program use by children	Not discussed	Not discussed
Lange et al [45]	Post Traumatic Stress Disorder	45 min/p	10 person/5 wks
Marshall et al [46]	Physical Activity	Not discussed	Not discussed
Oenema et al [47]	Tailored Nutrition Education	Not discussed	Not discussed
Ritterband et al [48]	Encopresis	Nor discussed	14 person/3 wks
Soetikno et al [33]	Ulcerative Bowel Syndrome	Not discussed	Not discussed
Southard et al [49]	Prevention of Secondary Cardiovascular Disease	25 min/p	47 person/26 wks
Strom et al [50]	Headache Disability	Not discussed	Not discussed
Winzelberg et al [51]	Eating Disorders	Not discussed	Not discussed
Wu et al [34]	HIV Touch Screen MOS HIV Administration	Not discussed	Not discussed
Combined		19.3 min/p	

Variation in Study Validity

The comparative intervention studies invited participation into their studies either by e-mail or by in-person enrollment [35,36,38,40-43,45-51]. In all these studies, personal information for continued contact (i.e., telephone number, mailing and e-mail addresses) was obtained. This is in contrast to some studies in

the instrument comparison study group where self-identification and e-mail participation was obtained for the Web-based participation and the participants were anonymous [3,32,37].

Selection bias may be introduced, as it is possible that Web-savvy clients and researchers may have differing attributes from non-Web-familiar clients and researchers. Familiarity with

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the use of computers and the Internet may lead to self selection in the use of these technologies. Conversely, non-familiarity with computers and the Internet may lead others to refrain from participation, increasing attrition in these interventions. In addition, some of the anonymous Web-based participants who may have completed the assessments may not have truly met the criteria for the study. Additionally, publication bias is possible as there is the possibility of missed publications in spite of the systematic literature review process.

Conclusion

There is substantial evidence that use of Web-based interventions improve behavioral change outcomes. These outcomes included increased exercise time, increased knowledge of nutritional status, increased knowledge of asthma treatment, increased participation in healthcare, slower health decline, improved body shape perception, and 18-month weight loss maintenance. Those interventions that directed the participant to relevant, individually tailored materials reported longer Web site session times per visit and more visits. Additionally, those sites that incorporated the use of a chat room demonstrated increased social support scores. The long-term effects on individual persistence with chosen therapies and cost-effectiveness of the use of Web-based therapies and hardware and software development require continued evaluation.

Conflicts of Interest

None declared.

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Original Paper

Web-Based Targeted Nutrition Counselling and Social Support for Patients at Increased Cardiovascular Risk in General Practice: Randomized Controlled Trial

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Abstract

Background: Using the Internet may prove useful in providing nutrition counselling and social support for patients with chronic diseases.

Objective: We evaluated the impact of Web-based nutrition counselling and social support on social support measures, anthropometry, blood pressure, and serum cholesterol in patients at increased cardiovascular risk.

Methods: We conducted a randomized controlled trial among patients with increased cardiovascular risk in Canadian family practices. During 8 months, patients in the intervention group and control groups received usual care. Patients in the intervention group also had access to a Web-based nutrition counselling and social support tool (Heartweb). Site use during the study was monitored. We measured social support, body mass index, waist/hip ratio, blood pressure, and cholesterol levels at baseline and at 4 and 8 months to assess the effectiveness of the intervention.

Results: We randomized 146 patients into the Web-based intervention (n=73) or the control group (n=73). Within the Web-based intervention group, Heartweb was used by only 33% (24/73) of patients, with users being significantly younger than nonusers (P=.03). There were no statistically significant differences between the intervention group and the control group in changes in social support, anthropometry, blood pressure, and serum cholesterol levels.

Conclusions: Uptake of the Web-based intervention was low. This study showed no favourable effects of a Web-based nutrition counselling and social support intervention on social support, anthropometry, blood pressure, and serum cholesterol. Improvements in reach and frequency of site use are needed to increase the effectiveness of Web-based interventions.

KEYWORDS

Internet; diet; nutrition counseling; social support; cardiovascular risk

Introduction

General practitioners are in an ideal position to provide nutrition counselling to patients at increased cardiovascular risk. Unfortunately, they perceive barriers that limit their nutrition counselling practices such as lack of time, lack of skills, and lack of patient motivation [1]. Using the Internet may prove useful in overcoming barriers related to lack of skills and lack of time [2]. The Transtheoretical Model may provide a framework in which general practitioners can deal with different levels of patient motivation and has been used repeatedly to give shape to nutrition counselling in general practice [3-5]. The model distinguishes 5 different stages of readiness to change behaviour: precontemplation, contemplation, preparation, action,

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and maintenance. Further, the model includes processes of change, decisional balance, and self-efficacy [6]. Nutrition counselling efforts thus far have not shown much success in the long term. Social support, which plays a role in many of the processes of change in the Transtheoretical Model, may be particularly crucial in this respect [7-9]. Unfortunately, social support is often not included in nutrition counselling interventions. The limited research thus far has suggested that Internet applications may increase social support levels by providing a significant avenue by which peer interaction can take place [10-13], eg, by means of online patient groups, listservs, bulletin boards, and chat rooms. Internet applications obviously have other advantages: they require a 1-time-only effort for design and implementation, after which they may be useful for large groups of people.

The current study assessed the effectiveness of a Web-based nutrition counselling and social support program as an addition to usual care in Canadian patients at increased cardiovascular risk in general practice. The Transtheoretical Model was used as the theoretical framework for the intervention. Because this study addresses the effectiveness rather than the efficacy of our intervention, care was taken to ensure a study protocol that would be feasible in general practice. As a result, patients were

not overly encouraged to use the study website. Outcome measurements were anthropometry, blood pressure, and serum cholesterol levels. We hypothesized that a Web-based nutrition counselling and social support program would lead to improved clinical outcomes in patients who used the program.

Methods

Study Participants

Fourteen general practitioners (including Dr Godwin, who is an author of this paper) with a total of 7944 patients in the Queen's University General Practice Centre in Kingston (Canada) agreed to bring the study to the attention of their patients who were at increased cardiovascular risk. The general practitioners sent letters to all 876 patients 40 years and older who appeared in the computerized billing system in the year before recruitment for at least 1 of the following: hypertension, type 2 diabetes mellitus, and dyslipidemia. To be eligible for the study, patients had to confirm the diagnosis of 1 or more of the aforementioned risk factors for cardiovascular disease and to report to use the Internet. We included 146 patients in the intervention study. Figure 1 provides details on the recruitment and flow of the participants.

Figure 1. Selection and flow of participants
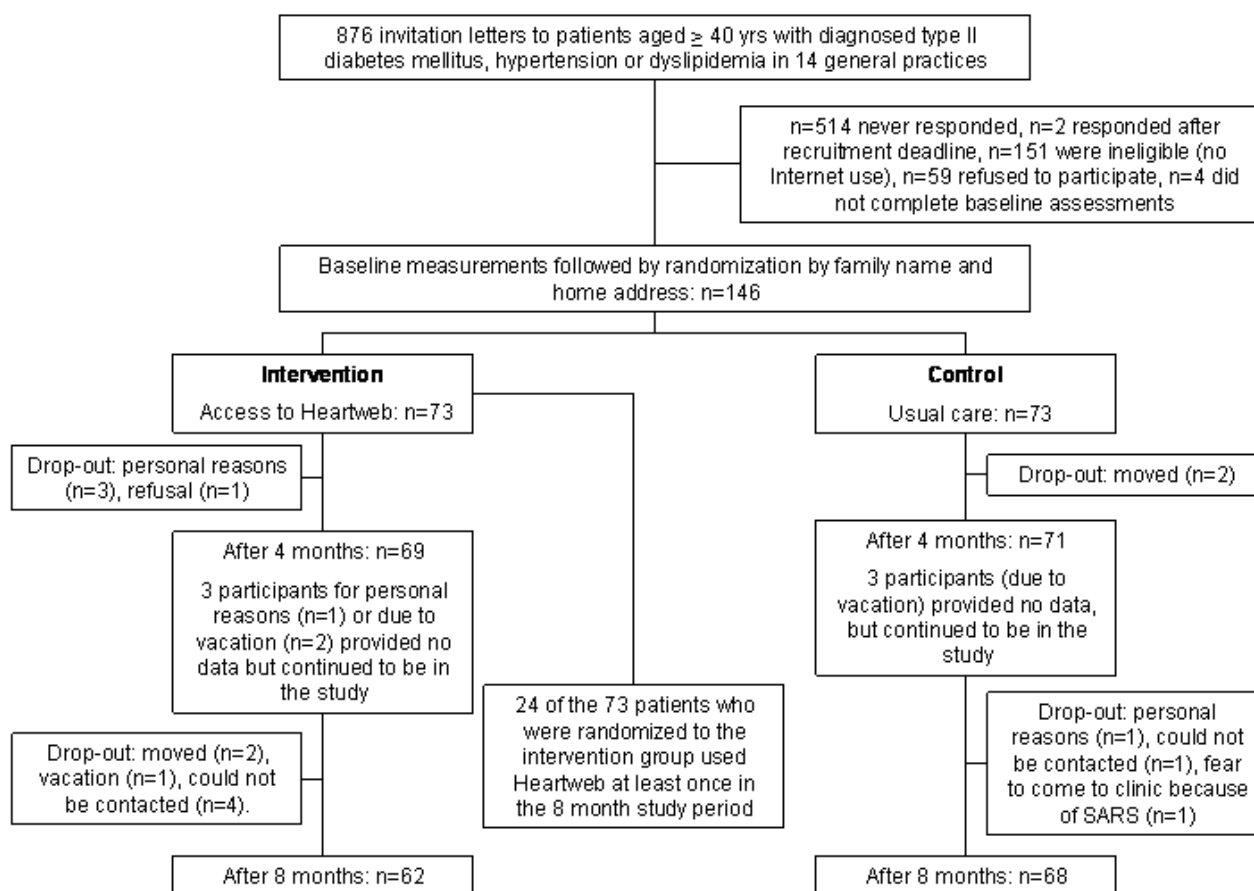
Procedure

At baseline, patients were contacted to schedule 2 appointments in their general practitioner's office. At the first appointment, patients' height and weight, blood pressure, and waist and hip circumferences were measured as described below. Patients were then referred to the phlebotomy laboratory of the adjacent hospital to have a blood sample taken. At the first appointment, patients were also given a study questionnaire. They were asked to return the questionnaire at the second appointment 1 week later. At the second appointment, patients only had to go the phlebotomy laboratory to have a blood sample taken. Follow-up assessments were scheduled 4 and 8 months after baseline. After completion of baseline assessments (September 2002 to December 2002), an independent researcher randomly assigned all 146 patients to the intervention group or the control group by using a computerized table. The control and intervention groups each comprised 6 pairs of participants (12 individuals) living at the same address and/or with the same surname. Patients within each pair were randomized into the same group to avoid contamination of the information within families or households. The randomization procedure resulted in 73 patients in the intervention group and 73 patients in the control group. Patients in the control group received usual care. In addition to usual care, patients in the intervention group were given a personal registration code for the password-protected access to a Web-based nutrition counselling and social support program (Heartweb) that was specifically designed for this study. After 4 months, patients were sent a reminder of their registration code. At each time point, patients in the intervention group and those in the control group were sent result sheets with their body mass index, blood pressure and cholesterol values. As requested by the Queen's University Human Research Ethics Board, result sheets were also sent to patients' respective general practitioners.

Patient blinding in nutrition counselling trials is difficult to achieve because patients in the intervention group may well be aware of the extra attention they receive. From our previous intervention study [5], however, it appeared that patients in both groups thought they had been in the intervention arm of the study because of all the physical assessments and the questionnaires. Most current treatment guidelines for patients at increased cardiovascular risk suggest nutrition and other lifestyle counselling, which should have made nutrition counselling a familiar notion for patients in both groups. Similar to the previous study, patients in the current study were told that the study was aimed at assessing nutrition-counselling practices in general practice. We anticipated that, as a result, patients in the control group and those in the intervention group would think they had been randomized into the intervention group.

The Human Research Ethics Board of Queen's University approved the study protocol and written informed consent was obtained from all participants. To assess the external validity of our trial, a random sample of 146 patient records was drawn from the nonresponders. These records were reviewed for blood pressure and lipid profile data from assessments between August 1, 2001 and August 1, 2002. Data were compared with baseline values of study participants.

The Intervention

As was previously done in other (Web-based) intervention studies [5,14-16], Heartweb included a procedure to target counselling messages to patients' readiness to decrease their fat consumption. Dietary fat reduction was chosen because of its key role in decreasing cardiovascular risk. We defined readiness to decrease fat consumption on an operational level using the Stages of Change Model [6].

Once every month, Heartweb presented patients with a short assessment tool to determine their stage of change. Patients were then automatically presented with an information package for that particular stage of change. Figure 2 shows an example of the personalized targeted counselling program. No longitudinal component was built into the site, ie, when patients logged on to the site a second time, no reference was made to their first "results." If patients did not progress through the stages, they were presented with the same information package twice. Once they were presented with the information package for 1 stage of change, patients could browse to the packages for the other stages of change. The targeted information packages were designed to create or enforce a positive attitude towards decreasing fat consumption, to make people aware of the risks associated with increased fat intakes, and to provide patients with practical advice on how to decrease fat consumption. Canada's Food Guide to Healthy Eating (Minister of Supply and Services Canada 1992; catalog number H39-252/1992E) and existing Web-based and non-Web-based materials were used during the development of the Web-based targeted intervention packages that constituted Heartweb [2-5,17-30]. In the precontemplation stage, for example, people were made aware of their problem behaviour and of the possible link between diet and the diagnosis of hypertension, type 2 diabetes mellitus, and dyslipidemia. They were also informed about the possibility to change and were encouraged to consider implementing dietary changes. Care was taken to avoid being patronizing. Common misconceptions about one's dietary behaviour could result in people classifying themselves in action or maintenance while not eating a sufficiently low-fat diet. This has consequences for the personalized feedback messages. In the action stage, people are usually encouraged to continue their efforts towards behaviour change (ie, further changes are often recommended). In the maintenance stage, by contrast, people are usually encouraged to maintain their current diet and no further changes are recommended. To limit the possibility of inappropriately doing so, people in the maintenance stage were presented with a short checklist designed to assess whether or not patients were likely to be truly eating a sufficiently low-fat diet [31]. Patients who were truly eating a low-fat diet were given the appropriate reinforcement. Patients who were most likely not eating a low-fat diet were given feedback on this possible misconception and were asked to reconsider dietary changes. This provided a means to ensure appropriate feedback even for those who mistakenly thought they were eating a low-fat diet.

Independent of peoples' stage of change, we included a self-assessment tool for dietary fat intake provided by the Nutrition Promotion Program of the Kingston, Frontenac and Lennox & Addington Health Unit to increase patients' awareness

of their dietary behaviour [32]. To increase peoples' confidence in their ability to adopt a low-fat diet, we added 4 heart-healthy recipes provided by the Dietitians of Canada to the web site. For more healthy recipes, patients were referred to web sites of the Canadian Heart and Stroke Foundation and the Dietitians of Canada. Heartweb also consisted of a bulletin board that enabled patients to post messages for social support. To encourage the use of the bulletin board, the information packages for each of the stages of change concluded by referring

participants to the bulletin board. Using a patient entry, we posted messages on the discussion board to get the online conversation started and to keep it going when it slowed down. The research team participated in the online discussion only when specifically requested by the participants.

Data on date, time, and duration of site use and the answers to the online Stages of Change questionnaire and the self-assessment tool for dietary fat intake were stored on the web site and were accessible only to the research team.

Figure 2. Stage-matched nutrition information for the preparation stage
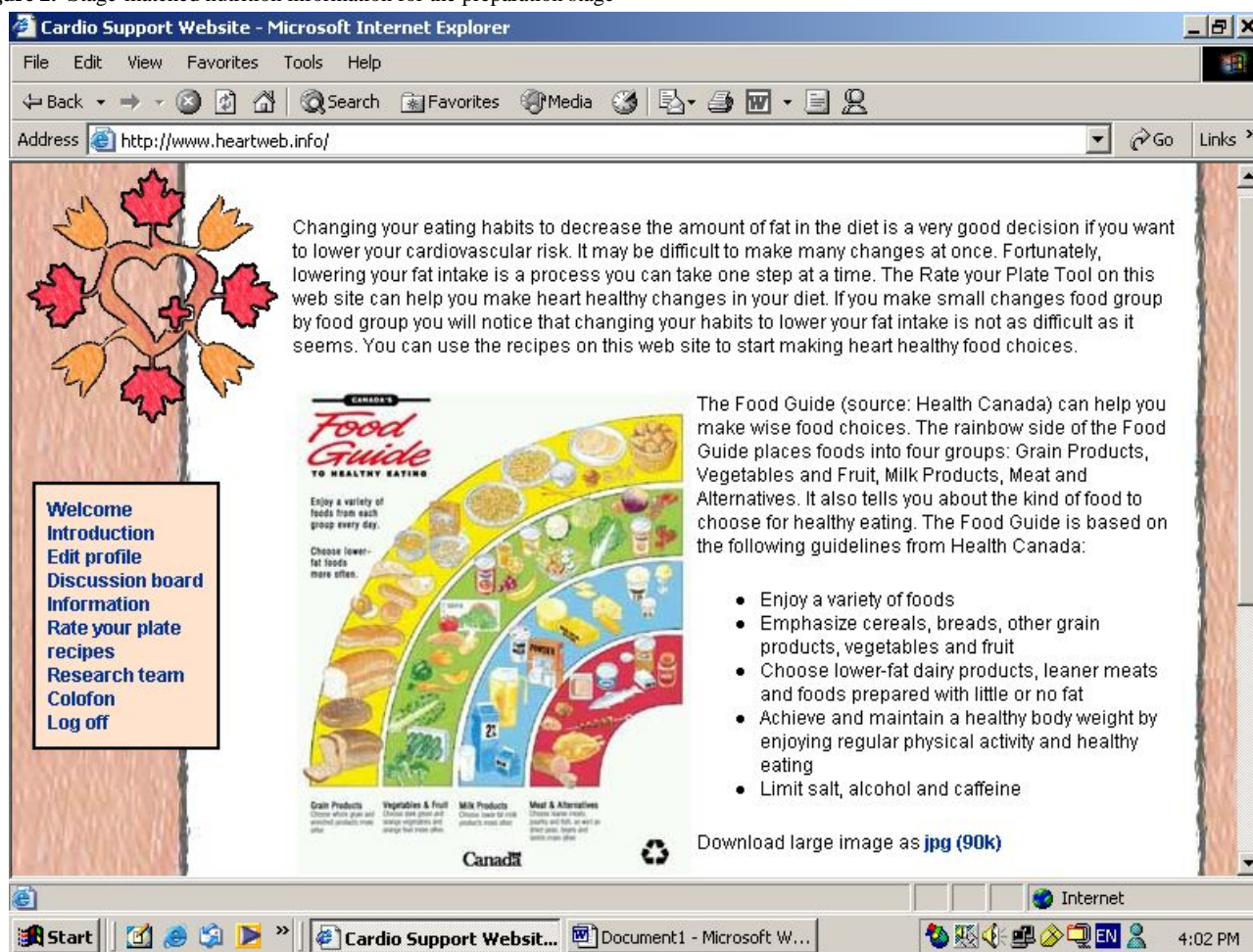
Outcome Measurements

Outcome measurements were assessed at baseline and 4 and 8 months after randomization by using the procedures described below. Measurements were conducted by researchers who were blinded to the outcomes of the randomization procedure.

Participants were asked to fill in a questionnaire consisting of a general section that included items on demographic data, smoking status, physical activity, Internet use, and medications. Stage of readiness to decrease fat intake was assessed with an algorithm [5]. The social support section consisted of a version of the 16-item social support scale used by Winzelberg et al [11] to measure perceived social support that was adapted to be applicable for a heart-healthy diet. The questionnaire included specific items on the exchange of online support. The availability and use of a social support network was measured with the 7-item National Population Health Survey social

support scale [33]. The introduction to this scale specifically requested patients to report personal, phone, mail, and email contact. Participants were also asked to complete a food frequency questionnaire [34] to assess nutrient intakes. In contrast to previous publications [34], we found high (partial) noncompletion rates. Patients were contacted by phone and/or by mail to obtain complete data. Despite this contact, reporting of unrealistically low total energy intakes was frequent (<1000 kcal = 4200 kJ). Therefore dietary intake data are not discussed in the current paper.

We measured body weight (to the nearest kilogram) by using a Healthometer (model 134KGS HOM 2599). Similar scales were in use in all clinics throughout the University General Practice Centre. Body height, waist circumference, and hip circumference (to the nearest centimetre) were also measured at the practice center. All measurements were conducted without

shoes or heavy clothing. Body mass index (BMI, kg/m^2) and waist-to-hip circumference ratio were calculated. Blood pressure was measured in the sitting position 4 times on each occasion by using an auto inflate blood pressure monitor (UA-767, A&D Engineering). Readings were conducted on the same arm for baseline and follow-up measurements. The mean of the last 3 readings was used for analyses.

We measured fasting serum levels of total cholesterol, high-density lipoprotein cholesterol (HDL), and triglyceride in 2 blood samples taken with a 1-week interval. The mean of the 2 samples was used for analyses. All analyses were conducted at the laboratory of the Kingston General Hospital (Kingston, Canada) by using the Roche Modular System (Roche Diagnostics, a division of Hoffmann-La Roche). Low-density lipoprotein cholesterol (LDL) was calculated according to the formula of Friedewald et al [35]. When triglyceride levels exceeded 4.52 mmol/L, no LDL levels were calculated.

After completion of the study, patients were asked to fill in an evaluation questionnaire. For patients in both groups, this questionnaire contained items on the organization of the study and contact with the research team. For patients in the intervention group, additional questions on the use of Heartweb were included. For example, patients were asked whether they remembered receiving the registration code for Heartweb and how they felt about the procedures and contents.

Analyses

Baseline differences between groups were tested with 2-sample t-tests, and χ^2 or Fisher exact tests. Descriptive statistics were used to present data on frequency and duration of site use. We conducted longitudinal data analysis (PROC MIXED) [36] with a compound symmetry covariance structure to assess differences between groups in changes in outcome measurements during the 8-month study period. The power calculations that were based on anthropometry, blood pressure, and cholesterol outcomes are described below. PROC MIXED in SAS (SAS Institute Inc., Cary, NC, USA) takes the dependence of repeated measures of a particular outcome within 1 participant into account. Because of clustering of patients within general practices, the intracluster correlation coefficients (ICCs) of the baseline values of anthropometry, blood pressure, and cholesterol levels were calculated. All ICCs were below 0.001, indicating that the average correlation between outcome variables measured in patients in the same general practices was not different from the average correlation between outcome variables measured in patients in different general practices [37]. The longitudinal analyses were therefore conducted without a random statement for general practice (ie, without taking a possible effect of general practice into account). In addition to the analyses in which all randomized patients were included irrespective of whether or not they had been exposed to the intervention (intention-to-treat analysis), we conducted longitudinal analyses that assessed the differences in effects between users in the intervention and control groups. Because the ICCs were sufficiently low (<0.0002), these analyses too were conducted without a random statement for general practice. All analyses were conducted with the SAS system and P values less than .05 were considered statistically significant.

Conservative power calculations (power=.90 and α=.05) based on the study by Van der Veen et al [5] showed enough power to detect differences in change between groups in anthropometry, blood pressure, and serum lipid levels. For example, we were able to detect significant differences in change of as little as 0.35 mmol/L in total cholesterol and approximately 0.5 kg/m^2 in BMI. However, for differences between the intervention group and the control group to be clinically relevant, (effect sizes that can be obtained with much less time-consuming prescription of medication are generally believed to be larger), they would have to be larger than the aforementioned exemplary critical values of 0.35 mmol/L in total cholesterol or 0.5 kg/m^2 in BMI.

Results

Participant Characteristics

Figure 1 shows the selection and flow of participants. Fifty-five percent of participants were male and participants' mean age was 63 years. Medication use was much less prevalent for type 2 diabetes mellitus (15% of participants) and dyslipidemia (33%) than for hypertension (67%). Most participants were in the maintenance stage of change (Table 1). In comparison with nonresponders (Figure 1), there was a higher percentage of men among the participants. Participants also had statistically and clinically significant higher levels of HDL cholesterol and lower systolic blood pressures (data not shown).

At 4 months, data were available on 66 participants in the intervention group and 68 patients in the control group (Figure 1). Reasons for drop out included illness of participant, death or illness of a family member, refusal to participate further, or movement outside the Kingston area. There was no significant difference (P=.18) in drop out between groups and the reasons for drop out seemed unrelated to the (nature of the) intervention. In the intervention group, 3 participants provided no data at 4 months because they were on vacation (n=2) or for personal reasons (n=1). In the control group, 3 participants could not be contacted for measurements after 4 months. In the intervention group, 90% and 84% of participants completed the assessments after 4 months and 8 months, respectively. In the control group, data were obtained for 93% of the participants at both time points. Of the patients who completed the measurements after 8 months, 92% of patients in the intervention group and 80% in the control group returned the evaluation questionnaire.

Heartweb Use and Users

By and large, Internet use among the participants was highest at home (98% of patients) and at work (27% of participants). Internet use at homes of friends or family, in the library, and at other locations was much lower (9%, 5%, and 2% of participants, respectively). At randomization, none of the patients reported using the Internet to contact other people with hypertension, type 2 diabetes mellitus and/or dyslipidemia. The evaluation questionnaires showed that 93% of participants in the intervention group could recall receiving the result sheet for the baseline measurements, but only 71% could recall receiving the registration code for Heartweb, which was sent with the

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result sheet. For measurements after 4 months, these rates were 88% and 52%.

Seventeen of the 73 participants (23%) visited Heartweb at least once in the first 4 months of the study. Between 4 and 8 months, 7 additional people visited the site. The 24 Heartweb users visited the site 95 times (range 1-36 times per user, median=1). The median visit duration was 9 minutes 31 seconds and median cumulative visit duration was 16 minutes 56 seconds. Peaks in site use were observed immediately after the result sheets had been sent and in the days immediately before patients were scheduled for their appointments after 4 and 8 months. In total, 33% of patients in the intervention group used Heartweb. Posting of messages to the bulletin board during the study was limited. Most messages on the bulletin board contained requests for factual information directed to the research team. Hardly any patient-patient interaction occurred.

Patients in the intervention group who used Heartweb were significantly younger than those who did not (58 ± 9 vs 64 ± 11 years, P=.03). At baseline, there were no differences between users and nonusers with respect to sex (P=.32) or in the following anthropometric and biochemical outcomes: BMI (P=.35), waist-to-hip ratio (P=.24), systolic and diastolic blood pressures (P=.77 and P=.51), and concentrations of total cholesterol (P=.24), HDL cholesterol (P=.40), LDL cholesterol (P=.33), and triglyceride (P=.62).

Effectiveness of the Intervention

There was no statistically significant difference in change between groups in distribution across stages of change. The prevalence of medication use for type 2 diabetes mellitus, hypertension, and/or dyslipidemia remained stable throughout the study (data not shown). At baseline, there were no differences between groups with respect to social support, anthropometry, blood pressure, and cholesterol levels (Table 2). We observed no statistically significant differences between groups with respect to change in any outcome measurement from baseline to 4 and 8 months. There were no significant differences in change over all 3 time points between groups. Subgroup analyses that compared users of Heartweb with patients in the control group showed similar results (data not shown).

Table 1. Baseline characteristics of 146 Canadian patients at increased cardiovascular risk in general practice*

	Intervention Group (n=73)	Control Group (n=73)	P
Demographics			
Age, mean (SD)	62 (11)	64 (10)	.13
Male	52	59	.51
Education Level			
Low (≤high school level)	21	18	.14
Intermediate	42	30	
High (>BSc level)	37	52	
Lifestyle			
Smoking Status			
Never smoker	35	39	.60
Ex-smoker	51	52	
Current smoker	14	9	
Alcohol (>3 glasses/wk)	56	54	.87
Exercise (>3 times/wk)	63	61	.81
Medication Use for			
Hypertension	67	67	1.00
Dyslipidemia	35	31	.72
Type 2 diabetes mellitus	13	18	.47
Stage of Change			
Precontemplation	15	16	.21
Contemplation	3	5	
Preparation	1	7	
Action	13	4	
Maintenance	68	68	

* Values are percentages unless otherwise specified.

Table 2. Baseline measurements and changes after 4 and 8 months in anthropometry, blood pressure, and cholesterol levels in Canadian patients at increased cardiovascular risk in general practice*

| | Baseline | | | | | Change after 4 mo† | | | Change after 8 mo‡ | | | |
| | I | | C | | | I | C | | I | C | | |
	Mean	SD	Mean	SD	P §	Mean	Mean	P ‖	Mean	Mean	P ¶	P #
Social Support*												
Perceived support	5.7	1.3	5.7	1.2	.87	0.11	-0.08	.29	-0.17	-0.07	.60	.31
Social network	3.5	0.5	3.5	0.5	.35	-0.06	0.04	.21	0.01	0.07	.49	.45
Anthropometry												
BMI, kg/m^2	29.5	5.2	29.2	4.5	.73	0.08	-0.21	.07	-0.02	-0.01	.97	.12
Waist-to-hip ratio	0.91	0.08	0.92	0.07	.25	-0.02	-0.01	.64	-0.004	-0.01	.32	.35
Blood Pressure, mm Hg												
Systolic blood pressure	134	14	136	18	.42	-0.4	-2.1	.46	-1.9	-5.2	.16	.37
Diastolic blood pressure	81	9	80	11	.61	-0.2	-1.4	.44	-2.5	-3.2	.60	.72
Cholesterol, mmol/L												
Total cholesterol	5.5	0.9	5.4	1.2	.56	0.03	-0.06	.41	-0.08	-0.11	.79	.70
HDL cholesterol	1.56	0.44	1.47	0.39	.21	0.04	0.02	.59	-0.01	0.01	.28	.27
LDL cholesterol	3.2	0.9	3.1	1.0	.68	0.06	-0.10	.09	-0.07	-0.10	.73	.20
Triglycerides	1.9	1.9	1.9	0.8	.90	-0.21	-0.04	.16	-0.02	-0.09	.58	.15

* Data are presented separately for the intervention group (n=73) and the control group (n=73). BMI, body mass index; C, control; HDL, high-density lipoprotein; I, intervention; LDL, low-density lipoprotein.

† Change between baseline and 4 months.

‡ Change between baseline and 8 months.

§ T-test *P* value for difference between the intervention group and the control group at baseline.

‖ PROC MIXED *P* value for difference between the intervention group and the control group in change between baseline and 4 months.

¶ PROC MIXED *P* value for difference between the intervention group and the control group in change between baseline and 8 months.

PROC MIXED *P* value for difference between the intervention group and the control group in change between baseline, 4 months, and 8 months.

** The range for perceived support is 1 to 7, and the range for social network is 1 to 5. A higher score indicates higher support levels.

Discussion

Principal Findings

This randomized, controlled intervention study failed to show favourable results of a Web-based, targeted nutrition counselling intervention with a social support component on anthropometry, blood pressure, and serum cholesterol levels compared with control. Changes after 8 months tended to be more favourable in the control group than in the intervention group. It is unclear what caused these effects. One possible explanation for the lack of effectiveness could be the low uptake of the intervention, with only 33% (24 of 73) of participants in the intervention group using the Web-based counselling tool. Most participants used the tool only once during a period of 8 months. Nonuse of the intervention by patients in the intervention group has been highlighted by Eysenbach [38] as one of the methodologic challenges of doing a randomized, controlled trial of a Web-directed intervention.

Changes in clinical outcomes were expected to be the effects of dietary changes, which in turn were expected to be the result of changes in motivation and changes in social support.

However, no beneficial changes in motivation or social support were observed in the intervention group.

Unfortunately, no reliable data on dietary intake are available in this study. To our knowledge, this is the first randomized controlled trial in which the effectiveness rather than the efficacy of a Web-based nutrition counselling and social support intervention was studied in older patients at increased cardiovascular risk by using clinical outcome measurements. An important strength of the study was the nonselective and low drop out rate; for 91% of participants, data on 2 or more time points were available. This was likely the result of the fact that patients were recruited through their respective general practitioners.

Comparison with Other Studies

Related studies by Tate et al [39] and Oenema et al [32] in different populations showed improvements in body weight and self-rated fat intake. In those studies, however, high exposure to the intervention was guaranteed by recruiting volunteers through email invitations and by installing the intervention program on a local hard disk. The low exposure to the intervention in our study was likely an important cause for the lack of effectiveness. Further, at baseline, participants had high

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levels of motivation and support and relatively good health compared with the non responders. Further, use of medication to control type 2 diabetes mellitus, dyslipidemia, and hypertension was frequent. Because current practice guidelines recommend nutrition counselling before the prescription of medication, it is reasonable to assume that most participants already had a history of nutrition counselling. One may wonder how much effect any intervention might have on a highly treated population with relatively good health at baseline. A final explanation for the lack of effectiveness may lie in the generally low effects of nutrition counselling on clinical outcomes [40].

Study Limitations

We had anticipated social support to be a key factor in the intervention. Nonetheless, despite previous studies showing positive and negative effects of Internet interventions on social support, we found no difference in change in social support during our study period [10,12,41,42]. The absence of changes in social support may have been the result of high baseline support levels. Other possible explanations include the potentially limited effect of extending older people's social networks, a reluctance to ask or provide social support for partly self-inflicted conditions such as being overweight, the relative short duration of the intervention for a long-term stressor such as risk factors for cardiovascular disease, the lack of involvement by a general practitioner, or the use of a random group of peers rather than peers matched by personal characteristics such as age, sex, level of education, religious beliefs, and type of stressor [43-45]. Another intermediate outcome, motivation to change, showed similarly minor effects. A median of 1 site visit may have been insufficient to produce significant improvements. Moreover, the high percentage of people who were already in the action and maintenance stages at baseline may have limited the possibility of finding improvements. It would be interesting to know whether there were any changes in the dietary fat intake of people in the intervention group who were in the maintenance stage at baseline. Their dietary fat intake at baseline was most likely higher than recommended as a result of common misconceptions. It is possible that participants who classified themselves in maintenance at baseline and did not eat a low-fat diet changed to in maintenance and began eating a low-fat diet as a result of the intervention. Unfortunately we have no dietary intake data to study this possibility.

The percentage of people who used the Web-based counselling tool (33% of people who reported to be regular Internet users and volunteered to be in a nutrition counselling study) was low in comparison with findings by Tate et al [39]. Further, the number of times participants used the site was limited (median=1 visit in 8 months). This is particularly disappointing because Tate et al [39] showed that the effect size in a weight-loss trial was related to the number of site visits. For Web-based tools to have considerable public health impact, it is absolutely necessary to increase the number of users and the frequency of use. This is particularly challenging because of the low percentages of people who are motivated to change their behaviour [46]. Cowdery et al [47], for example, predicted a reach of 22% for targeted Web products. Several approaches may have positive effects on reach and site use. Improved access to computers and

the Internet, improved computer skills, a stronger indication of the potential benefits, and improved privacy protection of online information have been suggested to increase the reach [48,49]. Adding a longitudinal component to the site (ie, providing patients with feedback on their progress over time), sending (email) reminders to use the site, and increasing the "fun" component of the site (eg, by including a nutrition knowledge game) may have positive effects on the frequency of site use. However, people's interest in the Internet as a medium for health information may be particularly pronounced only for more stigmatizing or directly life-threatening diseases.

The Future of Web-Based Approaches in Research and Practice

Because risk factors for cardiovascular disease occur frequently in older people [50], the elderly are a large target group for lifestyle interventions. However, because far fewer older than young people use the Internet, it is understandable that older people in particular are somewhat hesitant to use these innovative approaches. In addition to the narrowing digital divide, this attitude will likely change over time, thus increasing the potential of Internet-based interventions [51,52]. As with other technical advancements, it may take decades before the public fully adopts the medium. At present, it is too early to draw definite conclusions on the true use of Internet interventions. Cautious interpretation of our study results is also necessary because use of Heartweb in a real-life situation is different from study participation. Patients who were in principle interested in computer-based approaches may have been discouraged by the burden of the study questionnaires and appointments that are not necessary if Internet-based interventions are applied in real life [53]. The median cumulative site visit duration longer than 16 minutes stresses the potential of Internet-based tools in addition to the short practitioner-patient contact during regular health checks. Approaches to keep patients engaged and involved in interventions over a longer period are therefore necessary.

The lack of controlled trials on the feasibility and effectiveness of the thousands of health education web sites indicates the need for research in this area [54]. It is quite possible that the users of computerized patient education are already the most compliant proportion of patients with practitioner-directed care. However, Internet-based tools can only be exploited to their full extent if they also get through to patients who are otherwise hard to reach and possibly undertreated in regular primary care. For example, people with a low socioeconomic status are usually at higher risk but hard to reach in health-promotion programs. They would benefit from the individualized pace of instruction and the nonthreatening learning that can occur with a computer-based learning program [24,55]. Therefore future research should help identify characteristics of the users of Web-based interventions with respect to compliance and regular care. Similarly, little is known about the factors that determine whether people are likely to be attracted to and benefit from a support group [13,56].

Implications

Altering patients' dietary behaviour in a sustainable way has repeatedly been shown to be difficult to achieve. As of yet,

computer-based interventions have not been the magical breakthrough they were hoped to be. Uptake of the current Web-based intervention was low. Our study showed no favourable effects of a Web-based nutrition counselling and social support tool for patients at increased cardiovascular risk who were likely relatively healthy and more motivated than the general patient population. However, computers can partly take over the burden of continuous care for patients with chronic diseases [57]. Therefore we believe that real-life Internet-based interventions in the future have a true potential, particularly because the continuous contact that is necessary for long-term behaviour change is difficult due to time constraints for patient and clinician. Increasing the uptake of Web-based nutrition counselling interventions remains challenging and is a key factor to successful implementation. To make full use of the possibilities of face-to-face and computer-based interactions, we strongly advocate that the World Wide Web should never fully replace consultations and clinical examinations by general practitioners or other health professionals.

Acknowledgments

Conflicts of Interest

None declared.

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Original Paper

Feasibility of Collecting Diary Data From Asthma Patients Through Mobile Phones and SMS (Short Message Service): Response Rate Analysis and Focus Group Evaluation From a Pilot Study

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Abstract

Background: Self-management of asthma may improve asthma outcomes. The Internet has been suggested as a tool for the monitoring and self-management of asthma. However, in a recent study we found that a Web interface had some disadvantages and that users stopped using the application after a short while.

Objective: The primary objective of this study was to evaluate, from a user perspective, the feasibility of using short message service (SMS) for asthma diary data collection through mobile phones. The secondary objective was to investigate patient compliance with an SMS diary, as measured by response rates over time.

Methods: The study included quantitative response rate data, based on SMS collection, and qualitative data from a traditional focus group setting. In a period of 2 months, the participants received 4 SMS messages each day, including a medication reminder, a request to enter peak flow, data on sleep loss, and medication dosage. Participants were asked to reply to a minimum of 3 of the messages per day. Diary inputs were collected in a database and the response rate per patient was expressed as the number of diary inputs (SMS replies) divided by diary requests (product of number of days in the study and the number of diary questions per day) for each participant. After the study period, the participants were invited to a focus group interview addressing the participants' attitudes to their disease, their experience with the SMS asthma diary, and their future expectations from the SMS asthma diary.

Results: Twelve patients with asthma (6 males, 6 females) participated in the data collection study. The median age was 38.5 (range: 13 – 57) years. The median response rate per patient was 0.69 (range: 0.03 – 0.98), ie, half the participants reported more than about two thirds of the requested diary data. Furthermore, response rates were relatively steady during the study period with no signs of decreasing usage over time. From the subsequent focus group interview with 9 users we learned that, in general, the participants were enthusiastic about the SMS diary – it became an integrated part of their everyday life. However, the participants wished for a simpler diary with only one SMS message to respond to and a system with a Web interface for system customization and graphical display of diary data history.

Conclusion: This study suggests that SMS collection of asthma diary data is feasible, and that SMS may be a tool for supporting the self-management of asthma (and possibly other chronic diseases) in motivated and self-efficacious patients because mobile phones are a part of people's everyday lives and enable active requests for data wherever the patient is. The combination of SMS data collection and a traditional Web page for data display and system customization may be a better and more usable tool for patients than the use of Web-based asthma diaries which suffer from high attrition rates.

Introduction

The cornerstone of modern asthma care is self-management, allowing the patients to monitor their disease severity continuously and to adjust the dose of inhaled corticosteroid based on symptoms, lung function and the use of rescue medication [1]. A recent Cochrane Review concluded that self-management might improve asthma outcomes significantly [2]. Several strategies have been developed to support self-management, including patient education and written action plans. In a recent qualitative study on patients' and doctors' experience with a Web-based asthma diary, LinkMedica Asthma [3], we found that patients and doctors were first enthusiastic about the diary in general. This study allowed doctors to access patient diary data online, thus facilitating the cooperation between doctors and patients. However, we also identified severe problems of diary maintenance over time, mainly due to lack of integration of Internet use into users' everyday life [4]. We suggested the exploration of other technologies for diary data collection. The main requirement of such technology would be that the system actively requests data from the user instead of passively waiting for the user to enter data. The diary/user interaction should be initiated by the system – not by the user, thus helping users to remember to fill in their diary and making frequent access to the diary as easy as possible. The use of reminders (emails, phone calls, mobile phone text messages or letters) to improve patient behaviour is well documented within several areas, eg, vaccination [5], the use of oral contraceptives [6], the use of prescription medicines [7], and attendance rates [8].

A number of data collection and reporting technologies would be of interest in order to seamlessly integrate this process into the users' everyday lives and to initiate the interaction with the user, eg, Short Message Service (SMS), General Packet Radio Service (GPRS), Wireless Application Protocol (WAP), and Personal Digital Assistants (PDAs). We decided to explore the oldest and most commonly available of these, SMS, as we believed that a key factor for success would be availability and the users' familiarity with the technology. It was assumed that more than 80% of Danes own a mobile phone [9]. Another advantage of SMS was that the users already had the technology (mobile phones) and that no development of client software would be necessary.

SMS is a service for sending messages of up to 160 characters (224 characters, if using a 5-bit mode) to mobile phones that use Global System for Mobile (GSM) communication. GSM and SMS services are primarily available in Europe. SMS is similar to paging. However, SMS messages do not require the mobile phone to be active and within range and will be held for a number of days until the phone is active and within range.

This study explored the use of the mobile telephone and SMS as an appropriate interface for asthma diary data collection.

The primary objective of this study was to evaluate the feasibility of SMS for asthma diary data collection from a patient/user perspective. The secondary objective was to investigate response rates over a period of 2 months from SMS collection of asthma diary data in asthma patients. It was not an objective to investigate the effect of SMS diary data collection on clinical asthma outcomes, which is an important question, but beyond the scope of this pilot study.

Methods

This study included the collection of quantitative usage (response) data, based on SMS asthma diary data collection, and qualitative data from a traditional focus group setting [10].

Participant Recruitment

A convenience sample of self-selected participants was recruited from the Danish website LinkMedica Asthma [3] between 24 February and 25 March 2003. When visiting LinkMedica Asthma during this period, users were presented with a pop-up window asking if they were interested in participating in a test of asthma diary data collection using SMS. Except for the introductory text, a "yes" and a "no" button were the only elements on the pop-up window. If the user clicked the "no" button, the window closed. If the user clicked the "yes" button, an email address was displayed and the user was encouraged to contact this email address for more information. Regardless of the button clicked, a cookie was set on the user's hard disk to prevent the pop-up window from appearing at revisits. If the pop-up window was closed by other means (eg, by clicking the cross in the top right corner), no cookie was set.

The response rate of the pop-up was not monitored. But the number of respondents who indicated interest in the study was compared to the number of hits on the pop-up page in the same period (see Results).

Respondents then received a letter with information about the study and a short questionnaire about their background and their prior use of LinkMedica Asthma; those who responded to this were included in the study. Since the focus of the study was the SMS interface rather than the disease itself, we did not attempt to verify the diagnosis of asthma, nor did we interfere with the participants' current treatment.

The participants used their own mobile phones during the study and they did not receive any reimbursement of expenses for SMS messages, which were in the order of DKK 50 (Danish Kroner; about US $8.78, or 7.72 EUR). However, after completion of the study the participants received a gift voucher of DKK 500. They were not informed about this in advance.

Design of SMS Diary

During the 2-month study period (from 12 December 2003 to 15 February 2004) the participants received a sequence of text messages each day at a self-selected time of the day:

1. Remember to take your controller medication.
2. Remember to measure your peak flow – what was your peak flow?
3. Were you awake during the night due to asthma symptoms?
4. How many doses of your rescue medication have you taken during the last 24 hours?

An example of an SMS-message is displayed in Figure 1.

Figure 1. An example of an SMS-message; the user is supposed to reply with an appropriate answer, in this case "yes" or "no".
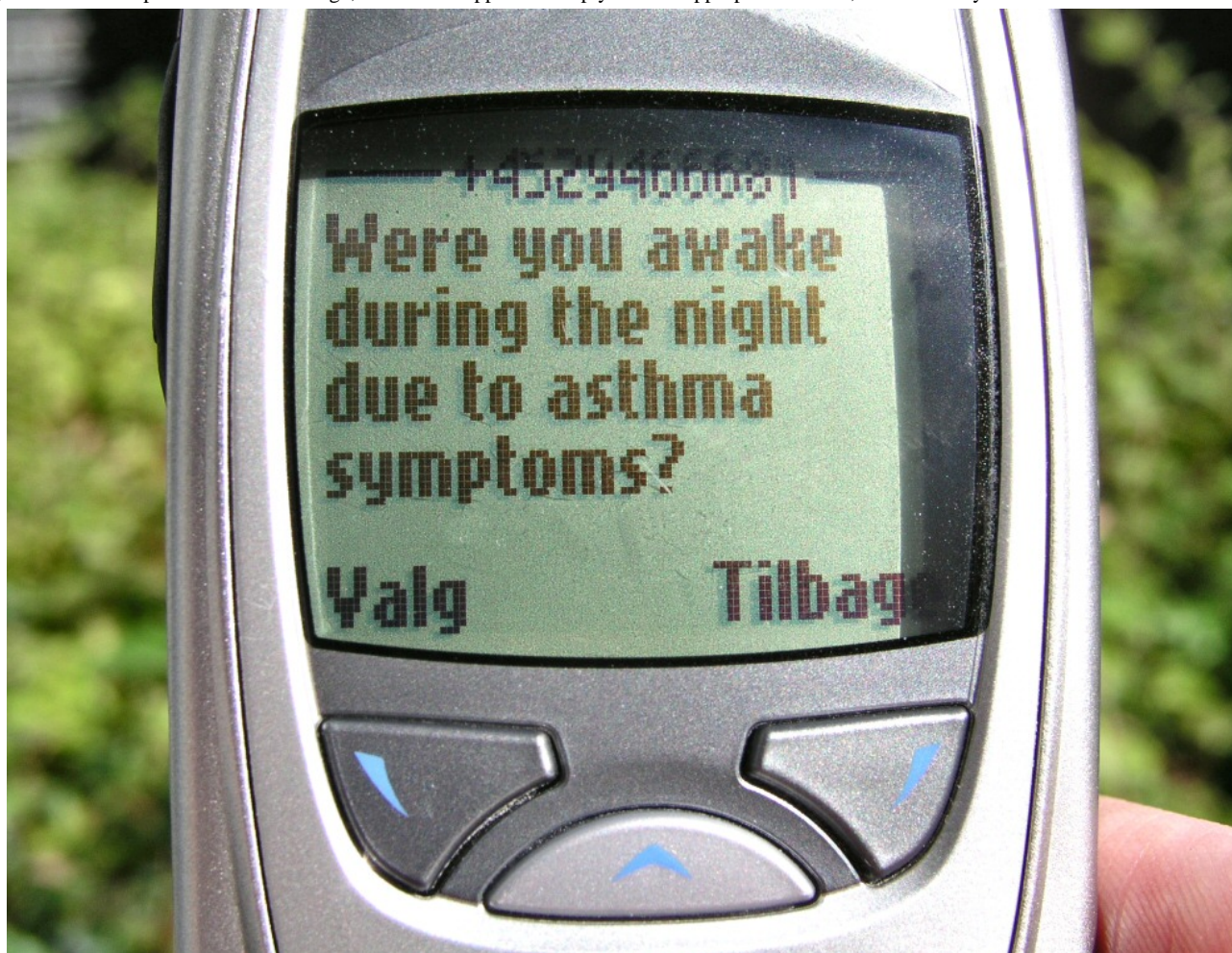
Three of these questions (questions 2, 3, and 4) required a response and are referred to as "diary questions". The participants were expected to answer these diary questions by replying with an appropriate answer: peak flow (L/min.), yes or no, and number of doses respectively. Messages number 3 and 4 were sent only if the user had answered questions 2 and 3 respectively. The delay between the users' reply to one message and the reception of the next message was approximately 1 minute. This was the time needed for the reply message to reach the server, the server to validate the reply and send out the next message and for the next message to reach the user.

The diary questions were the same as previously used in the Web-based LinkMedica Asthma diary. They were devised by LinkMedica's advisory board. As recently reported, usage of this Web-based asthma diary was found to be suboptimal as users were not using the site for more than short periods of time. The primary reason for this appeared to be that LinkMedica did not fit into their everyday lives because of technical and psychological aspects [4].

A database system collected information about diary requests and inputs (ie, user ID, question ID, date and time of request, date and time of input, and input value).

Two participants (user IDs 2 and 7) who had not used peak flow measuring prior to the study did not receive the second message about peak flow, because we did not want the study to interfere with their current routines.

In contrast to the asthma diary on LinkMedica Asthma, the SMS diary did not provide any feedback to participants on asthma status on the basis of their diary values. Thus, it was stressed to the participants before entering the study that they themselves were responsible for consulting their general practitioner or their asthma clinic if their asthma deteriorated.

Analysis of Usage Data

Usage data was analysed with R Statistical Software version 1.8.1 [11] and are reported as response rate per patient and per day:

- Response rate per patient: Total number of diary inputs (SMS replies) divided by diary requests (product of number of days in study and number of diary questions per day) for each participant
- Response rate per day: Number of diary inputs divided by number of requests for each study day.

We also looked at the total number of days where users replied to all, some or none of the diary questions. A study day with full usage is a day where the user answered all (two or three) questions in the diary. A study day with partial usage is a day where the user answered some (one or two), but not all questions in the diary.

Focus Group Interview

The focus group interview was done on 23 February 2004 and videotaped for subsequent qualitative analysis. Three themes were addressed during the interview:

- How participants related to their asthma in general
- The participants' experience with the SMS asthma diary
- The participants' future expectations from the SMS asthma diary.

Results

Participant Recruitment

During the recruitment period, the recruitment pop-up was shown 1317 times. Fifteen persons responded with "yes" (indicating interest in study participation) and were sent, via the mail, an information letter with a questionnaire. Twelve (6 males and 6 females) responded and were included in the study. The median age was 38.5 (13 to 57) years. Geographically, the participants represented both urban and rural areas of Denmark and one came from Sweden. Nine of these individuals participated in the subsequent focus group interview, which was held 1 week after the study period ended.

The self-reported prior experience with SMS messages (as determined in the subsequent focus group) was moderate for the majority of the participants for whom data were available. One participant had never used SMS prior to this study. Five participants were medium users receiving and sending 1 to 3 messages daily. Three participants were heavy users receiving and sending more than 4 messages daily. Prior to this study, none of the participants had used a questionnaire based on SMS. However, in general the mobile phone was an integrated part of the everyday life of all participants.

Diary Usage

The median response rate per patient was 0.69, ranging from 0.03 to 0.98, ie, half the participants replied to more than two thirds of the requested diary data. Four participants had a low response rate – less than 0.4 (and did not attend the focus group meeting) – while the rest had response rates greater than 0.6 (Table 1, Figure 2).

Apart from relatively low response rate in the days around Christmas and New Year's Eve, response rate per day, ie, number of diary inputs divided by number of diary requests, was relatively steady during the study period with no apparent signs of declining usage over time (Figure 3).

Out of a total of 727 study days, there were 423 days (58%) where users replied to all diary questions, 31 days (4%) where users replied to some diary questions, and 273 days (38%) where users did not reply at all.

Figure 2. Diary response rate per patient: total number of diary inputs (SMS replies) divided by diary requests (product of number of days in study and number of diary questions per day) for each participant. Numbers are shown in Table 1. The horizontal line marks the median compliance (0.69).
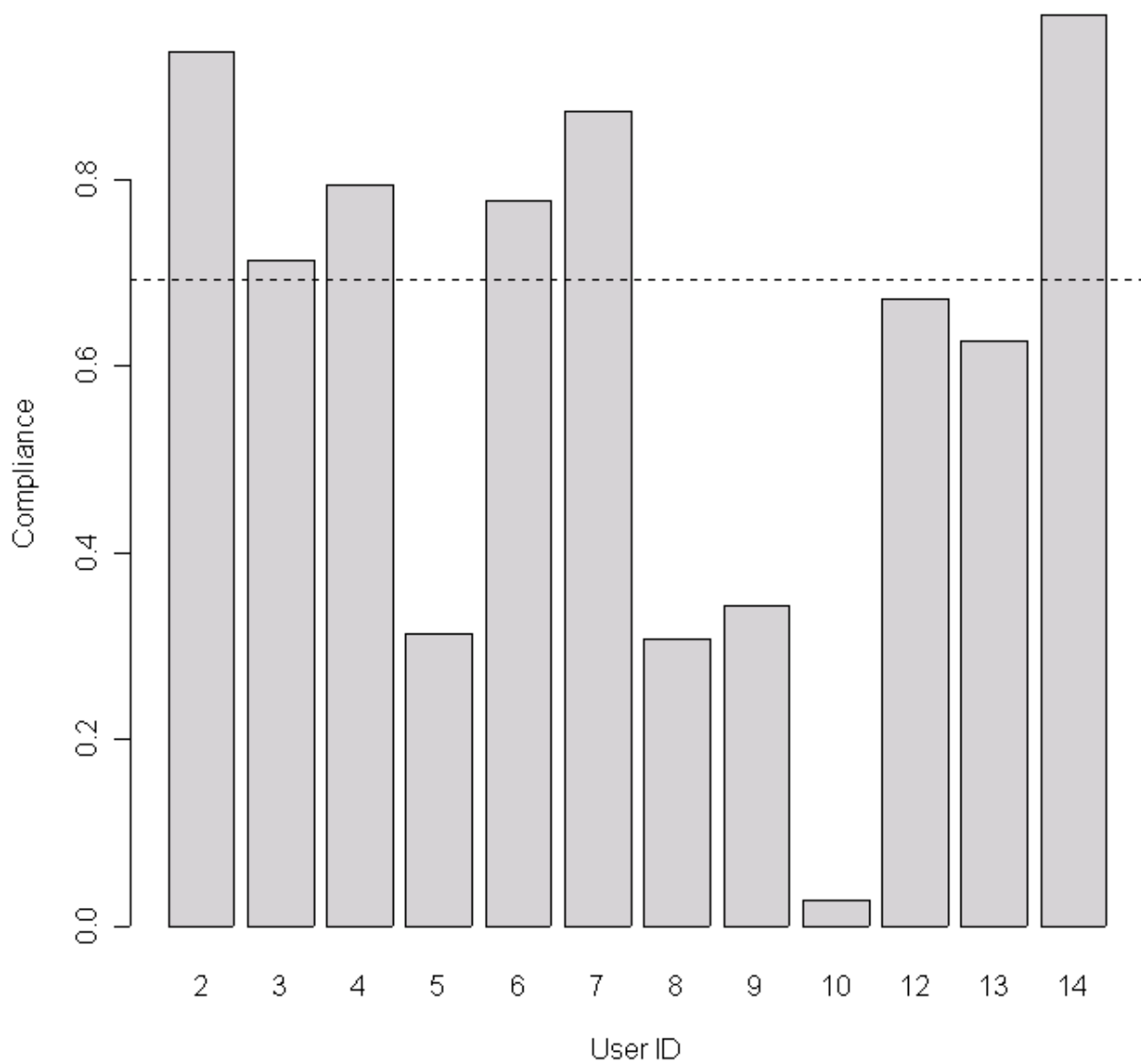
Figure 3. Response rate per day in the study period: number of diary inputs divided by number of requests for each study day
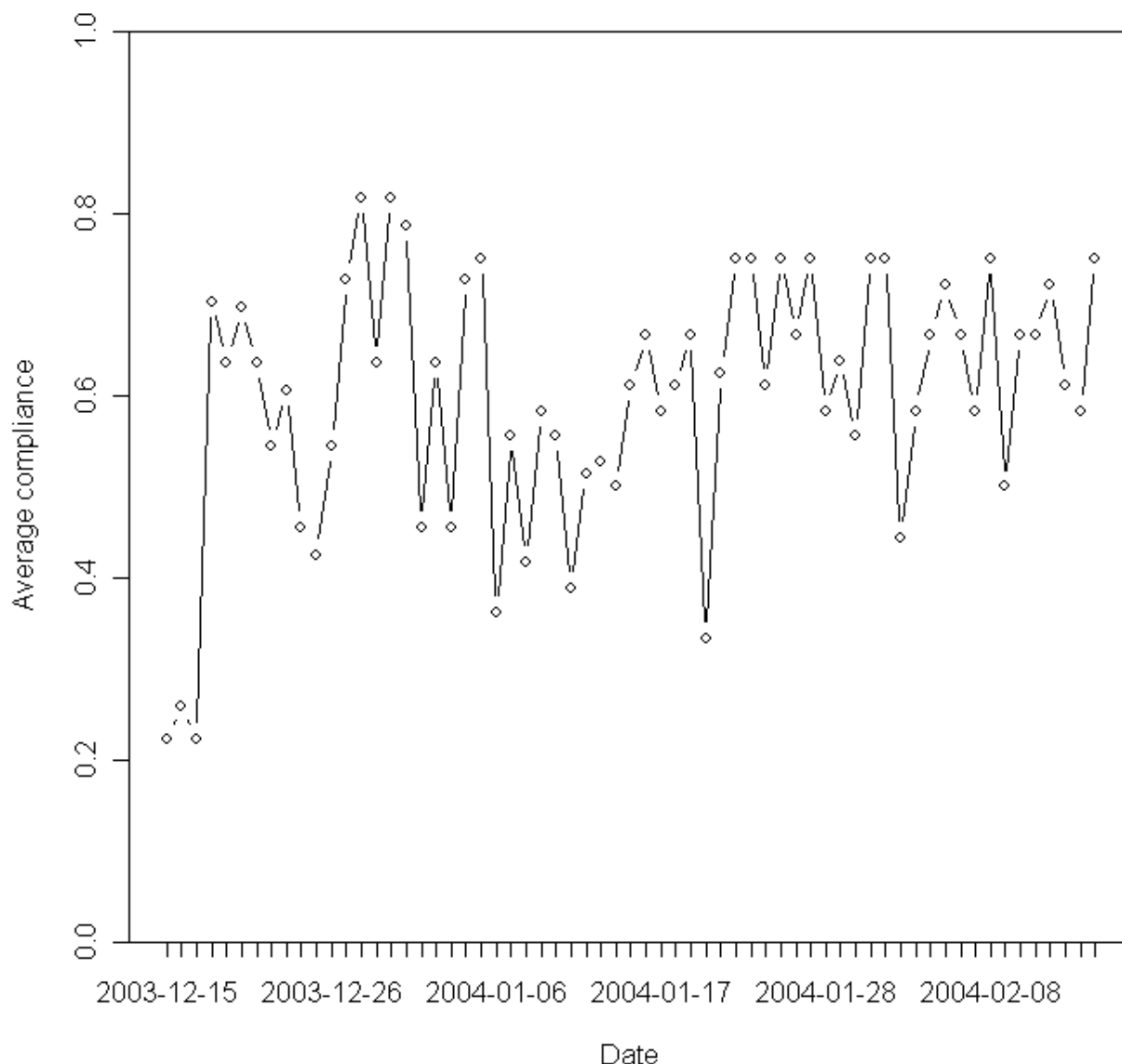
Focus Group Interview

How Participants Related to Their Asthma in General

In the focus groups, asthma was described as a burden requiring constant awareness and daily routines in order to gain and maintain control of the disease. Although the participants were aware that they had a chronic disease, they regarded their disease as something that occurs periodically like the flu or similar conditions.

In general, the participants agreed that their goal was to be able to handle everyday life without any symptoms. In contrast to what is recommended in current asthma care guidelines that emphasize the importance of self-care and awareness [1], they strived to create a stable situation taking the asthma disease out of focus thereby making them feel free from restrictions.

The participants also reflected on the patient/doctor relationship. It was evident that the participants found this relationship to be of extreme importance, but they also found that most doctors had limited interest in their disease. As one participant expressed:

> *Patient 14: "…he [the general practitioner] may have all the information but lacks the continuous insight in my situation…"*

Some of the participants had previously participated in clinical research. They explained that the purpose of this was to gain more knowledge about asthma and, hopefully, to improve their own treatment.

Table 1. User demographics and response rate for the diary questions (user ID 1 and 11 were used for testing purposes and are not shown)

User ID	Sex	Age (Years)	SMS Use Prior to the Study (per Day)	Days in Study	Number of Diary Questions per Day	Total Number of Diary Requests in Study Period	Response Rate*
2	Male	48	0	63	2†	126	0.94
3	Female	40	1-3	63	3	189	0.71
4	Male	37	4-10	63	3	189	0.79
5	Female	57	1-3	63	3	189	0.31
6	Female	42	1-3	63	3	189	0.78
7	Female	22	> 10	63	2†	126	0.87
8	Female	19	NA‡	63	3	189	0.31
9	Female	34	NA‡	63	3	189	0.34
10	Male	30	NA‡	63	3	189	0.03
12	Male	13	4-10	59	3	177	0.67
13	Male	50	1-3	59	3	177	0.63
14	Male	51	1-3	42	3	126	0.98

* Response rate per patient was calculated as the total number of diary inputs (SMS replies) divided by diary requests (product of number of days in study and number of diary questions per day) for each participant.

† Two participants (user IDs 2 and 7) had not used peak flow measuring prior to the study and thus did not receive question #2 about peak flow, because we did not want the study to interfere with the participants' current routines.

‡ NA: Data not available (user not present at focus group interview).

Participants' Experience With the SMS Asthma Diary

On the negative side, the participants reported technical issues: Why three messages every day, instead of just one? Why was there a waiting time of 1 minute between each text message? Why did the system not provide feedback when diary data indicated lack of asthma control? The messages were delivered at the same time of the day during weekends and holidays, and some participants preferred not to be awakened early on their days off. Thus, all negative issues were attributable to the fact that the SMS diary system was in the early stages of development.

The positive aspects, which were predominant, were related to the feeling of control and support provided by the SMS diary. Suddenly the participants did not have to use their energy to remember to take their medication or enter diary data – the SMS system took care of this. All participants felt that the system positively influenced their ability to cope with the disease. One expressed this as follows:

> Patient 4: "...I am not good at routines. Therefore, it is great to get a reminder saying, ʹtake your medication.ʹ It gives me freedom and creates control."

Some participants mentioned that for some purposes they preferred the daily support of the SMS diary to frequent personal support from a health care professional. It was not that they did not want to see their doctor or their asthma nurse for regular check-ups; but frequent (daily) self-monitoring using a computer system is less demanding and less insistent than frequent contact with a professional.

After the test period, several participants expressed the feeling of missing something. They missed the reminders and the diary questions. Some participants called the technical provider to report the missing text messages as a system breakdown. It was a general experience that the SMS diary became an integral part of the participants' everyday lives.

Participants' Future Expectations From the SMS Asthma Diary

The participants asked for a more flexible, dynamic, and customizable system. It is important that the patient – not the system – dictates how the SMS interface should behave. Some participants liked the daily "remember your medication" notices, others found them annoying. Some did not use peak flow measuring as part of their asthma monitoring every day and would have preferred to be able to switch peak flow measures on and off as needed. Some would have liked the system to work periodically, eg, in case of asthma exacerbation or before scheduled doctor visits instead of continuously. The participants agreed that the system should be much more interactive and responsive. If reported data indicate poor asthma control, the system should respond with an alert message or with a recommendation to see the doctor. The participants also suggested that the system be integrated with an Internet interface so there would be an opportunity to review the asthma symptoms over a period of time and options to customize the system to one's personal preferences. At best, the system should be integrated with the doctor's office either through the Internet or just by emails. Some participants suggested the use of picture messaging as part of the service.

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Discussion

In this study, we found that for a highly motivated and (self-)selected, but geographically and age diverse group of asthma patients, SMS collection of asthma diary data is feasible. In general, the participants were enthusiastic about the SMS diary. They suggested development of a live system combining an interactive SMS diary that included feedback messages with a personal Web page. The Web page should allow customization of the service to the preferences of the individual user and provide graphing and aggregation facilities for presentation of long-term diary data.

Limitations of External Validity

The participants represented a diverse group of asthma patients in terms of age, sex, and prior usage of SMS. But the participants were also a homogeneous group in the sense that they were all concerned with their asthma disease status, otherwise they would not have volunteered for the study. The sample represents a biased (self-selected) population, and our conclusions almost certainly do not apply to asthma patients in general. While this study focuses on asthma patients, the objective of this study was to evaluate the feasibility of using SMS as an interface between the patient and disease, and we believe that our findings may also be valid for similar (self-efficacious) groups of patients with other chronic diseases.

Diary Usage

We regard a median response rate per patient over 3 months of 0.69 as a positive result. But most importantly, we found that day SMS diary usage did not seem to decline during the study period, which is a common experience both from clinical practice and from previous studies. In our recent study of LinkMedica Asthma, we found that although patients and doctors appreciated the Web-based asthma diary, the use of the Web diary declined rapidly over time, mainly due to poor integration of Internet use into users' everyday life [4].

In this study, the response rate per patient was either below 40% or above 60%, which suggests the existence of two distinct groups of users: high compliers and low compliers. Three of the four low compliers also did not attend the focus group meeting suggesting a relationship between modest overall motivation for participation in the study and low response rate. However, the study was not designed with user segmentation in mind, and this observation should be investigated further in studies with higher sample sizes and a more representative study population.

Contrary to what we expected, the response rate did not seem to be related to the number of messages needing a response each day. Although the participants complained about the number of messages requiring a response, there were only 31 days of incomplete diary data compared to 423 days with complete data.

SMS Messages as Interface Between Patient and Disease

The results from the focus group interview indicate that the participants did not regard themselves as sick; their chronic asthma was regarded as a condition of life. In relation to this,

it is important that any interface between the patient and the disease does not itself make the patient feel sick. However, this does not seem to be the case as expressed by this participant:

> *Patient 13: "I was participating in a study [another study] on an Internet data collection system and someone asked me if I felt sicker due to the focus that the study put on my asthma? Certainly not – I feel that I am in control."*

Interestingly, the participants seemed to make a distinction between technological support and personal support, and they noted that in some cases the support given by a computer system might be superior to in-person support from a health care professional. The attention from another person is, in some situations, felt to be more a burden than help, whereas information technology may provide informal support helping them to gain control without criticism if the user "breaks the rules." This is in agreement with previous findings by Lange and colleagues who found greater effect from Internet-based psychotherapy of post-traumatic stress than from traditional in-person therapy [12,13].

Most participants in this study truly adopted the SMS diary. It became a part of their disease management, and it gave them a sense of control over the disease, providing more freedom. Looking at the patients' perspective on their asthma disease, it seems as if SMS supports the patients with regard to most of the negative issues of the asthma disease (routines, control). At the same time, it helps them to reach their targets (remembering medication, asthma monitoring). The mobile phone seems to be a good solution to support this process because the mobile phone can easily become an integral part of people's everyday life, not only for traditional phoning but also as a personal management system and information provider. Even though some of the participants had not used SMS prior to this study, the good response rates and the interview showed that this technology was not an obstacle.

Future Perspectives

In our opinion, the main advantages of SMS diary data collection over traditional Web-based diaries are that SMS is (or easily becomes) an integral part of people's everyday lives, and that SMS includes instant reporting to a central server, which is usually not the case when using, for example, PDAs for data collection and feedback [4,14-18].

The relatively good and, most importantly, stable response rates observed in this study open opportunities for optimizing patient self-care in management of chronic diseases and possibly also for data collection of clinical data during clinical trials.

For the future development and integration of SMS into self-managed asthma care, it is of crucial importance to regard patients as individuals with individual needs. A high degree of system customization is needed. It is also important to recognize the limitations of SMS and mobile phones. The screen and memory size of mobile phones are usually small compared to PDAs and personal computers. Thus, integration with an Internet service that stores and reviews data and makes it possible to customize the mobile phone service is needed as a back-end

information hub where the mobile phone serves as the front-end daily communication interface.

We expect that new mobile technologies will appear in the near future, and as these technologies become commonly available, the integration of traditional Web pages with multimedia applications and mobile devices will provide many opportunities for self-management applications in health care.

Conclusion

The primary objective of this study was to evaluate the feasibility of using SMS for asthma diary data collection from a user perspective. The secondary objective was to investigate response rates of SMS collection of asthma diary data in motivated and self-selected asthma patients.

We conclude that SMS collection of asthma diary data is feasible, and that SMS may be a tool for supporting self-management of asthma (and possibly other chronic diseases) in motivated and self-efficacious patients because mobile phones easily become integrated into people's everyday lives. Thus, the combination of SMS data collection with a traditional Web page for data display and system customization may solve previously addressed problems of poor compliance with Web-based asthma diaries.

Conflicts of Interest

None declared.

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Abbreviations

GPRS: General Packet Radio Service
PDA: Personal Digital Assistant
SMS: Short Message Service
WAP: Wireless Application Protocol

<u>Original Paper</u>

A Comparison of Changes in Anxiety and Depression Symptoms of Spontaneous Users and Trial Participants of a Cognitive Behavior Therapy Website

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Abstract

Background: In randomized controlled trials Internet sites have been shown to be effective in the treatment of depression and anxiety. However, it is unclear if the positive effects demonstrated in these trials transfer to community users of such sites.

Objective: To compare anxiety and depression outcomes for spontaneous visitors to a publicly accessible cognitive behavior therapy website (MoodGYM) (http://moodgym.anu.edu.au) with outcomes achieved through a randomized controlled efficacy trial of the same site.

Methods: All community visitors to the MoodGYM site between April 2001 and September 2003 were sampled: 182 participants in the BlueMood Trial who had been randomly assigned to the MoodGYM site as part of a large trial and 19607 visitors (public registrants) to the site. Symptom assessments (quizzes) were repeated within the website intervention to allow the examination of change in symptoms across modules. Outcome variables were (1) age, gender, initial depression severity scores, and number of assessments attempted, and (2) symptom change measures based on Goldberg anxiety and depression scores recorded on a least two occasions.

Results: Public registrants did not differ from trial participants in gender, age, or initial level of depression, which was high for both groups relative to previously published epidemiological data sets. Trial participants completed more assessments. No significant differences in anxiety or depression change scores were observed, with both public registrants and trial participants improving through the training program.

Conclusions: Public registrants to a cognitive behavior therapy website show significant change in anxiety and depression symptoms. The extent of change does not differ from that exhibited by participants enrolled on the website for a randomized controlled trial.

Introduction

The Internet is increasingly seen as a resource to disseminate self-help and clinician-based mental health interventions. To date, there have been 6 published trials evaluating the delivery of cognitive behavior therapy (CBT) using the Internet for anxiety and depression [1-6], of which 4 reported positive outcomes [1,2,4,5]. As yet, however, there has been no assessment of whether these evaluated websites are as useful for public users as for trial participants. The experience of a user of an open website is less structured than the experience of a participant in a randomized controlled trial (RCT). For example, RCT participants are encouraged by trial managers, either in person or by phone. They are tracked and monitored

over the trial period, and may be called to complete questionnaires over the phone or on the Internet. These aspects of the intervention may be responsible for the efficacy of these sites, either directly through personal support provided to the participant, or indirectly through the greater adherence that results from this support.

In this paper, we compare the mental health outcomes of public registrants and trial participants using the MoodGYM website, a cognitive behaviour therapy website [1, 7]. Public registrants directed themselves to the site using search engines and links from relevant Web pages. Trial participants were Internet users in the community in Canberra, Australia, who had elevated depression symptoms. Previous research on the site has demonstrated the effectiveness of the site in an RCT (subsequently referred to as the "BlueMood Trial") [1] and change in symptoms by site users [7]. However, no previous investigation has directly compared treatment outcomes from the two samples, or evaluated factors of age or initial depression severity in treatment outcome.

Methods

Sample

All participants, except 71 students (who were recruited via tutorial) were recruited from among MoodGym registrants between April 2001 and September 2003 [7]. Registrants are individuals who enroll on the site (by providing a name and password) and who create a record in our database. The BlueMood trial participants were recruited by survey and subsequently randomized to the MoodGYM website as part of a three arm trial (the other arms were a psycho-education intervention and an attention placebo condition; see [1]). Trial participants scored more than 12 on the Kessler Psychological Distress Scale [8] and were not receiving clinical care from either a psychologist or a psychiatrist at the time of recruitment. The latter requirement was imposed so that the trial included individuals who were the target audience for self-help interventions and excluded individuals who might already be receiving CBT. Because in this paper our central goal was to evaluate change in symptom scores over the course of the MoodGYM training program, only those individuals from both samples who completed more than one assessment on the website were included.

There were 19789 people registered between April 2001 and September 2003, of whom 182 were participants in the BlueMood RCT trial, and 19607 were members of the public who had registered online. Among the public registrants, 12141 (61.9%) completed at least one quiz, but only 3055 (15.6%) completed at least 2 of the Goldberg Depression Scales. Among the BlueMood RCT trial participants, 157 (86.3%) completed at least one quiz, while 121 (66.5%) completed 2 or more of the Goldberg depression assessments.

Table 1. Mean (SD) and n of the Goldberg Depression and Goldberg Anxiety Scales for the first module

	Number of modules completed	Public Registrants		BlueMood Trial Participants		Total	
		Mean (SD)	n	Mean (SD)	n	Mean (SD)	n
Depression Scale							
Male	1	5.23 (2.51)	2266	6.50 (1.29)	4	5.23 (2.51)	2270
	2 or more	5.37 (2.56)	782	6.07 (1.86)	27	5.40 (2.54)	809
	Total	5.27 (2.52)	3048	6.13 (1.78)	31	5.28 (2.52)	3079
Female	1	5.37 (2.38)	4983	4.79 (1.93)	14	5.37 (2.38)	4997
	2 or more	5.70 (2.32)	1842	5.55 (2.02)	86	5.69 (2.31)	1928
	Total	5.46 (2.37)	6825	5.44 (2.01)	100	5.46 (2.36)	6925
Total	1	5.33 (2.42)	7249	5.17 (1.92)	18	5.33 (2.42)	7267
	2 or more	5.60 (2.40)	2624	5.67 (1.98)	113	5.60 (2.38)	2737
	Total	5.40 (2.42)	9873	5.60 (1.98)	131	5.40 (2.41)	10004
Anxiety Scale							
Male	1	5.22 (2.56)	2393	5.60 (1.52)	5	5.22 (2.56)	2398
	2 or more	5.41 (2.61)	537	5.37 (2.51)	30	5.41 (2.60)	567
	Total	5.25 (2.57)	2930	5.40 (2.38)	35	5.25 (2.57)	2965
Female	1	5.74 (2.47)	4932	5.38 (1.47)	24	5.74 (2.46)	4956
	2 or more	5.93 (2.41)	1014	5.83 (2.13)	87	5.92 (2.39)	1101
	Total	5.77 (2.46)	5946	5.73 (2.00)	111	5.77 (2.45)	6057
Total	1	5.57 (2.51)	7325	5.41 (1.45)	29	5.57 (2.51)	7354
	2 or more	5.75 (2.49)	1551	5.71 (2.23)	117	5.75 (2.47)	1668
	Total	5.60 (2.51)	8876	5.65 (2.10)	146	5.60 (2.50)	9022

That is, 3176 participants provided sufficient data to allow change in depression scores to be assessed (see Table 1). Change in Goldberg anxiety score could be assessed for 1668 people, all of whom had completed 2 or more anxiety scales. Appendix A provides exact participant numbers for the major analyses.

Site Description

The site consists of a set of 5 cognitive behavioral training modules, a personal workbook (containing 29 exercises and assessments) that records and updates each user's responses), an interactive game, and a feedback evaluation form. Module 1 introduces the site "characters" (who model patterns of dysfunctional thinking) and demonstrates the way mood is influenced by thinking, using animated diagrams and interactive exercises. Module 2 describes types of dysfunctional thinking and the methods to overcome them, and provides scales for self-assessment of "warpy" (dysfunctional) thoughts. Module 3 provides behavioral methods to overcome dysfunctional thinking, and includes sections on assertiveness and self-esteem training. Module 4 assesses life-event stress, pleasant events, and activities, and provides three downloadable relaxation tapes. Module 5 covers simple problem-solving and typical responses to relationship break-up. Workbook exercises are integrated into each of the modules.

Each module was designed to take between 30 and 45 minutes to complete, but users can opt to skip sections. Module 1 has approximately 30 pages but many of these contain browser-supported interactive features (creating additional pages) and supplementary pop-up windows. Module 3 has more than 60 pages, but users are directed to specific sections depending on their scores on earlier tests and thus may not access all pages (see multimedia presentation [7]). Although users were encouraged to proceed through the assessments and modules in order, they were free to move about within the site at will. Thus, some registrants started with later modules and did not necessarily work through them in order; however, research previously conducted that matched log files to user profiles indicated that most individuals do approach the modules sequentially [7]. No assessments were compulsory in the original MoodGYM site. Since September 2003, however, a new version of the software has been installed (Mark II) that consists of compulsory core assessments and a requirement that modules be completed in order.

The MoodGYM site provides CBT for depression over 5 modules. Users complete online anxiety and depression scales in each of the 5 modules. This allows us to assess whether anxiety and depression scores change over the training program.

Assessments

Online assessments included the anxiety and depression items from the Goldberg Depression and Anxiety Scales [9]. Each of the Goldberg scales comprises 9 items. These assessments were introduced at the beginning of each of the modules, so it was possible for individuals to complete between 1 and 5 assessments. Other online assessments included the Warpy

Thoughts Quiz, a 42-item scale that measured dysfunctional thinking [10]; the Life Whacks Questionnaire (adapted with permission from the Tennant & Andrews scale to measure the stress of life events) [11]; the Measure of Parenting Style (the MOPS, used with permission from G. Parker) [12]; and the Pleasant Events Schedule [13]. These additional assessments are not reported on in this paper. Age and gender variables were collected at registration, and initial level of depression was measured by Goldberg scales at the beginning of module 1.

Analysis Strategy

Differences in response rates were analyzed using logistic regression. Differences in symptom change scores were analyzed using analysis of variance (ANOVA) with repeated measures using SPSS software. Models predicting final depression score accounting for initial score were derived from linear regression models. SPSS 11.5 software was used [14].

Results

Demographic Variables

Two thirds of all registrants were female (66.1%). Among those registered, females were more likely than males to complete at least 2 Goldberg Depression Scales (odds ratio [OR] controlling for sample [public or trial] 1.24; 95% confidence interval [CI] 1.14-1.34), while there was no difference between the sexes for completion of at least two anxiety scales (OR 0.97; 95% CI 0.87-1.1). Appendix A provides full participant numbers.

Initial Depression and Anxiety Scores

Initial levels of depression, as measured by the Goldberg Depression Scale in module 1, are shown in Table 1. Differences between the samples were not significant ($F[1, 10004]=1.25$; $P=.26$), nor were any interactions between gender and number of modules completed ($F[1, 10004]=2.661$; $P=.10$) Those who completed more than one module had significantly higher scores ($F[1, 10004]=15.7$; $P<.001$). Appendix B provides full details of analysis.

Initial levels of anxiety are shown in Table 1. Differences between the samples were not significant, nor were any interactions between sample, gender, or number of modules completed (see Appendix B).

Change in Depression and Anxiety Scores

For 3176 people, it was possible to compare the initial and final completed depression scales, although there were only 138 for whom the profile across all 5 modules could be traced. The change in depression score between the first and last modules attempted was analyzed using repeated measures ANOVA controlling for sample, gender, number of modules completed (1 to 5), and all interaction terms. The sample numbers are presented in Appendix C. Sample (public or trial) was not significant, nor were any of the interaction terms. A final model included gender and number of modules completed; the parameter estimates are shown in Table 2.

Figure 1. Estimated means with standard error bars for initial and final scores on Goldberg Depression Scale, by gender and number of modules completed, as derived from repeated measures ANOVA with fixed factors being gender and number of modules completed
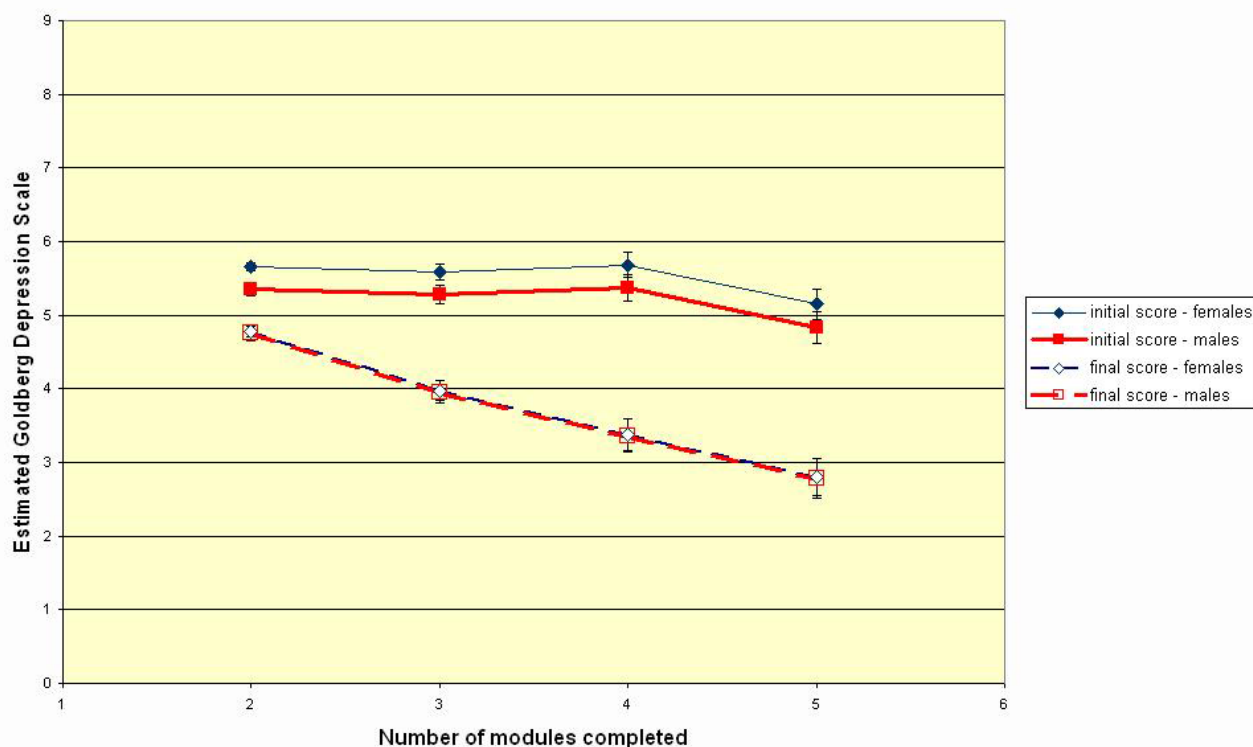
Improvement increased as the number of modules completed increased from 2 to 4, but there was no significant difference in estimated improvement between 4 and 5 modules completed. Females had higher depression scores than males for the first module, but there were no differences between the sexes for the final depression score. Figure 1 shows the estimated marginal means for the first and final modules completed, by gender and number of modules completed.

Figure 2. Estimated means with standard error bars for initial and final scores on Goldberg Anxiety Scale, by gender and number of modules completed, as derived from repeated measures ANOVA with fixed factors being gender and number of modules completed
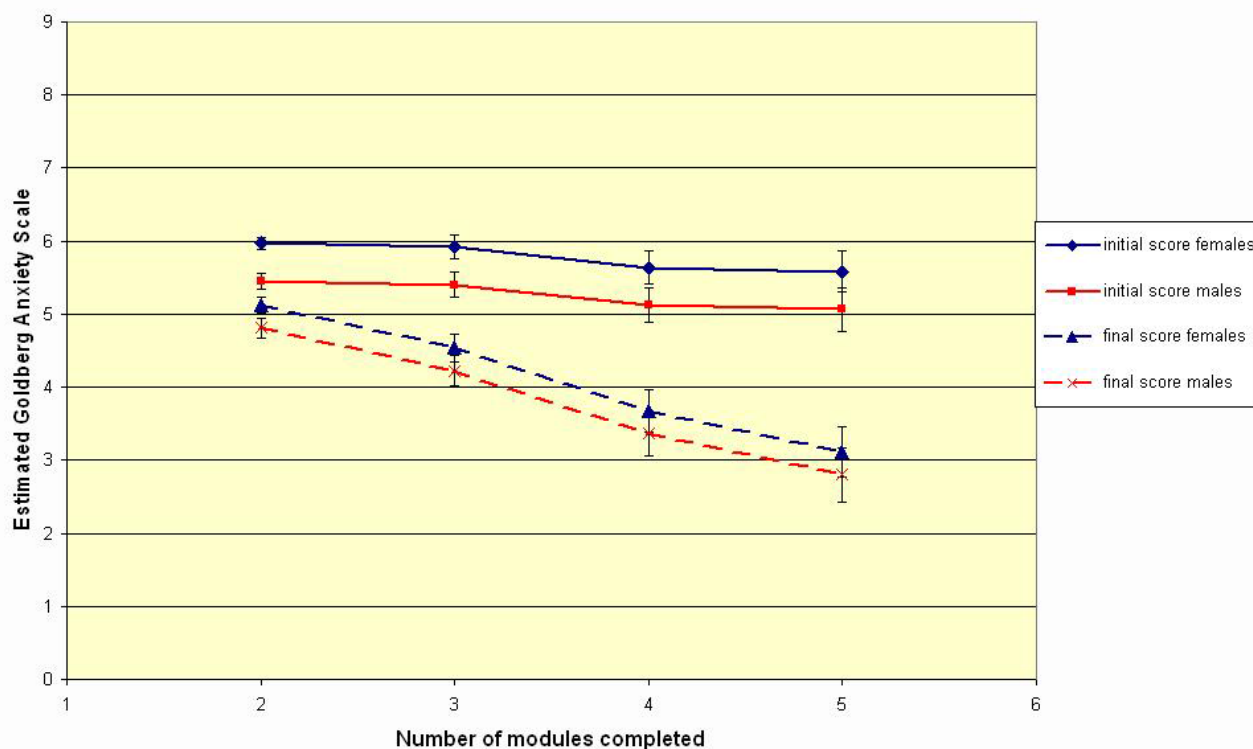
For 1668 people, it was possible to compare the first and last completed anxiety scales, although there were only 76 for whom the profile across all 5 modules could be traced. The change in anxiety score between the initial and final modules attempted were analyzed using repeated measures ANOVA controlling for sample (public or trial), gender, number of modules completed (1 to 5) and all interaction terms. Neither sample type nor any of the interaction terms was significant.

A final model included gender and number of modules completed; parameter estimates are shown in Table 2. Improvement increased as the number of modules completed increased from 2 to 4, but there was no significant difference in estimated improvement between 4 or 5 modules completed. Females had higher scores than males. Figure 2 shows the estimated marginal means for the first and final modules completed, by gender and number of modules completed.

Table 2. Parameter estimates for prediction of first and last Goldberg depression and Goldberg anxiety scores completed as derived from repeated measures ANOVA with factors being gender and number of modules completed

| Dependent Variable	Parameter	B	S.E.	t	*P*-value
Depression					
Initial depression score	Intercept	5.15	0.21	24.83	<.001
	Male	-0.32	0.09	-3.39	<.001
	2 modules completed	0.52	0.21	2.43	.02
	3 modules completed	0.45	0.23	1.92	.05
	4 modules completed	0.53	0.27	1.99	.05
	5 modules completed *	0.00	.	.	.
Final depression score	Intercept	2.80	0.26	10.95	<.001
	Male	-0.02	0.12	-0.16	.87
	2 modules completed	1.98	0.26	7.57	<.001
	3 modules completed	1.18	0.29	4.13	<.001
	4 modules completed	0.58	0.33	1.76	.08
	5 modules completed *	0.00	.	.	.
Anxiety					
Initial anxiety score	Intercept	5.58	0.28	19.65	<.001
	Male	-0.52	0.13	-4.05	<.001
	2 modules completed	0.39	0.29	1.33	.18
	3 modules completed	0.34	0.32	1.06	.29
	4 modules completed	0.06	0.36	0.16	.88
	5 modules completed *	0.00	.	.	.
Final anxiety score	Intercept	3.11	0.35	8.94	<.001
	Male	-0.31	0.16	-2.01	.04
	2 modules completed	2.01	0.36	5.63	<.001
	3 modules completed	1.43	0.39	3.64	<.001
	4 modules completed	0.56	0.45	1.26	.21
	5 modules completed *	0.00	.	.	.

* excluded category

Predicting Depression Scores at End of the Intervention

We also examined the expected magnitude of the final score for different starting levels of depression. In a linear regression with dependent variable equal to the final score and independent variables gender, number of modules (treated as 3 dummy variables), initial score, and a quadratic term in the initial score, all independent variables and the interaction between initial score and number of modules were significant. Males are expected to be 0.193 (SE = .095) higher than females, controlling for the initial level and number of modules. For initial scores above 2, it is expected that the final score will indicate improvement, the improvement increasing with the number of modules attempted. Figure 3 illustrates these relationships for the Goldberg Depression Scale.

Figure 3. Estimated final Goldberg depression score by initial score, number of modules completed, and gender. Derived from general linear model with final score as dependent variables, gender, and number of modules completed as fixed factors, and linear and quadratic terms for the Goldberg scale as covariates
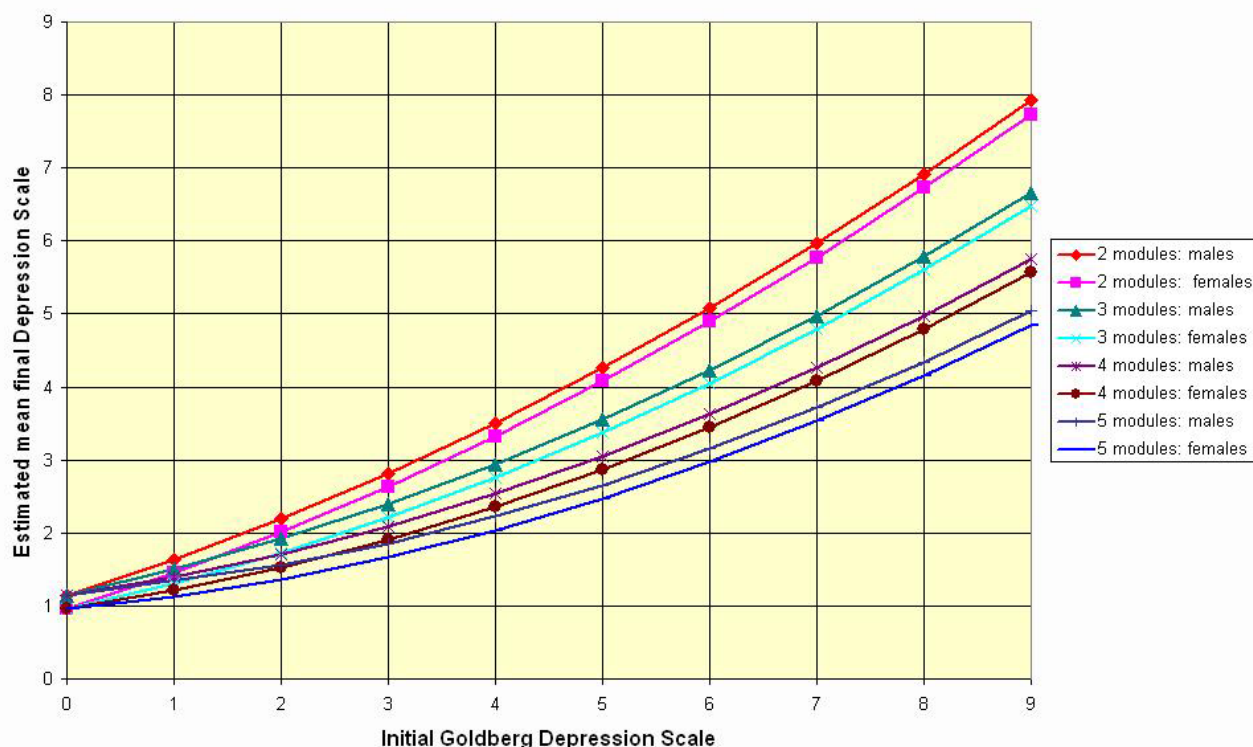
Discussion

The present study evaluated the outcomes of public registrants using MoodGYM delivered openly on a website by comparing them with trial participants in a RCT using the same site. We found that there were no differences in the initial level of depression or anxiety in the samples, that the gender balance did not differ significantly, and that the rate of change in symptoms was not different for the two samples. Both public registrants and trial participants exhibited significant improvement in symptoms.

Our findings suggest that MoodGYM can be used effectively in the community. If we had found stronger effects in the BlueMood Trial participants, we might have concluded that structured weekly human contact was a necessary condition for the site to deliver effective outcomes. However, we conclude that community users of the site are similar in gender distribution and severity of depression, and that site exposure results in similar significant symptom improvement.

Although there were no differences in outcome among participants who stayed in the program and completed at least 2 modules, we did find that community users were less likely than the trial participants to adhere to the full treatment program. Thus, the community users infrequently progressed beyond the first module of the program. Among the public, only 15.6% completed 2 or more of the modules, while over 66% of the trial participants completed 2 or more of the modules. This finding suggests that the formal structure of the trial may be important for compliance. Merrill et al reported a similar finding for clinic-based CBT: community clients attended substantially fewer sessions than clients in RCTs, yet "still showed similar levels of improvement" [15]. Only 15% completed 2 or more modules, a finding that may reflect the usability of the site, the acceptability of CBT type interventions, commitment to change, symptom level, user preference, or other factors. Factors such as these are likely to influence the uptake of non-Internet-based services as well, although comparative published data on potential users of standard health care services are not readily available. The low completion rate is not a major problem for free Internet services, which do not have specific costs based on user numbers (few additional costs are incurred for large numbers of non-completers).

There are limitations to the present study that need to be acknowledged. As is the case for studies using a benchmarking strategy, the samples involved are likely to be quite different given the operation of selection biases. The trial participants were Canberra-based, and from a population sample with high education and occupation levels. In contrast, the user sample is international, with participants from more than 62 countries. There was selective attrition, with many participants from the public sample dropping out before completion, and greater retention for the trial sample (although there were many opportunities for trial participants to be excluded or to drop out before randomization). These sample differences are difficult to characterize. However, they should be acknowledged as having the potential to mask differences in outcomes. Other sample characteristics, such as the concurrent use of evidence-based treatments other than psychotherapy (antidepressants, other medications, physical activity), were not measured but did not preclude participation in either sample.

The possibility cannot be ruled out that community users were assisted in the program by clinicians or other counselors. If this occurred for the majority of community users, our claim that the trial participants were the subject of greater assistance/support would be invalid. However, we consider it highly unlikely that the majority of public participants were assisted by a counselor or other person.

Clinicians and researchers have argued that although treatment *efficacy* needs to be established, it is crucial to demonstration of the *effectiveness* of treatments in real world settings [15]. Demonstrations of real-world effectiveness often employ benchmarking strategies where RCTs are chosen to compare results to community settings [16]. We have employed this strategy in the present study using outcomes from our own RCT. Unlike benchmarking in clinical settings where there can be considerable flexibility in application of the clinical therapy, Internet sites have the advantage of transferring the treatment with fidelity, so that differences that may exist between the trial and the real-world site can be more reliably attributed to external factors such as degree of human contact, capacity to maintain compliance, sample characteristics, and intensity of monitoring.

The findings of the present study demonstrate the effectiveness of Internet-based interventions in the early treatment and prevention of depression. Health systems in developed countries are expected to change radically over the next 10 years, with self-help and self-responsibility for health forming a new tier of the health system [17]. Sites such as MoodGYM are likely to provide both tools for the self-delivery of evidence-based prevention/treatment and resources to be used as adjuncts to professionally managed primary care.

Conflicts of Interest

None declared.

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Appendix A

Table 3. Participant numbers for all analyses §

		Public	BlueMood trial	Total
Total number registered	**Males**	6640 (33.9%)	52 (28.6%)	6692 (33.8%)
	Females	12967 (66.1%)	130 (71.4%)	13097 (66.2%)
	Total	19607 (100%)	182 (100%)	19789 (100%)
Completed at least one quiz	**Males**	3823 (31.5%)	40 (25.5%)	3863 (31.4%)
	Females	8318 (68.5%)	117 (74.5%)	8435 (68.6%)
	Total	12141 (100%)	157 (100%)	12298 (100%)
Completed 2 or more Goldberg Depression Scales*	**Males**	918 (30.0%)	30 (24.8%)	948 (29.8%)
	Females	2137 (69.9%)	91 (75.2%)	2228 (70.1%)
	Total	3055 (100%)	121 (100%)	3176 (100%)
Completed 2 or more Goldberg Anxiety Scales	**Males**	537 (34.6%)	30 (25.6%)	567 (34.0%)
	Females	1014 (65.4%)	87 (74.4%)	1101 (66.0%)
	Total	1551 (100%)	117 (100%)	1668 (100%)
Completed both Warpy Thoughts quizzes	**Males**	34 (34.7%)	10 (25.0%)	44 (31.9%)
	Females	64 (65.3%)	30 (75.0%)	94 (68.1%)
	Total	98 (100%)	40 (100%)	138 (100%)
Completed Life Whacks quiz	**Males**	268 (36.2%)	20 (20.6%)	288 (34.4%)
	Females	473 (63.8%)	77 (79.4%)	550 (65.6%)
	Total	741 (100%)	97 (100%)	838 (100%)
Completed Mum and Dad quiz	**Males**	107 (39.2%)	27 (26.5%)	134 (35.7%)
	Females	166 (60.8%)	75 (73.5%)	241 (64.3%)
	Total	273 (100%)	102 (100%)	375 (100%)
Completed Pleasant Events quiz	**Males**	103 (37.2%)	26 (24.8%)	129 (33.8%)
	Females	174 (62.8%)	79 (75.2%)	253 (66.2%)
	Total	277 (100%)	105 (100%)	382 (100%)

* Among participants who completed at least 1 quiz, all but 125 completed at least 1 Goldberg Depression Scale.

§ 1370 people completed the quizzes for module 2 and 566 completed them for module 5.

Appendix B

Linear regression model with initial levels of depression and anxiety as independent variables for participants who completed at least 2 modules

Table 4. Tests of between-subject effects (depression)

Source	Type III Sum of Squares	df	Mean Square	F	P
Corrected model	255.616	5	51.123	8.817	<.001
Intercept	11555.687	1	11555.687	1993.061	<.001
Gender	6.402	1	6.402	1.104	.29
Module number*	91.030	1	91.030	15.700	<.001
Sample	7.265	1	7.265	1.253	.26
Gender x module number	15.431	1	15.431	2.661	.10
Gender x sample	22.536	1	22.536	3.887	.049
Error	57968.006	9998	5.798		

* Module number refers to whether participants had at least 2 completed tests for either the depression or anxiety tests.

Table 5. Tests of between-subject effects (anxiety)

Source	Type III Sum of Squares	df	Mean Square	F	P
Corrected model	582.699	7	83.243	13.435	<.001
Intercept	6817.017	1	6817.017	1100.211	<.001
Gender	5.640	1	5.640	.910	.34
Sample	5.084E-02	1	5.084E-02	.008	.93
Module number	1.259	1	1.259	.203	.65
Gender x sample	2.246	1	2.246	.362	.55
Gender x module number	1.629	1	1.629	.263	.61
Sample x module number	9.467E-02	1	9.467E-02	.015	.90
Error	55851.618	9014	6.196		
Total	339306.000	9022			
Corrected Total	56434.317	9021			

Appendix C

Table 6. Number of people who completed at least 2 modules by the total number of depression modules completed

	Number of Modules Completed	Public Registrants n	BlueMood Trial Participants n	Total n
Males	2	677	5	682
	3	152	6	158
	4	60	12	72
	5	29	7	36
	at least 2	918	30	948
Females	2	1611	18	1629
	3	347	23	370
	4	111	16	127
	5	68	34	102
	at least 2	2137	91	2228
Total	2	2288	23	2311
	3	499	29	528
	4	171	28	199
	5	97	41	138
	at least 2	3055	121	3176

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Abbreviations

CBT: Cognitive behavior therapy
RCT: Randomized controlled trial

Original Paper

Knowledge and Utilization of Information Technology Among Health Care Professionals and Students in Ile-Ife, Nigeria: A Case Study of a University Teaching Hospital

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Abstract

Background: The computer revolution and Information Technology (IT) have transformed modern health care systems in the areas of communication, teaching, storage and retrieval of medical information. These developments have positively impacted patient management and the training and retraining of healthcare providers. Little information is available on the level of training and utilization of IT among health care professionals in developing countries.

Objectives: To assess the knowledge and utilization pattern of information technology among health care professionals and medical students in a university teaching hospital in Nigeria.

Methods: Self-structured pretested questionnaires that probe into the knowledge, attitudes and utilization of computers and IT were administered to a randomly selected group of 180 health care professionals and medical students. Descriptive statistics on their knowledge, attitude and utilization patterns were calculated.

Results: A total of 148 participants (82%) responded, which included 60 medical students, 41 medical doctors and 47 health records staff. Their ages ranged between 22 and 54 years. Eighty respondents (54%) reportedly had received some form of computer training while the remaining 68 (46%) had no training. Only 39 respondents (26%) owned a computer while the remaining 109 (74%) had no computer. In spite of this a total of 28 respondents (18.9%) demonstrated a good knowledge of computers while 87 (58.8%) had average knowledge. Only 33 (22.3%) showed poor knowledge. Fifty-nine respondents (39.9%) demonstrated a good attitude and good utilization habits, while in 50 respondents (33.8%) attitude and utilization habits were average and in 39 (26.4%) they were poor. While 25% of students and 27% of doctors had good computer knowledge (P=.006), only 4.3% of the records officers demonstrated a good knowledge. Forty percent of the medical students, 54% of the doctors and 27.7% of the health records officers showed good utilization habits and attitudes (P=.01)

Conclusion: Only 26% of the respondents possess a computer, and only a small percentage of the respondents demonstrated good knowledge of computers and IT, hence the suboptimal utilization pattern. The fact that the health records officers by virtue of their profession had better training opportunities did not translate into better knowledge and utilization habits, hence the need for a more structured training, one which would form part of the curriculum. This would likely have more impact on the target population than ad hoc arrangements.

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KEYWORDS

Information management; information retrieval; information technology; health care providers; students; Nigeria

Introduction

Since the development of the computer and the evolution of the Internet, Information Technology (IT) has had a positive impact on health care delivery systems worldwide, particularly in the areas of disease control, diagnosis, patient management and teaching [1-3].

While the use of CD-ROM and interactive software packages have greatly contributed to dissemination of information among health care professionals, its use is still very limited in developing countries in Africa [4,5]. The computer and IT offer the physician the ability to store and retrieve patient clinical and sociodemographic information, laboratory results and preparation of referral notes. It also aids the preparation of discharge summaries, clinic letters and financial statements of the hospital [6], as well as delivery of laboratory results [6].

The Internet provides opportunities to retrieve up-to-date information on different aspects of diseases, interact with colleagues via videoconferencing, and enhance communication amongst colleagues in different continents. Free access to Medline, medical journals, textbooks and the latest information on breakthroughs in medicine also encourages learning and research [7].

With a population of approximately 120 million people, Nigeria is the most populous country in Africa. Knowledge of computers and IT had remained poor in Nigeria. Ajuwon and colleagues [8] looked at computer and Internet use by first year clinical and nursing students at the University College Hospital in Ibadan, Nigeria and found that while about 60% had used the Internet and email, only 42.6% of them could use a computer. Ogunyade and Oyibo [4] at the College of Medicine, University of Lagos established that 52% of the 250 medical students in the study were aware of Medline on CD-ROM while only 24% had utilized it. Odusanya and Bamgbala [5] in the same institution found that 80% of the medical and dental students in their final year had used the computer; however, the use of software applications was poor, with computer games being the most frequently used (19%) followed by word processing software (18%). The Internet and email were used by 58%, but only 23% had used the Internet for medical research. All these studies concluded that that utilization of computers and IT was poor amongst Nigerian students. In sharp contrast to these findings, a Malaysian study by Nurjahan et al [9] found that 94.3% of the studied population had used a computer either in the university or at home. Of that group, 55% had adequate word processing skills, 78% had used email and 67% had surfed the Internet.

Little is known about the perception and utilization patterns of students, and to our knowledge there are no published reports on the knowledge and utilization patterns of IT among health care professionals in Nigeria.

In 2001, Edworthy reviewed the applications of telemedicine and felt that it may in fact have a more profound impact on developing countries than on developed ones. He noted that even in very remote and relatively underdeveloped communities such as the satellite stations in Uzbekistan, Cambodia, and Kosovo, low bandwidth Internet reached into the most remote areas, despite their unstable political climate and poor socioeconomic environments [2].

Figure 1. An annex of Obafemi Awolowo University Teaching Hospital Complex in Ile-Ife, Nigeria (Comprehensive Health Center, Eleyele) (Photo: Anja Mursu)

Figure 2. Renal Center-Haemodialysis Unit at the hospital (Photo: Fatiu Arogundade)

An information-proficient workforce that is computer literate, trained in information management skills and motivated to use the well-designed clinical systems would be necessary in a tertiary institution particularly in a developing country such as Nigeria. Clinical informatics aims to improve patient care by the intelligent application of technology and hopes to increase the effectiveness and efficiency of care, as well as patient safety [10,11]. Informatics can fulfil its promises in developing countries only if health care professionals are trained in basic computing skills and IT. Designing such training will necessitate an assessment of baseline knowledge and the utilization patterns of all personnel involved in health care delivery which is the major thrust of this survey.

The aim of this study is to assess the knowledge and utilization patterns of IT among health care professionals and students in Nigeria using the Obafemi Awolowo University Teaching Hospital in Ile-Ife as a case study.

Figure 3. A senior health records officer in the hospital's coding room at the Obafemi Awolowo University Teaching Hospital, Ile-Ife, Nigeria (Photo: Anja Mursu)

Methods

The survey was conducted at the Obafemi Awolowo University Teaching Hospitals Complex (OAUTHC) in Ile-Ife, Nigeria. OAUTHC is one of the first-generation teaching hospitals established by the Nigerian government to deliver quality health care to its people, and was, until very recently, the only teaching hospital in Osun State, drawing patients from the whole of Ondo, Ekiti and parts of Oyo and Kwara states, which include a predominantly Yoruba ethnic population of about 20 million.

Launched in 1977 at the then fledgling University of Ile-Ife (now Obafemi Awolowo University), the hospital complex has grown to encompass 2 major hospital facilities, 1 dental hospital and 3 primary care centers. The major centers include the tertiary referral center in Ile-Ife and the Wesley Guild Hospital at Ilesa, located in a rural setting 30 kilometers from Ile-Ife. OAUTHC has 565 beds, and (in 2003) saw 204669 patients.

A pretested questionnaire that was to be self-administered, and which probed into the knowledge, attitude and utilization of computer and IT, was given to health care professionals and medical students (see Multimedia Appendix). We distributed 180 questionnaires to randomly selected staff which included 3 groups of personnel: medical doctors (n = 60), health record staff (n = 60) and medical students (n = 60).

The randomly selected medical students were in their fourth and fifth years of training at the Obafemi Awolowo University. The preclinical class was not studied because the students were located at another campus.

Respondents' names were not elicited in the questionnaire in order to enhance participation and reduce respondent bias.

The first section of the questionnaire (see Multimedia Appendix) sought sociodemographic information of the respondents. Computer knowledge was assessed by analyzing responses to a set of 19 questions (questions 7 to 25) while another set of 16 questions (questions 26 to 40) was used to determine attitude and utilization patterns. Continuous scores from these categories were converted into an ordinal "good-fair-poor" scale. Participants who scored greater than 80% on the knowledge questions were categorized as having "good" computer knowledge. Those with scores between 60% and 79% were determined to have "fair knowledge", while individuals with scores less than 60% were categorized as having "poor knowledge".

In the "attitude and utilization" categories, total scores above 60% were categorized as "good", while scores ranging between 50 and 59% were rated as "fair", and those with scores less than 50% were considered to have "poor" attitude and utilization skills.

Statistical Analysis

Data analysis was done using SPSS package version 10 and Computerized Programme for Epidemiological Analysis. Comparison of knowledge and utilization patterns in different groups was done using an independent Student's t-test. Pearson correlation was used to evaluate an association between knowledge and utilization patterns. Chi-square and Fisher's exact tests were used when appropriate to find any associations between the categorical variables.

Results

Sociodemographic Characteristics of Respondents

Out of 180 who received questionnaires, 148 (82 %) responded, including 60 medical students, 41 medical doctors and 47 health records staff. Their ages ranged between 22 and 54 years. The majority of respondents (120) were males, while the remaining 28 were females (Table 1).

Table 1. Sociodemographic data of respondents and type of computer training

		Students (n = 60)	Doctors (n = 41)	Health Records Officers (n =47)
Age Range in years (Mean ± SD)		22-32 (24.7 ± 2.29)	26-54 (33.02 ± 6.46)	20-51 (35.83 ± 8.41)
Gender	Male	52 (86.7%)	39 (95.1%)	29 (61.7%)
	Female	8 (13.3%)	2 (4.9%)	18 (38.3%)
Marital Status	Single	58 (96.7%%)	22 (53.7%)	10 (21.3%)
	Married	2 (3.3%)	17 (41.5%)	35 (74.4%)
	Divorced	-	1 (2.4%)	-
	Widowed	-	1 (2.4%)	-
	Separated	-	-	2(4.3%)

Computer Possession and Training Received

Eighty respondents (54%) had received some form of computer training, while the remaining 68 (46%) had no training. Only 39 respondents (26%) owned a computer while the remaining 109 (74%) had no computer (Table 2).

Table 2. Previous computer training received by the respondents

		Students (n = 60)	Doctors (n = 41)	Health Records Officers (n = 47)
Number of respondents with computer training		21 (35%)	22 (53.7%)	37 (78.9%)
Computer possession	Yes	17 (28.3%)	19 (46.3%)	3 (6.4%)
	No	43 (71.7%)	22 (53.6%)	44 (93.6%)
Knowledge	Good	15 (25%)	11 (27%)	2 (4.3%)
	Fair (Average)	31 (51.7)	25 (61%)	31 (66%)
	Poor	14 (23.3%)	5 (12%)	14 (29.8%)
Attitude and utilization	Good	24 (40%)	22 (54%)	13 (27.7%)
	Fair (Average)	25 (41.7%)	11 (27%)	14 (29.8%)
	Poor	11 (18.3%)	8 (19%)	20 (42.6%)

Table 3. Computer possession, knowledge and utilization patterns among respondents

		Students (n = 60)	Doctors (n = 41)	Health Records Officers (n = 47)
Previous computer training received	Short course	16 (26.7%)	13 (31.7%)	19 (40.4%)
	Certificate course	4 (6.7%)	5 (12.2%)	5 (10.6%)
	Diploma course	1 (1.7%)	4 (9.8%)	9 (19.1%)
	Degree course	-	-	4 (8.5%)
	No training	39 (65%)	19 (46.3%)	10 (21.3%)

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Knowledge and Utilization Pattern of Respondents

A total of 28 respondents (18.9%) demonstrated a good knowledge of computers while 87 (58.8%) of them had an average knowledge. Only 33 (22.3%) showed poor knowledge. Fifty-nine respondents (39.9%) had good attitude and utilization habits, while 50 (33.8%) showed average or fair habits and 39 (26.4%) exhibited poor attitude and utilization habits.

Only 4.3% of the records officers demonstrated good knowledge, compared to 25% of students and 27% of doctors (P=.006) (Table 3). The knowledge scores were not significantly different between medical students and health records officers (P=.06), or between the medical students and the doctors (P=.374). However, the doctors' scores were significantly higher than those of the health records officers (P=.001).

Forty percent of medical students, 54% of the doctors and 27.7% of the health records officers scored "good" in the attitudes and utilization category (P=0.01). The medical students' attitude and utilization scores were significantly higher (P=.008) than those of the health records officers, as were the doctors' scores (P=.001). However, the difference between the doctors' and medical students' attitude and utilization scores were not significant (P=.10).

The detailed data for the three different groups are further elaborated below.

Computer Training Received, Knowledge and Utilization Pattern in the 3 Study Groups

Medical Students

The age of the medical students ranged from 22 to 32 years (mean = 24.7; SD = 2.29). Thirty (50%) of them were in the fifth year of their course, 28 (46.7%) were in the fourth year and only 2 were in the sixth (final) year. Fifty-two (86.7%) of them were males while the remaining 8 (13.3%) were females. With regard to marital status, 58 (96.7%) were single and 2 (3.3%) were married. Despite the fact that 35% of the students had some training in computers and IT, only 15 (25%) demonstrated good knowledge in this field, 31 (51.7%) had a fair knowledge, and in the remaining 14 (23.3%) knowledge base was poor. Of the 35% who had received training, 16 (26.6%) had informal training, 5 (8.3%) attended a certificate course and only 1(1.6%) had a diploma. The training was not found to influence their computer/IT knowledge (P=.8). Forty percent of them had "good" attitude and utilization habits while attitude and utilization habits were "fair" in 41.7% and "poor" in 18.3% of the students (Table 3).

Medical Doctors

Among the doctors recruited, age ranged from 26 to 54 years (mean = 33.02; SD = 6.46). The majority were males (39; 95.1%), while only 2 females (4.9%) responded. Fifty-eight percent were married while the remaining 41.5% were single. While 46.3% had no training, 53.7% had varying degrees of exposure, out of which 31.7% had informal training, 12.2% had taken a certificate course and the remaining 9.8% had taken a diploma course. Despite this training only 27% of the doctors had good knowledge scores, while 61% showed fair knowledge and 12% had poor knowledge. With regard to attitude and

utilization habits, 54% of the doctors had good scores, 27% had fair scores and 19% showed poor attitude and utilization habits. Marital status, number of children, gender and computer training were not found to influence significantly knowledge and utilization habits (Table 3).

Health Records Officers

The age of the health records staff ranged from 20 to 51 years (Mean = 35.83; SD = 8.41). There were 18 (38.3%) females and 29 (61.7%) males. Thirty five (74.4%) were married with children while 10 (21.3%) were single and 2 (4.3%) were separated. Despite the fact that 78.7% had received some training, only 4.3% demonstrated good knowledge of computers and IT. Sixty-six percent had a fair knowledge and 29.7% had poor knowledge. Also only 27.7% showed good utilization habits, while in 29.8% they were fair and in 46.6% they were poor. Rank, social obligations, age and gender were not found to significantly influence knowledge, utilization patterns and attitudes (Table 3).

Discussion

In this study we found that computer possession and utilization among health care professionals and students in a major university teaching hospital in Nigeria were low. Only 26% of respondents owned a computer and 18.9% and 39.9% had good knowledge and utilization habits respectively. This is similar to the findings in other parts of Nigeria. Ajuwon [8] found that only 42.6% of medical and nursing students could use a computer while about 60% had used the Internet. Ogunyade and Oyibo [4] discovered that 52% of the 250 students studied were aware of Medline on CD-ROM while only 24% had used it. In sharp contrast to our findings, Odusanya and Bamgbala [5] in Lagos reported that 80% of their final year medical and dental students had used the computer, but the use of software applications was very poor (19%).

Among our medical student population, 25% demonstrated good knowledge while 40% showed good utilization patterns, which is in agreement with the findings of other researchers in Nigeria, but significantly lower than the figures from Malaysia [9], Jeddah (Saudi Arabia) [12], Glasgow (UK) [13] and Oulu in Finland [14]. Lack of structured training and computer accessibility may have contributed to the poor knowledge and utilization patterns observed. In addition limited access to the Internet and the relatively expensive nature of Internet cafés may also be contributory. Provision of computer laboratories in various departments in our universities where students can have full access to Internet services that are cost free would certainly assist in improving utilization pattern and, hence, the acquisition of knowledge.

Computer possession was found to be higher among doctors when compared with the 2 other groups; this may be because of the perceived need and relative ease of affordability. Unfortunately only 27% of the doctors demonstrated good knowledge and 54% showed good utilization habits. These were not statistically different from those of the students.

Despite the lowest computer possession rate (4.3%), 78.9% of health records personnel had received training on computer use

and IT. This was a result of required job training which was usually employer sponsored as opposed to the other 2 groups who sought training for personal and/or professional reasons. Surprisingly, both knowledge and utilization scores were statistically lower among health records officers when compared with the medical students or doctors. This may be related to their level of educational attainment since only a diploma is required to become a health records officer, although many senior officers have higher levels of education including university degrees.

The finding of higher utilization patterns compared with computer knowledge among all the respondents is not surprising as most respondents who do not own computers utilize them by going to Internet cafés where attendants can be found to assist them. This is consistent with the findings of others [5,8,9].

The gains of IT can only be fully harnessed when the majority, if not all, of the staff become knowledgeable and are willing to utilize computers and IT. Such utilization will naturally impact on health information management. The use of Medline, CD-ROMs and interactive software packages would enhance dissemination of medical information, knowledge and teaching among health care professionals. It would also improve health care delivery and collaborative multicenter research, which is still very limited in the developing countries particularly in Africa [4,5].

It has been established that computers and IT can have numerous applications ranging from storage and retrieval of patient clinical and sociodemographic information to patient management, particularly in specialties such as cardiology, neurology, pediatrics, otorhinolaryngology, general practice (family medicine) [15-19] and even in hospital administration [20].

The availability of email, websites, chat rooms, multimedia presentations, and occasional opportunities for communication via Internet phones, videoconferencing and even Internet conferencing have rejuvenated medical education and teaching, patient care, and collegial support [21].

Our student population has increased over the years and even now would likely overwhelm our facilities if it were not for the use of IT enabling lectures, demonstrations and illustrations to be delivered to multitudes of students simultaneously.

The fact that the health records officers by virtue of their profession had better training opportunities did not translate into better knowledge and utilization habits, which raises questions about the style and type of computer and IT training offered. It is our belief that a structured training, which forms part of the curriculum, would likely have more impact on the target population than ad hoc arrangements. The introduction of a structured computer training course, which includes the applicability of IT to medicine, into the curriculum of medical students, health record students, residency and continuous medical education training (CME) programs for all practicing physicians and health workers would certainly assist in ensuring maximal utilization of the innumerable advantages offered by IT.

Medicine is an ever-evolving and information-based discipline, and as such the provision of structured computer and IT training for all members of the health team would equip them with the skills they need to practice up-to-date and evidence-based medicine, which are essential to improving the quality of medical care.

Further research should focus on designing and evaluating computer and IT training for students and staff in developing countries.

Acknowledgments

Multimedia Appendix

Information Technology Questionnaire: [PDF file, 64 KB - jmir_v6i4e45_app1.pdf]

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<u>Original Paper</u>

Parents of Urban Adolescents in Harlem, New York, and the Internet: A Cross-sectional Survey on Preferred Resources for Health Information

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Abstract

Background: Vulnerable populations suffer disproportionately from a variety of health conditions. Access to health information is an important component of health promotion. Reports suggest that while health providers and print media are traditional sources of information, the Internet may be becoming an increasingly important resource for consumers. Particularly, for parents of urban adolescents of color, the Internet could prove to be a valuable asset in helping them understand adolescent health and behavioral issues.

Objective: To determine the types of adolescent health and behavioral issues of concern to parents of color and to assess their preference for sources of health information, including the Internet.

Methods: A confidential, self-administered survey was administered to parents (largely of African American and Hispanic descent) of 9th-grade students over a 2-year period during 2001-2002 in Harlem, NY. The instrument assessed health and behavioral topics of concern, preferred resources for information, ownership and utilization patterns of computers and the Internet, and interest in obtaining additional computer/Internet training.

Results: A total of 419 surveys were completed; 165 in 2001 (67% response rate) and 254 in 2002 (no response rate available). Analysis of responses indicated a substantial degree of interest in obtaining information about a variety of adolescent health issues, including: HIV, sexually transmitted infections, , mental health concerns and relationships with family and peers. While home ownership of computers (84%) and access to the Internet were reasonably high (74%), use of the Internet for health information was low (14%). However, 62% of parents indicated a strong desire to have more instruction on computers and the Internet.

Conclusions: Compared to other sources of health information, the Internet is underutilized by urban parents of color. Additional research is needed to identify strategies to improve utilization and assess subsequent impact on parenting activities.

KEYWORDS

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Introduction

When properly educated, motivated and supported, parents can be instrumental in providing better monitoring of their adolescent's activities with resultant reductions in risk-taking behaviors [1]. Parents, in general, desire more information and guidance on child rearing [2], and health providers can play an important role in educating parents and/or steering them towards additional sources of information on health and behavioral issues. However, while the average duration of pediatric well-child visits has increased to about 15 minutes [3], only 15%-20% of parents recall their child's provider discussing psychosocial issues with them [2].

Parents of adolescents are at an even greater disadvantage than parents of younger children, since adolescents have fewer routine visits than infants and children [4]. Additionally, to ensure confidentiality, parents may appropriately be asked to wait in the waiting room during at least part of the encounter and, in some cases, parents may not even accompany their adolescent to office visits. Thus, parents of adolescents may have less contact with health providers than parents of younger children.

To supplement advice given by health providers, parents may turn to popular magazines. While several exist for parents of infants and younger children, few have regular features or special sections that cover the 13-19 age group, and no magazine exists exclusively for parents of adolescents. Finally, books are important information resources for parents, but a recent review by 1 of the authors in this study found that of the over 3,000 titles carried by Amazon.com on child health, only about 25% focused exclusively on adolescents (unpublished observations).

Over the last several years, surveys suggest that millions of Americans are increasingly turning to the Internet, not only for communication and entertainment, but for health information as well. Available information reveals that as of March 2003, 66% of Internet users have accessed the Web for health or medical information [5]. Having children in the home is a particular impetus for having both computer and Internet access. Allen and Rainie reported that among adults who do not currently own a computer, parents are more inclined to "intend to purchase a computer and log on" in the near future, than non-parents [6]. In addition to educational enrichment, parents are particularly interested in using the Internet to seek out health information with respect to their children [6].

Although inequities in socioeconomic status and education contribute to disparities in access to the Internet (the "Digital Divide"), evidence suggests that the gap may be narrowing. In particular, the percentage of African American and Hispanics/Latinos logging on to the Internet is rising faster than among whites [7]. Additionally, there is a suggestion that African Americans are using the Internet in increasing numbers for health information, because they have been "cut off" from traditional forms of health information [8]. For example, only 3% of the books available on Amazon.com deal specifically with minority youth issues. Thus, while it is important that all parents obtain needed resources to assist them in coping with the rigors of parenting, parents of color are particularly in need.

In general, youth of color are over-represented with respect to many health-compromising behaviors. For example, the 2003 Youth Risk Behavior Surveillance reports a higher prevalence of sexual intercourse (67.3%, 51.4%, 41.8%), pregnancy (9.1%, 6.4%, 2.3%), and attempted suicide (8.4%, 10.6%, 6.9%) among African American and Hispanic youth as compared to their white peers respectively [9].

Potentially, the Internet could mitigate some of the gaps in health information for parents of color; however, little is known about their preferences for health information resources and, specifically their use of the Internet to seek information about adolescent health and behavioral topics. This study was designed to obtain more information on those issues, as part of a larger project (ie, the School Health Promotion Initiative) developed by the Harlem Health Promotion Center. This center is 1 of 33 prevention research centers funded by the Centers for Disease Control and Prevention to engage community partners such as government agencies, schools, and community-based organizations in the design and implementation of applied prevention research programs. The goal of the School Health Promotion Initiative is to enhance opportunities for high school students to engage in health promotion activities. A related area of investigation centers on the crucial role parents play in enhancing adolescent health promotion. This paper focuses on the latter component of the overall initiative.

Specifically, we are interested in learning more about parental preferences for sources of health information for themselves and their children, parental access to computers and the Internet, and ultimately, parental interest in using the Internet to obtain health information.

Methods

The study was conducted in a public high school in Harlem, New York where parents (or guardians) of incoming 9th-grade students participated in a 1-day orientation session prior to the start of the academic year. During the 9th-grade orientation sessions in June 2001 and 2002, an anonymous 24-item questionnaire, offered in both English and Spanish, was administered (see Multimedia Appendix for the questionnaire). Inclusion criteria for consideration in the study were being a parent or guardian of a child entering the 9th grade of the school in the fall following the orientation. The project was reviewed and approved by the Institutional Review Board of Columbia University and by the Office of External Research for the New York City Board of Education. All participants were informed that their participation was voluntary and that any information obtained would be kept confidential. The questionnaire collected data on: parental demographics, insurance coverage, usual source of health care, and frequency of visits, for their adolescents. Further, they were encouraged to prioritize their preferred sources of health information, and provide information on their use of computers and the Internet. Finally, their interest in obtaining training on computers and the Internet was assessed.

Surveys were collected and entered with a less than 1% data entry error rate. SPSS version 11.0 was used for record keeping and subsequent analysis. Frequencies were calculated and grouped by general themes, including demographics, health

care visits, and sources of information on health issues. Chi-square tests were used to examine relationships where the dependant variable was categorical or ordinal. If the dependant variable was continuous, a t-test was used. Only differences that were significant at a $P < .05$ level are reported.

Results

Demographic Characteristics of Respondents

A total of 419 surveys were completed; 165 in 2001, and 254 in 2002. Data did not differ significantly on any variables based on the year of collection. During the first collection year, out of a total of 367 parents of entering 9th-grade students, 248 (68%) attended the school orientation program and 165 returned a completed survey (67% of attendees, or 45% of the overall sample frame). Although year 2 participation rates were not available, there is little reason to believe that response rates would be dissimilar. Additionally, there were no significant differences in the demographic profile of the sample between 2001 and 2002, nor were responses significantly different between the 2 years; therefore data sets for both years were combined for analysis.

Table 1. Demographic profile (N = 419)

	n	%
Age		
Less than 29	8	3
30-39	132	42
40-49	136	43
50 and older	39	12
Unknown/no response	104	
Race/Ethnicity		
Black/African American	177	47
Hispanic/Latino	175	47
Other*	24	6
Unknown/no response	43	
Gender		
Female	325	86
Male	51	14
Unknown/no response	43	
Relationship to Child		
Parent	353	92
Grandparent	7	2
Aunt/uncle	11	3
Other	11	3
Unknown/no response	37	
Health Insurance		
None	21	5
Medicaid	135	34
Child Health Plus	52	13
Private insurance	189	48
Unknown/no response	22	

* Includes white, Native American, Asian and other.

Since 92% of the sample consisted of parents (n = 353), for this analysis we will use the term parent to refer to all participants, including guardians. Eighty-six percent of our sample were women (n = 325). Forty-seven percent of the sample identified themselves as black or African American (n = 177); a like number (47%) self-identified as Hispanic (n = 175), and 6% as white, Native American, Asian or other (n = 24). Because only 1 individual was identified as white, we did not exclude this person from our analysis since our paper focused on urban parents rather than exclusively on people of color and 1 person out of 419 would not appreciably alter the data. Most participants (85%) were 30-49 years old (n = 268). Although

specific data on socioeconomic status is not available, 46.4% of adolescents in the school qualify for free lunch, a proxy for low socioeconomic status. Table 1 illustrates the demographic profile of the sample.

Parents' Sources of Health Information

Parents were asked a series of questions regarding health information such as: where they believed their children received health information, where they *preferred* their child receive health information, and where they themselves received health information. Table 2 summarizes their responses. Most respondents believed that family (n = 252; 66%) and school (n = 154; 40%) were the main sources of health information for adolescents. By contrast, in terms of *preferred sources* of health information, support provided by health professionals (n = 240; 62%) equaled family members (n = 240; 62%). In terms of their own sources for health information, health professionals (n = 213; 57%) held the most prominent ranking, followed by magazines and newspapers (n = 173; 46%), television (n = 100; 27%) and family members (n = 102; 27%).

Table 2. Current sources of health information for parents and adolescents*

	My child gets information on health issues from…		I would prefer that my child get information on health issues from…		I get information on health issues from…	
	n	%	n	%	n	%
Church	27	7	30	8	28	7
Family member	252	66	240	62	102	27
Friends	96	25	8	2	40	11
Healthcare provider	113	29	240	62	213	57
Internet	34	9	27	7	53	14
Magazines/newspapers	94	25	51	13	173	46
Other	25	7	20	5	44	12
School	154	40	200	52	69	18
TV	113	29	28	7	100	27

* Respondents were asked to circle all that apply. Hence, results do not sum to 100%.

Table 3. Profile of Internet use by parents (N = 419)*

	Yes n	Yes %
Would you be interested in attending a workshop designed to help parents learn how to better use the Internet?	216	62
Do you have Internet access at home?	286	74
Do you have Internet access at work?	121	35†
How often do you use the Internet?		
never	100	26
less than once a month	43	11
1-3 times per month	49	13
1-3 times per week	101	27
Everyday	88	23
Unknown/no response	38	

* n's for selected characteristics may vary due to missing data.

† Question asked "Do you have Internet access at work?" but did not allow for those who were unemployed. As such, 18% (n = 75) of the responses were missing.

Profile of Internet Access and Utilization

Eighty-four percent of participants indicated that they had a computer at home (n = 325). Seventy-four percent had access to the Internet at home (n = 286) and 35% had access at work (n = 121). However, while 23% indicated that they used the Internet everyday (n = 88), and 27% used it 1 to 3 times weekly (n = 101), 26% indicated they never used the Internet (n = 100) (See Table 3).

Access to the Internet (either at home or work) did not differ based on age or gender; however, African Americans (66%) were nearly twice as likely to have access to the Internet at work

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as Latinos (34%) (Pearson's χ^2 = 19.89, P < .001). Younger parents (under the age of 40) were slightly more likely to use the Internet (81%) than those parents over the age of 40 (70%) (Pearson's χ^2 = 4.8, P = .03).

Health information seeking via the Internet was relatively low. Fourteen percent of parents used the Internet as a health information resource (n = 53), and 9% thought their children were getting health information on the Internet (n = 34). Only 7% *preferred* the Internet to be a source for health information for their adolescents (n = 27) (Table 2).

While there were no significant differences in responses based on age or gender, among those who used the Internet for health information, African Americans (68%) were more than twice as likely as Latinos (32%) to identify the Internet as a source of health information (Pearson's χ^2 = 7.23, P = .007).

Interest in Attending Workshops in School

Although the percentage of regular Internet users was low, 62% of respondents indicated they would be interested in attending a workshop on how to use the Internet (n = 216) (Table 3). Not surprisingly, parents who identified that they never used the Internet were more likely to express interest in attending a workshop to improve their Internet skills (75% of non-users versus 60% of users). This interest indicates that it is not lack of interest, but rather lack of familiarity with the Internet that is hindering some parents from using the Internet. Further, while traditional sources of health communication (eg, newsletters, health providers, small group workshops) were cited as preferred means of obtaining health information, 27% reported that they would like to receive information on adolescent health issues via the Internet (Table 4).

Table 4. Preferred channels for future receipt of health information by parents*

Which of the following ways would you like to receive information on teen health issues? (Choose at least 2.)		
	n	%
Monthly newsletter	257	69
Health provider	162	43
Workshops for parents to be held at school	157	42
Internet website for parents	102	27
Health videos	77	21
Interactive CD-ROM	37	10
Other	4	1

* Respondents were asked to circle all that apply. Hence, results do not sum to 100%.

Discussion

Limitations

Before the implications of these results are presented, there are several limitations of this study that should be addressed. First, the internal and external validity of these results may be limited. Only 68% of the parents of 9th graders attended the orientation, and only 67% of those returned the survey for an overall participation rate of 46% for the 2001 survey. The participation rate for 2002 is unknown, but assumed similar. As such, these results may not reflect the knowledge and attitudes of all parents of 9th graders in this school. Additionally, since our sample consisted primarily of minority parents in an urban community, these results may not necessarily be generalizable to non-minority parents or to parents in rural or suburban settings. Additionally, these results were obtained 2-3 years ago and may understate current trends in access and utilization of the Internet.

Implications

Nonetheless, several interesting findings can be noted. The majority of parents in our sample reported home ownership of computers (n = 325; 84%) and Internet access (n = 286; 74%). Half of the participants reported using the Internet on at least a weekly basis at home or at work (n = 189). This is substantially higher than national samples of people of color. For example,

a Pew Study of the Internet and American Life conducted in 2002 found that 45% of African American and 54% of English-speaking Hispanics reported access to the Internet [7]. It has been noted, however, that parental status, younger age and urban residence are positively correlated with Internet access [7], which may provide partial explanation for the discrepancy between our sample of primarily young urban parents and national surveys which sampled a broader cross section of the population. For example, results from a 2003 Pew Internet and American Life report indicated that parents in general were more likely to report Internet use than non-parents (75% of parents reported usage versus 57% of non-parents) [10]. However, 26% of our total sample reported never accessing the Internet (n = 100).

Although we did not ask specific follow-up questions, based on our experience and review of the literature, reasons for non-use may be varied. In the past, cost may have been a notable deterrent, but recent advances in technology have dramatically lowered the costs of a basic computer and Internet set-up. As noted, the majority of our sample had access at home. However, access need not necessarily be equated with utilization. Stanley, in her study of computer utilization by residents of a low-income community in California, suggests that psychosocial issues may play a more significant role in creating and maintaining barriers for computer and Internet use among adults in low-income

communities [11]. Lenhart concurs, noting that some individuals fail to see the relevance of computers and the Internet, are embarrassed or intimidated by technology, or are concerned about fraud or disturbing content [7]. Anecdotal conversations with parents in our community reveal similar misgivings. However, additional research is necessary to delineate the particular factors hampering utilization of the Internet by parents in this sample.

With respect to health information seeking, similar to other reports of minority adults [12], parents in our sample cited health professionals as their preferred source of health information. Other important resources include magazines and newspapers. Adults in our sample reported unexpectedly low rates of health information seeking via the Internet. Only 14% reported seeking health information on the Internet. Overall, parents rated the Internet 6th on a list of 9 sources of health information.

Reasons for low utilization may be varied. As noted above, psychosocial issues may hamper access and utilization. Further, parents with limited Internet skills may lack the ability to accurately search and retrieve valuable health information on the Web. Additionally, even skilled parents may become frustrated in finding easy-to-understand information. A survey of pediatric patient information materials on the Web revealed many are written at a 12th-grade reading level. Current recommendations suggest development of materials at the 8th-grade level or lower [13]. Concerns about lack of available content, and cultural relevance have been cited as common complaints by minority adults [14]. Finally, language may be a barrier. Latino parents in our sample were less likely to access health information on the Internet, as compared to African American parents. The dearth of Spanish-language content may be an impediment to Latino parents finding and retrieving information online [13].

Further, only 9% of parents believed their children were getting information from the Internet. By contrast, both national and local studies indicate that adolescents of color are turning to the Internet in significant numbers to seek health information. The Kaiser Family Foundation Generation Rx.com survey revealed that 75% of adolescents sought health information on the Internet. Similarly, surveys conducted in low-income communities in New York City suggest that 55 % of minority adolescents have obtained health information on the Web [15].

The discrepancy between what parents believe youth are doing on the Internet and what actually is occurring may reflect a general lack of parental awareness of how interested youth are about health issues. Additionally, it may illustrate a lack of parental monitoring of adolescent Internet activities.

Further, only 7% of parents preferred the Internet as a source of information about health for their adolescents. This may suggest parental concern about the potential for youth accessing pornographic information, as well as the potential for youth being subject to untoward advances from sexual predators [7]. It will be important to elucidate and address parental concerns as they may potentially hamper adolescent utilization of the Internet for health promotion.

Of note, despite their reservations, 27% of parents indicated they would be interested in receiving information on adolescent health issues delivered by an Internet website (n = 102). Health providers [16], may be of assistance by identifying user-friendly, peer-reviewed, medically accurate Web resources for parents.

Additionally, 62% expressed interest in attending workshops to obtain or improve their computer/Internet literacy (n = 216). Community technology centers (CTCs) exist in many vulnerable communities, and provide free or low-cost access and training. Particular for novice users, CTCs "play a pivotal role in helping (new computer users) overcome their resistances…the majority of new computer users quickly overcame their fears and reservations once they had an actual hands-on computer encounter in a supportive and comfortable adult learning environment." However, "many individuals do not know that CTCs exist or about the services they offer…" [11]. Therefore, a key role for health providers and local schools may be to identify CTCs in their communities and suggest parents access their services to improve their computer/Internet literacy.

Additionally, over the past several years, a significant upgrade in the technological capacity of schools has been undertaken. Many not only have the computer resources and Internet access to provide educational advancement for students, but basic training for parents, as well, during off-hours. As such, schools may provide a valuable service for parents in vulnerable communities by also providing basic instruction. This may be increasingly important, as many schools are developing websites wherein information about school activities and their child's academic performance can be relayed to parents. Additionally, the potential also exists to improve parent-teacher communication via email. However, if parents lack the skills or the ability to access the Internet, this potential will not be easily realized.

Finally, the potential for adolescents to influence parental behavior should be considered. In addition to being avid seekers of health information themselves, 39% of all adolescents (52% of African American adolescents and 42% of Hispanic adolescents) report changing their behavior because of online content. Fifty-three percent of adolescents say they have had a conversation with a parent or other adult about something they had seen online [17]. Adolescents are the most technologically proficient members of most households, and as such, may be able to teach those parents who are novice users how to more efficiently access information. In a quarter of families with Internet access, teens often master the technology before their parents and take the lead on teaching them [6]. Thus, adolescents may indirectly (through modeling) or directly (through teaching) influence parents to become Internet health seekers.

However, this study suggests that additional research is warranted to further elucidate factors that may enhance utilization of the Internet for health information. Additionally, if utilized, the comparative degree of satisfaction with Internet resources as compared to more traditional forms of health information would be important to ascertain. The impact of Internet-based health information on parental awareness of adolescent health and behavioral issues is currently unknown. Potentially, a positive feedback loop could be envisioned by

which adolescent health promotion is enhanced, not only by the adolescent's own efforts but also by reinforcement coming from better-informed parents.

Conclusion

Our study indicates that parents of adolescents in an urban community are interested in receiving additional information and support to become more knowledgeable and informed. At present, the Internet is potentially an important but underutilized tool in their arsenal. Parents in urban communities may need specific guidance and support in order to take better advantage of this valuable resource. Creation of culturally relevant content of appropriate literacy levels will be important to maintain the interest and attention of parents of color. Further, increased efforts to provide Spanish-language content may be an important factor in making the Internet accessible to Latino parents.

Acknowledgments

Conflicts of Interest

None declared.

Multimedia Appendix

Survey Instrument

24 item survey instrument fielded in 2000 and 2001. [PDF file, 56 KB - jmir_v6i4e43_app1.pdf]

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Original Paper

Crystal Methamphetamine Use Predicts Incident STD Infection Among Men Who Have Sex With Men Recruited Online: A Nested Case-Control Study

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Abstract

Background: Among men who have sex with men (MSM), the number of newly diagnosed human immunodeficiency virus (HIV) infections has increased by approximately 60% since 1999. Factors that may be contributing to this resurgence include a widely reported increase in bacterial sexually transmitted diseases (STDs) among HIV-positive and HIV-negative MSM, as well as unsafe sexual practices.

Objective: This research was undertaken to learn more about risk behaviors associated with an incident STD among MSM.

Methods: A nested case-control study was conducted, using data from a cross-sectional Internet survey of MSM (N=2643), which investigated risk behaviors during a 6-month period in 2001. Chi-square and logistic regression methods were used to estimate the likelihood of acquiring an incident STD versus no STD.

Results: Eighty-five percent of the respondents were white, 46% were under age 30, and 80% had met sex partners online; 7% were HIV-positive. Men with an incident STD were more likely than men without an STD to report drug use (crystal methamphetamine odds ratio 3.8; 95% confidence interval 2.1-6.7; cocaine OR 2.3; 95% CI 1.2-4.2; ecstasy OR 2.2; 95% CI 1.3-3.8; Viagra OR 2.1; 95% CI 1.2-3.7), alcohol before or during sex (OR 1.9; 95% CI 1.2-2.9), and high-risk sexual behavior (unprotected anal intercourse OR 5.0; 95% CI 2.8-8.9; multiple sex partners OR 5.9; 95% CI 2.5-13.8). In the multivariate analysis, significant independent predictors associated with an incident STD were crystal methamphetamine use (adjusted OR 2.0; 95% CI 1.1-3.8), unprotected anal intercourse (adjusted OR 3.4; 95% CI 1.9-6.3), and 6 or more sex partners during the study period (adjusted OR 3.3; 95% CI 1.4-7.8).

Conclusion: Identifying and treating MSM who have STDs, or who are at increased risk for acquiring STDs, is crucial in preventing the further spread of disease. In addition, there is a need to integrate HIV/STD and substance use prevention and education into Web-based and community-based venues.

Introduction

Among men who have sex with men (MSM), the number of newly diagnosed human immunodeficiency virus (HIV) infections has increased by approximately 60% since 1999 [1]. Several factors may be contributing to the increase in HIV transmission. One is the widely reported increase in bacterial sexually transmitted diseases (STDs), namely syphilis and gonorrhea, among MSM [2,3]. Not only are STDs a marker for unsafe sexual behavior, but ulcerative and non-ulcerative STDs facilitate the transmission and acquisition of HIV [4,5] and increase HIV viral load and infectivity in persons with HIV

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[6,7]. Moreover, studies have found a high proportion of HIV-positive MSM with incident STDs [8,9], suggesting continued unsafe sexual practices and exposure of others to HIV. Substance use has also been associated with sexual risk behaviors among MSM [10-12].

Crystal methamphetamine (crystal) use in MSM communities has been problematic in the Western US since the early 1990s [13,14], and has more recently spread to the Midwest [15], as well as the East Coast [16]. Crystal use is associated with "marathon sex" (prolonged sexual activity), receptive and insertive anal sex without a condom, the ability to have sustained arousal for multiple partners, and unsafe sex with HIV-serodiscordant partners or partners of unknown HIV serostatus [15,17,18]. Thus, substance use and its relationship to high-risk sexual behavior among MSM is of particular concern, as drugs may help men to avoid feelings of anxiety associated with same-sex behavior and their own awareness of HIV risk [17,19,20].

This research was undertaken to learn more about risk behaviors associated with an incident STD among MSM. We compared sexual and drug use behaviors between men with a self-reported incident bacterial or viral STD and men without an STD.

Methods

We conducted an anonymous, cross-sectional Internet study, inquiring about sexual and drug-using behaviors among MSM between June and December 2001, as part of a larger study of behavior change pre- and post-September 11, 2001. The banner ad (Figure 1) linking to the survey was posted in the online chat rooms of a general interest, gay-oriented website between June 3 and July 24, 2002. Overall, 2284 individuals clicked on the banner but exited the survey without answering any questions; 3697 clicked on the banner and answered the survey. A total of 2949 questionnaires were complete enough for statistical analysis (79% completion rate): 2934 were completed by men (18 of whom were exclusively heterosexual), 10 by women, and 5 by transgendered individuals. Analysis was limited to the 2643 men who reported sex with other men or who self-identified as gay or bisexual, excluding those who never had sex, those who were missing information on STDs, and those who had chronic viral STDs. To assess incident STDs, the questionnaire asked if the respondent had been diagnosed with any STDs during two consecutive 3-month periods between June and December 2001 and provided a checklist of the most common infections. For men reporting viral STDs, we included only viral STDs that were reported in the second 3-month period. Overall, 102 (4%) men reported being diagnosed with an incident bacterial or viral STD during the 6-month study period.

Figure 1. Survey banner ad
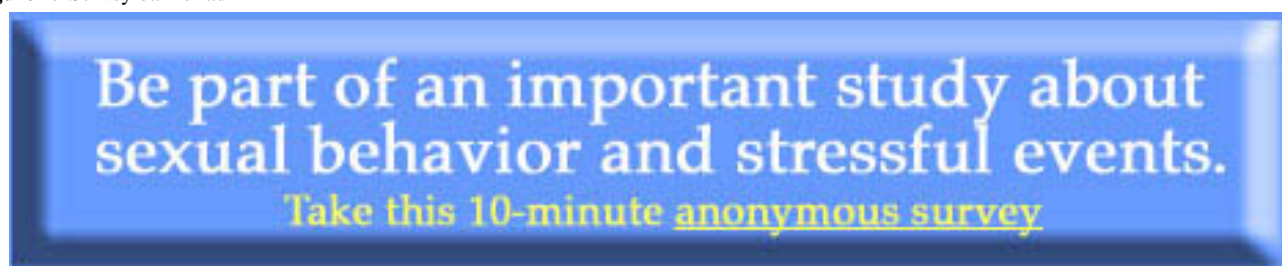
In order to minimize non-valid data, we incorporated reliability checks into the survey for age and certain risk behaviors. To reduce the likelihood of participants' completing multiple surveys, the study banner was rotated through the online chat rooms approximately every 20 minutes. Also, it was not technically possible for participants to bookmark the survey, and there were no monetary incentives to complete the survey.

The general interest, gay-oriented website agreed to host the banner in all of its US adult chat rooms. Individuals had to be registered with the website in order to enter chat rooms. The chat room banner provided the only link to the survey. No personally identifying information was collected. The survey did not use cookies and neither collected user IP addresses nor stored them with submitted data. Study participation was limited to those 18 and older, and all participants clicked on an online consent form before gaining access to the anonymous survey. The Medical and Health Research Association of New York City, Inc. (MHRA) institutional review board approved the study.

The survey included information on demographics (age group, race/ethnicity, education, income and residence), and assessment

of risk behaviors, such as type of sexual contact (anal, oral, vaginal; with and without condoms) with main and non-main partners, knowledge of partners' HIV status, type of illicit drug use before or during sex, alcohol use before or during sex, how sex partners were met, and HIV testing. Links to STD prevention/treatment websites and mental health hotlines appeared at the end of the survey. Survey questions were adapted from questionnaires used by the investigators in previous studies.

Data analyses were conducted using SPSS 9.0 for Windows [21]. Bivariate categorical data were evaluated using chi-square and odds ratios. Statistically significant bivariate analyses were simultaneously assessed by multiple logistic regression models. To guard against Type I error, we set the *P*-value to .01 in the bivariate analyses, given that controls outnumbered cases almost 25 to 1.

Respondents were asked how many sex partners they had during two distinct 3-month periods. Respondents could only choose one response from a pull-down menu for each time period. Answer choices were none, 1, 2-5, 6-10, 11-20, 21-50, and 51 or higher. This variable was collapsed for the entire 6-month period; men who reported no partners or one were grouped into

the first category. Men who reported 2-5 partners were grouped into the second category, and men who reported 6 partners or more were grouped into the third. For this analysis, "multiple sex partners" refers to 2 or more partners during the study period. Regarding unprotected anal intercourse (UAI), respondents were asked about insertive and receptive sex without a condom. The UAI variable represents men who reported any unprotected receptive and/or insertive anal intercourse. Age was categorized in a pull-down menu: 18-24, 25-29, 30-39, 40-49, 50-59, 60 and older. For ease of analysis, age was collapsed into three categories.

Results

Overall, the study sample was representative of the host website user population. The host website was able to provide several demographic variables on new registrants from the entire site for the month prior to sample recruitment. Most new registrants were male (87%), and the study sample was identical to the site population in age, and similar in educational attainment and by US region. Although two of the demographic variables were significantly different, the findings may be a reflection of the large samples sizes, which can detect small differences.

Table 1. Characteristics of study sample and host Internet website

	Study	Host Website	P *
	N (%)	N (%)	
Age †	n=2599	n=10 124	
18-24	730 (28)	3090 (29)	
25-34	809 (31)	3091 (29)	
35-44	635 (24)	2451 (23)	
45-54	331 (13)	1172 (11)	
55-64	80 (3)	320 (3)	
65 and older (reference)	14 (<1)	74 (<1)	0.168
Education	n=2633	n=6394	
High school or less (reference)	335 (13)	939 (15)	
Some college	1093 (41)	2578 (40)	
College degree or more	1205 (46)	2877 (45)	0.050
US Regional Breakdown	n=2874	n=8846	
Northeast	472 (16)	1658 (19)	
CT, ME, MA, NH, RI, VT, NJ, NY, PA			
Midwest	661 (23)	1998 (22)	
IN, IL, MI, OH, WI, IA, KS, MN, MO, NE, ND, SD			
South	1026 (36)	2910 (33)	
DE, DC, FL, GA, MD, NC, SC, VA, WV, AL, KY, MS, TN, AR, LA, OK, TX			
West (Reference)	715 (25)	2280 (26)	0.006
AZ, CO, ID, NM, MT, UT, NV, WY, AK, CA, HI, OR, WA			

* Chi-square goodness-of-fit statistic used.

† Age brackets were recategorized in order to compare to the host website.

Participants resided in all 50 states, roughly in proportion to the population of each state. Less than 1% resided in Guam, Puerto Rico, and a few locations outside the United States. Approximately half (46%) of the study participants were younger than 30 and had at least a college degree (46%). Most were white (85%). Overall, 6% reported crystal use, 7% reported cocaine, 9% reported ecstasy, 9% reported Viagra, and about half (48%) reported drinking alcohol before or during sex. The aforementioned drugs were commonly used before or during sex (over 85% reported these drugs before or during sex). Most (80%) reported meeting new sexual partners online, and most (80%) engaged in sex with multiple partners. The majority (81%) engaged in sex exclusively with men, and 7% were HIV-positive.

Respondents reported newly diagnosed bacterial or viral STDs (n=102), which included syphilis (n=9), genital herpes (n=4), genital warts/anal warts/HPV (n=16), gonorrhea (n=49), hepatitis B (n=2), chlamydia (n=29), and non-gonococcal urethritis (n=24). Sixteen men reported 2 STDs, and 7 reported 3 or more. Many respondents in the STD group made an effort to notify partners of potential exposure. Approximately 30% notified all partners, 26% told some partners but not all, 17% tried to notify their partners but could not locate them, and less

than 5% had the health department notify their sex partners; 21% told none of their partners.

Men with new STDs were more likely to be between 30 and 39 years of age than the controls (see Table 2). The bivariate and multivariate analyses of risk correlates for STDs were structured by drug use and behavioral risk categories as there were no demographic differences between cases and controls. Cases were significantly more likely to report drug use before or during sex (crystal, cocaine, ecstasy, and Viagra), alcohol use before or during sex, and sexual risk behaviors (ie, UAI and multiple sex partners) than the controls (see Table 2). Gamma hydroxy butyrate (GHB), poppers (nitrite inhalants), ketamine, and marijuana use were excluded from the analyses, as their use was not statistically different between groups.

Table 2. Comparison of demographic and behavioral characteristics of men with incident STDs and controls

(N=2643)	STD	Controls	P*
Demographics	N (%)	N (%)	
Age	**(n=102)**	**(n=2541)**	
18-29	51 (50)	1167 (46)	.073
30-39	33 (32)	695 (27)	.050
40+ (reference group)	18 (18)	679 (27)	--
Race/Ethnicity			
White	81 (82)	2126 (85)	.316
Black	3 (3)	51 (2)	.894
Hispanic	5 (5)	140 (6)	.464
Other/mixed race (reference group)	10 (10)	186 (7)	--
Education			
High school or less (reference group)	10 (10)	325 (13)	--
Some college	44 (44)	1049 (41)	.384
College degree or more	47 (46)	1158 (46)	.434
Income			
Up to $40 000	58 (64)	1375 (60)	.453
$41 000 or more	33 (36)	924 (40)	
Met Partners Online			
Yes	87 (87)	1954 (80)	.080
No	13 (13)	492 (20)	
HIV Status			
Positive	11 (11)	180 (7)	.157
Negative or unknown	91 (89)	2361 (93)	

* Age, race, and education used logistic regression to calculate the *P*-value. Income, meeting partners online, and HIV status used chi-square to calculate the *P*-value.

To test for multicollinearity, we ran a linear regression with "any STD" as the dependent variable and the drug and behavioral risk variables from the bivariate analyses as the independent variables. The variance inflation factor (VIF) value for each variable was below 1.5, indicating that multicollinearity was not present. We separated the drug and behavioral risk variables for the multivariate logistic analyses into 3 logistic regression models to assess risk correlates for acquiring an incident STD: model 1 comprised crystal, cocaine, ecstasy, Viagra, and alcohol before or during sex; model 2 comprised UAI and number of sex partners during the study; and model 3 (see Table 3) comprised the significant variables from models 1 and 2.

In model 1, only crystal and alcohol before/during sex were predictive of acquiring an incident STD (crystal, OR 2.7, 95% CI 1.2-6.0, P<.05; alcohol, OR 1.6, 95% CI 1.0-2.6, P<.05). In model 2, UAI and having 6 or more sex partners during the study were predictive of acquiring an incident STD (UAI OR 3.9, 95% CI 2.2-7.1, P<.001; 6 or more partners, OR 4.3, 95% CI 1.8-10.1, P=.001). In the final multivariate model (see Table 3), alcohol before/during sex lost significance and UAI, crystal use before or during sex, and having 6 or more sex partners were the strongest predictors of acquiring an incident STD.

In order to assess the potential for HIV transmission, we compared the HIV status of the participants to that of their partners. Among HIV-positive men with multiple sex partners who reported UAI (n=109), 47% reported UAI with

HIV-negative/unknown partners only, 43% reported UAI with positive and negative/unknown partners, and 10% reported UAI with positive partners only. Seven of the 8 respondents with an STD in this subgroup reported sex with serodiscordant partners.

Table 3. Bivariate and multivariate analyses: factors associated with incident STDs

	Incident STD [#]		Drug Use and Behavioral Risk		Crystal and Behavioral Risk	
	Yes	No	Bivariate Odds Ratio (95% CI)	P	Multivariate Adjusted Odds Ratio[*] (95% CI)	P
	N (%)	N (%)				
Drug Use Before/During Sex [§]	n=94	n=2411				
Crystal methamphetamine	16 (17)	124 (5)	3.8 (2.1-6.7)	<.001	2.0 (1.1-3.8)	.024
Cocaine	13 (14)	159 (7)	2.3 (1.2-4.2)	.007		
Ecstasy	17 (18)	219 (9)	2.2 (1.3-3.8)	.003		
Viagra	16 (17)	211 (9)	2.1 (1.2-3.7)	.006		
Alcohol Use	n=98	n=2499				
Alcohol before sex[†]	62 (63)	1192 (48)	1.9 (1.2-2.9)	.002	1.3 (0.8-2.1)	.207
Behavioral Risk	n=102	n=2538				
Unprotected anal intercourse[‡]	88 (86)	1409 (55)	5.0 (2.8-8.9)	<.001	3.4 (1.9-6.3)	<.001
Sex partners	n=100	n=2494				
0-1 (reference)	6 (6)	503 (20)	--			
2-5	31 (31)	1103 (44)	2.3 (0.9-5.7)	.056	1.6 (0.6-3.9)	.294
6-100+	63 (63)	888 (36)	5.9 (2.5-13.8)	<.001	3.3 (1.4-7.8)	.007

[*] Adjusted odds ratio = the odds ratio estimated after adjusting for all other variables included in the parsimonious model.

[#] Note: In model 1 (data not shown), crystal use and alcohol before/during sex were associated with incident STDs. In model 2 (data not shown), UAI and having 6 or more sex partners were associated with incident STDs.

[†] Sometimes/most of the time

[‡] Receptive and/or insertive UAI

[§] Drug use variables are not mutually exclusive

Discussion

In this case-control study of men recruited through the Internet, strong associations were found between unprotected anal intercourse, crystal use, and multiple sex partners and an incident STD. In the overall sample, 4% reported a diagnosis of an incident bacterial or viral STD during the 6-month study period. The great majority of HIV-positive men with multiple sex partners reported unprotected sex with HIV-negative or status unknown partners, which signifies the continued risk of spreading HIV and other STDs to non-infected individuals [8]. Other studies of HIV-positive men report a range of serodiscordant or potentially discordant sex, from 21% to 49% [18,22,23]. An average of 80% of our sample met sex partners online, and study findings indicate risk comparable to other Web-based studies on recent sexual risk behavior trends among MSM [24-26].

Men who begin having sex with men while on drugs may develop a pattern of using drugs during sexual experiences [27], and certain drugs such as nitrite inhalants (poppers) and crystal may be used specifically to enhance sexual experiences [27]. Impaired judgment due to drug use may lead to unprotected sex, increasing the risk of HIV/STD transmission [13]. It has been hypothesized that substance use may help men avoid feelings of anxiety associated with same-sex behavior and concerns about HIV risk [20]. Reback's report [17] found that MSM used crystal to cope with negative internal messages about gay sexuality, and HIV-positive MSM reported using it to cope with the fear of transmitting HIV. Reback's report also found that most HIV-positive participants reported that they did not disclose their HIV status to casual sex partners as it was their partner's responsibility to use protection or to set behavioral limits.

Certain limitations of this study deserve mention. Our survey was posted on only one gay-oriented website. We do not know whether survey respondents would differ if the survey had been posted on multiple sites or on sites that specifically facilitate meeting sex partners. Minority MSM were underrepresented in the sample; our data suggest that white, non-Hispanic MSM were unintentionally oversampled, as those who have computer skills and access to participate in online sex surveys tend to be younger, wealthier, educated white males [28-30]. STD was self-report only and we did not ask for the site of infection. There may have been underreporting in this sample, as certain

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STDs, like chlamydia and gonorrhea, are often asymptomatic and go undetected and unreported [31]. This may also be true for certain viral STDs such as genital herpes [32]. Finally, it is not possible to determine whether respondents who participated in this Internet-based survey are representative of MSM who use the Internet, of MSM in general, or of MSM with HIV, since the MSM population has never been enumerated. Despite these limitations, Internet research is an efficient and inexpensive way to reach large samples of high-risk groups.

Identifying and treating MSM who have STDs, or who are at increased risk of acquiring STDs, is crucial in preventing the further spread of disease. The Internet is a necessary and appropriate medium to reach sex-seeking populations for prevention and intervention efforts [33], especially when factoring in increasing numbers of people living with HIV who are resuming sexual activity as a result of improved treatment regimens [34]. Just as bathhouses and shooting galleries have been used to deliver STD prevention messages, Internet-based interventions should be considered for those seeking sex online [35]. Results of preliminary research on Internet HIV prevention for MSM are promising, suggesting that the Internet may be a reliable resource for studying and targeting risk behaviors in MSM [36].

Studies conducted over the past 20 years have found associations between substance abuse treatment and a reduction in HIV risk behaviors [37]. Primary and secondary substance abuse treatment among MSM has been successful, as treatment can affect decisions about sexual behavior uninfluenced by drugs and alcohol [38]. However, treatment remains challenging, and it has been suggested that men need to abstain from drug use and learn skills to meet and initiate sex with men while sober [12]. The rise in crystal use among the MSM population may require a special focus on current substance abuse treatment approaches, such as addressing drugs in exchange for sex, and disclosure of HIV status [17]. In addition, there is a need to integrate HIV/STD and substance use prevention and education into Web-based and community-based venues. Study findings raise questions concerning the spread of disease and the multiple high-risk behaviors, specifically, how drug use is situated within the trajectory to unprotected sex, multiple partners, and ultimately HIV/STD transmission. Additional data are needed to better understand specific pathways between sexual and drug using practices and HIV/STD transmission among MSM.

Acknowledgments

Conflicts of Interest

None declared.

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Abbreviations

HIV: Human immunodeficiency virus
MSM: Men who have sex with men
STD: Sexually transmitted disease
UAI: Unprotected anal intercourse

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CATCH-IT Report: Evaluation of an Internet-Based Smoking Cessation Program: Lessons Learned From a Pilot Study

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Comment in: Eysenbach G, Norman C. Introduction to CATCH-IT Reports: Critically Appraised Topics in Communication, Health Informatics, and Technology. J Med Internet Res. 2004;6(4) p. e49 http://www.jmir.org/2004/4/e49/

Introduction

It is estimated that more than 4 million people die annually from tobacco-related illnesses globally [1]. Well-designed smoking prevention and smoking cessation programs can make substantial contributions to global public health. Any intervention that can reduce tobacco use, offer global reach, and do so in a cost-effective manner presents a tremendous opportunity to reduce the future burden of disease. To this end, the paper by Feil et al, *Evaluation of an Internet-based smoking cessation program: lessons learned from a pilot study* [2] represents a significant opportunity to move tobacco control forward. This paper reports on a pilot test evaluation of a Web-based smoking cessation program, the Quit Smoking Network (http://www.qsn.ori.org/), and the efforts to recruit participants and conduct a study through the Internet.

The authors of this paper have considerable experience in medical computing and in the burgeoning area of behavioural eHealth, having published several recent papers on Internet-based interventions for diabetes [3-6]. Although this is the first of their papers to address smoking cessation, the authorship team includes a recognized expert in the field of tobacco control (Ed Lichenstein) who also plays a role in the delivery of the intervention. The site is publicly available; however, it was unavailable for viewing at the time of this review because of upgrades to the website.

Objectives

The aim of the study is to evaluate a strategy for online study recruitment and retention, to evaluate the influence of incentives on follow-up response, and to assess the impact of the Quit Smoking Network site on smoking behaviour.

Feil and colleagues [2] describe their intervention as having several components including

> a structured intervention that guides development of a cessation quit plan, interpersonal support (both peer-peer and professional-peer support in postings forum and E-mail response formats), and a library of a wide variety of cessation resources (e.g., online

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pamphlets, motivations materials, and links to other sites).

The intervention was also described as "based on theoretically grounded and empirically validated intervention approaches" citing an earlier paper by Lichenstein and Glasgow [7]. Despite this assertion, no reference to a specific theoretical model for the intervention or theory of implementation was provided (see Grembowski, 2001 [8]). Social support and self-efficacy are mentioned as desired process outcomes, but how these theories were used is not made explicit.

Methods

The research design is a single-condition study with a randomized follow-up component. Participants were recruited largely through magazine ads, local media coverage of the study and through the website itself (hits, web searches etc). All participants were exposed to the website intervention and then randomly assigned to 1 of 4 follow-up conditions (2 email and 2 postal mail) afterwards. Participants completed a pretest survey online prior to the intervention and were contacted at 3 months postintervention to complete the follow-up online. Participants who did not complete the 3-month follow-up were randomly assigned to receive further follow-up notifications by email or regular US mail after 3 weeks. No description of the randomization process was provided.

Results

Two hundred and nine participants (56%) completed the 3-month follow-up, mostly through the Internet (81% Web, 5.5% email). Both the mode of communication (US Mail, 60%; email, 55%) and incentive amount (US$20, 60%; US$10, 55%) provided similar rates of follow-up. With regard to the impact of the intervention, 38% (67) of participants reported abstinence (7-day point prevalence) at 3-month follow-up (18% using intent-to-treat analysis). Such results are comparable to many other non-Internet smoking cessation trials [9].

Limitations

Although there was a reported cessation rate of 18% at 3 months, it is unclear whether this effect can be attributed to the intervention as no method of accounting for alternative explanations was provided. Since participants were self-selected based on an expressed interest in smoking cessation it seems reasonable that participants also sought other treatment options at the time of their participation. Another limitation of the study is the absence of the reported mean time to response after the second 3-month reminder was sent to participants.

From a tobacco control perspective, there are additional concerns. An absence of a detailed description of instruments used to assess smoking variables is unfortunate. With a large body of literature in tobacco control, a number of acceptable measures or items have emerged to assess smoking behaviours and tobacco use. However no details of the items, item source, or scale reliability were provided and, in the case of cessation self-efficacy, were not even defined. Outside the effect on

cigarette abstinence, the study's effects on outcome variables such as cessation self-efficacy were not reported.

Discussion

This study introduces a number of innovations for advancing knowledge of eHealth. The implementation and evaluation of an intervention completely at a distance represents a significant step forward in advancing eHealth research. Another innovation is the study of both incentive value and mode of contact on follow-up participation rates--issues that clearly require further study.

Although the study design was innovative, the study as reported was problematic in a number of areas. With respect to eHealth issues, many of the evaluation reporting guidelines recommended by the Science Panel on Interactive Health Communication [10] were not followed. Furthermore, many basic reporting guidelines from the CONSORT statement were also not followed including a description of the randomization process [11]. Although the study was submitted as a "Brief Report", it was expected that these quality issues would be mentioned in the text or with reference to another source (eg, web page). Such information enables a reader to assess the study's merit while providing guidance on developing future eHealth intervention studies.

Despite its limitations, many of which could have been reduced by more complete reporting, this is an important study for eHealth and tobacco control. As with many pioneering studies, this work offers more questions for eHealth research than answers; but the answers it does provide are nonetheless important. Furthermore, the findings of the study have great clinical significance for tobacco control given that the intervention was delivered in absentia and the potential for widespread, population-based translation of the intervention is high. Building on the results of this pilot test it is hoped that the authors will soon offer a more extensive evaluation of the Quit Smoking Network, one that has addressed some of the concerns stated here and that furthers this study's unique contribution to the literature.

Questions for Authors

- What method or process was used to randomize participants into each condition?
- Among those participants who did not respond to the initial follow-up request, what was the mean time to follow-up?
- What are the theoretical model(s) guiding the Quit Smoking Network site and how are they applied?
- How was intervention exposure (dose) assessed or measured for each participant?
- What other smoking strategies did participants report engaging in? If not measured, why?
- How was cessation self-efficacy measured?
- What were the levels of reported social support at baseline and how were such measures correlated with smoking cessation at 3-month follow-up?

- How do you propose researchers address the issue of validating smoking self-report using remotely-delivered interventions?

Acknowledgments

Multimedia Appendix

Powerpoint slides by C. Norman presenting the Feil paper. [PPT File, 965KB - jmir_v6i4e47_app1.ppt]

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CATCH-IT Report

Response to CATCH-IT Report by Cameron Norman: Evaluation of an Internet-Based Smoking Cessation Program: Lessons Learned From a Pilot Study

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Related Articles:

Comment on: Feil EG, Noell J, Lichtenstein E, Boles SM, McKay HG. Evaluation of an Internet-Based Smoking Cessation Program: Lessons Learned From a Pilot Study. Nicotine Tob Res. 2003 Apr;5 p. 189-194

Comment on: Norman C. CATCH-IT Report: Evaluation of an Internet-Based Smoking Cessation Program: Lessons Learned From a Pilot Study. J Med Internet Res. 2004;6(4) p. e47 http://www.jmir.org/2004/4/e47/

Cameron Norman's critique [1] of our brief report in *Nicotine & Tobacco Research* [2] provides a good summary of its contents. The author makes several legitimate suggestions, but perhaps does not stress enough the core issues of our original study. These issues are

1. comparatively equal effectiveness of Internet-based health interventions and intensive clinical treatment;
2. the methodological problem of assignment to a control condition;
3. high attrition at follow-up assessments.

As one of the authors of the original report I take this opportunity to respond to some of the design criticisms noted in the CATCH-IT report.

Our small pilot study was presented as a brief report; it was therefore limited in scope and not as detailed as a full manuscript. Several items such as randomization, mean time to follow-up, and measures collected (ie, other smoking strategies and cessation self-efficacy, and social support) could not be described in detail in a brief report.

Our report [2] noted that while

these results provide reason for further evaluations. ... However, given the lack of a control condition, we cannot conclude that quitting was a function of our

Web site rather than other factors. Determining the relative contribution of a specific Web site presents difficult challenges, given that typical Internet users appear to sample various sites.

Therefore, an alternative treatment is only a click away, especially for a person seeking out a website for help in smoking cessation. We surmised that given the nature of the Internet, any assignment to a control condition would be futile. Additionally, the welcoming anonymity of the Internet combined with the transitory nature of email addresses makes follow-up difficult. Unless this methodological problem can be addressed by Internet health researchers, a true randomized trial on the open Internet is untenable and definitive results will remain elusive [3].

The CATCH-IT author states that no reference was made to a specific theoretical model for the intervention, while noting that our brief report did cite Lichtenstein and Glasgow [4]. This paper notes that behavioral intervention with relapse prevention is the type of treatment most used in intensive clinical settings, and is the most effective. Our pilot study attempted to use the most intensive clinical and empirically-proven approach and adapt it for delivery over the Internet.

The amount of intervention exposure (dose) was assessed and measured for each participant through the use of a fairly standard

tracking system for an Internet-based intervention, namely, the number of log-ins. Our brief report [2] did state that

> *The Web site recorded 24 252 logins (i.e., instances when a participant used a username and password to gain access to the Web site), with an average of 108 logins per day. ... Most activity occurred immediately after completion of baseline assessment and on weekdays. ... Considerable variation in the number of logins was noted, with 10% of the participants accounting for 79% of logins. ... While the gender differences and participation rates might indicate trends, these results were not statistically significant.*

The CATCH-IT author was concerned with the lack of biochemical verification of self-reported abstinence in the context of a "remotely-delivered intervention." [1] According to the Society for Research on Nicotine and Tobacco Subcommittee on Biochemical Verification [5], the decision to use biochemical validation of tobacco use depends on three issues: demand characteristics, type of study, and type of population. Biochemical verification is recommended in randomized clinical trials of intensive interventions where repeated contacts between research or intervention personnel and subjects might elicit relatively high demand characteristics. The authors review several recent large-scale studies and conclude that biochemical verification is not warranted in population-based interventions with limited face-to-face contact. As to the impact of inaccurate self-report, the Subcommittee states that while it is likely that self-report will inflate quit rates, the magnitude of such inflations is small.

Overall, this particular CATCH-IT report (and - hopefully - future CATCH-IT reports in this new series in the *Journal of Medical Internet Research*) lays the groundwork for a discussion of the important issues germane to Internet-based health interventions. The need for rigorous evaluation of randomized controlled trials is imperative as the number of Internet-based health interventions promoted to the public increases. Such emphasis on high standards will help to prevent dissemination of unproven interventions and to provide effective programs to Internet and World Wide Web users.

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Correction

Correction and Republication: Internet Versus Mailed Questionnaires: A Controlled [Correction of "Randomized"] Comparison (2)

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Related Articles:

Correction of: http://www.jmir.org/2004/3/e30/

This is a corrected version. See correction statement: http://www.jmir.org/2004/4/e39/

A number of errors occurred in the article by Pam Leece et al. (J Med Internet Res 2004;6(3):e30). The corrected version has been republished as J Med Internet Res 2004;6(4):e39 and is available at http://www.jmir.org/2004/3/e39/. Please do not cite the old version.

The title of the article should have been "Internet Versus Mailed Questionnaires: A Controlled Comparison" (rather than "Internet Versus Mailed Questionnaires: A Randomized Comparison"), because the subjects were alternately assigned to receive a postal or an Internet questionnaire, thus the allocation process was not truly random, but pseudo-random. The authors have also noted an error in their previous analysis and changed the number of primary responders in mail group to 128, rather than 129. This change also affects Table 1 and Table 2, so that the denominator in the mail group should be 128 instead of 129 and the total respondents to be 227 instead of 228. Some of the numerators in this table were also revised after the authors noted an additional error in which respondents were attributed to each group. The original Figure 2 that was published omitted information at the bottom of the figure that we intended to be included, so this figure has also been updated. Due to a revised intention to treat analysis of the results to include all participants we contacted in both groups, Table 3 has been revised to include 221 participants in the denominator rather than 176 as originally published. Finally, the original publication included a figure (Figure 3) that represented the cumulative frequency of responses by group and by follow-up contact according to a per protocol analysis. This figure has been removed to avoid confusion and to keep the intention to treat analysis as the primary analysis of the results consistent throughout the paper.

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Corrected and Republished Paper

Internet Versus Mailed Questionnaires: A Controlled Comparison (2)

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Related Articles:

Correction of: http://www.jmir.org/2004/3/e30/

Letter: http://www.jmir.org/2004/4/e38/

Abstract

Background: Low response rates among surgeons can threaten the validity of surveys. Internet technologies may reduce the time, effort, and financial resources needed to conduct surveys.

Objective: We investigated whether using Web-based technology could increase the response rates to an international survey.

Methods: We solicited opinions from the 442 surgeon–members of the Orthopaedic Trauma Association regarding the treatment of femoral neck fractures. We developed a self-administered questionnaire after conducting a literature review, focus groups, and key informant interviews, for which we used sampling to redundancy techniques. We administered an Internet version of the questionnaire on a Web site, as well as a paper version, which looked similar to the Internet version and which had identical content. Only those in our sample could access the Web site. We alternately assigned the participants to receive the survey by mail (n=221) or an email invitation to participate on the Internet (n=221). Non-respondents in the mail arm received up to three additional copies of the survey, while non-respondents in the Internet arm received up to three additional requests, including a final mailed copy. All participants in the Internet arm had an opportunity to request an emailed Portable Document Format (PDF) version.

Results: The Internet arm demonstrated a lower response rate (99/221, 45%) than the mail questionnaire arm (128/221, 58%) (absolute difference 13%, 95% confidence interval 4%-22%, P<0.01).

Conclusions: Our Internet-based survey to surgeons resulted in a significantly lower response rate than a traditional mailed survey. Researchers should not assume that the widespread availability and potential ease of Internet-based surveys will translate into higher response rates.

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KEYWORDS

Survey; methods; mail surveys; Internet surveys; response rate

Introduction

Health-care surveys are an important research tool to study the attitudes, beliefs, behaviors, practice patterns, and concerns of physicians [1]. Response rates to surveys, especially among physicians, have been suboptimal (mean response rates=62%, SD=15%) [2]. Investigators have attributed the lower response rates to increasing physician workloads and to the low priority physicians place on survey completion. The return rates have been especially low in surveys of surgeons, who have responded at rates from 15%-77% [3-6]. Low response rates threaten the validity of a survey by increasing the risk of a non-response bias [1,7,8].

Dillman's Tailored Design Method is the current standard for conducting mail and Internet surveys [9]. A recent Cochrane Methodology Review verified the success of these strategies for achieving reproducible response rates in the general population [10,11]. Another systematic review also confirmed that some of these methods are effective in physician surveys: monetary incentives, stamps on outgoing and return envelopes, and short questionnaires [1].

The suboptimal response rates among surgeons calls for exploration of alternative survey administration strategies. Internet technology has the potential to decrease the time and cost involved in conducting a health-care survey. Couper presents a review of issues and approaches to Web surveys, and suggests that Web surveys may improve the response rate and lower the cost of surveys [12]. While some Internet-based surveys have shown promising response rates (up to 94% [13]), their potential has not been realized in other studies (response rates ranged from 11%-70%) [14-17]. To date, no studies have evaluated the response rates to Internet surveys among orthopaedic surgeons.

We hypothesized that orthopaedic surgeons who were given the opportunity to participate in an Internet-based questionnaire would respond at a higher rate than surgeons who were mailed a paper copy of the survey. We tested this hypothesis in a survey of orthopaedic surgeons on their views about managing hip fractures.

Methods

Questionnaire Development

We developed an 8-page self-administered questionnaire to identify the preferences and practice patterns of orthopaedic traumatologists in the operative treatment for femoral neck fractures. Using previous literature, focus groups with orthopaedic surgeons, and key informants, using sampling to redundancy techniques, we identified items that fell into six domains: 1) surgeon experience; 2) classification of fracture types; 3) treatment options; 4) technical considerations in the operative technique; 5) predictors of patient outcome; and 6) patient outcomes. We pre-tested the 8-page questionnaire to establish its comprehensibility, face validity, and content validity [18].

Figure 1. Welcome screen for Internet questionnaire

Study Sample

Of the 453 members of the Orthopaedic Trauma Association (OTA) listed on the 2002 membership list, we included all active, international, emeritus, and associate members, but excluded 11 members who are not surgeons. Therefore, we included all 442 surgeon–members of the OTA. We obtained the email addresses for the surgeons in the Internet group from the OTA's online directory.

Development of Web Questionnaire

We hired a professional Web designer to create an Internet version of the questionnaire on a Web site. The questions were displayed in the same order and format as they were in the paper version. The "welcome screen" of the Web site invited participants to enter their assigned personal identification number (PIN) and user identification (user ID) before beginning the questionnaire, so that only those in the Internet group had access to the questionnaire (Figure 1).

We also included our contact information, as well as the option to request a questionnaire by mail, fax, or email as a Portable Document Format (PDF) attachment. The Web questionnaire was 6 pages long (1 page per section), took approximately 5 minutes to complete, and had 38 questions. The responses to the Internet questionnaire were automatically entered into a database.

Study Design and Allocation

We alternately assigned the surgeon–members of the OTA to receive a postal or an Internet questionnaire. One of us (PL), who did not know the surgeons, prepared the allocation schedule for each of the 442 surgeon–members of the OTA by using the association's membership list and, starting at the top of the alphabetical membership list, alternately assigning each name to the mail or Internet group using a systematic sampling approach. Of the 221 surgeons originally assigned to the Internet group, 45 did not have email addresses and thus received the mail version and reminders in the same way as those in the mailed questionnaire group. We selected 45 surgeons from the mail group known to have email addresses to receive the electronic questionnaire.

One of us (PL) recorded the costs associated with development and implementation of the mail and Internet-based surveys to assess the feasibility of each method. Our costs included labor, supplies, postage, Web-site administration, and our domain name. These costs were calculated and compared between groups.

Questionnaire Administration

We planned five points of contact for the questionnaire administration: 1) advanced notification by post (mail group) or email (Internet group) 2 to 5 days prior to receiving the survey; 2) a mailed copy of the survey, or an email with a link to the Internet survey; 3) another mailed copy or email with a

link to the survey at 6 weeks; 4) a further copy or link at 12 weeks; and 5) a copy of the survey sent by mail only to all non-respondents in both groups (22 weeks for the mail group and 19 weeks for the Internet group). We conducted the final mail-out to non-responders in both groups at the same time, and stopped the study for both groups at the same time, although the mail group had started three weeks before the Web site was ready for the Internet group. We calculated our primary response rates based on the number of responses received before the final mail-out; it was at that final mail-out that we changed our method of administration.

Our University Research Ethics Board reviewed and approved this research.

Statistical Analysis

We analyzed all participants according to their final group (per protocol analysis) and the group to which they were originally assigned, following the intention to treat (ITT) principle. We summarized response rates by the proportion of respondents at each time point. Chi-square analyses were used to compare the proportion of respondents in the mail group with the proportion in the Internet group using the MINITAB version 14.0 statistical software package. All statistical tests were two-sided, at a pre-determined alpha level of 0.05.

Results

Of the 442 surgeons, 221 received a copy of the questionnaire by mail, and 221 received an email invitation to complete the survey online. Characteristics of respondents (age, geographic location, type of practice, and the proportion who had completed a fellowship in trauma) were not different between groups (Table 1).
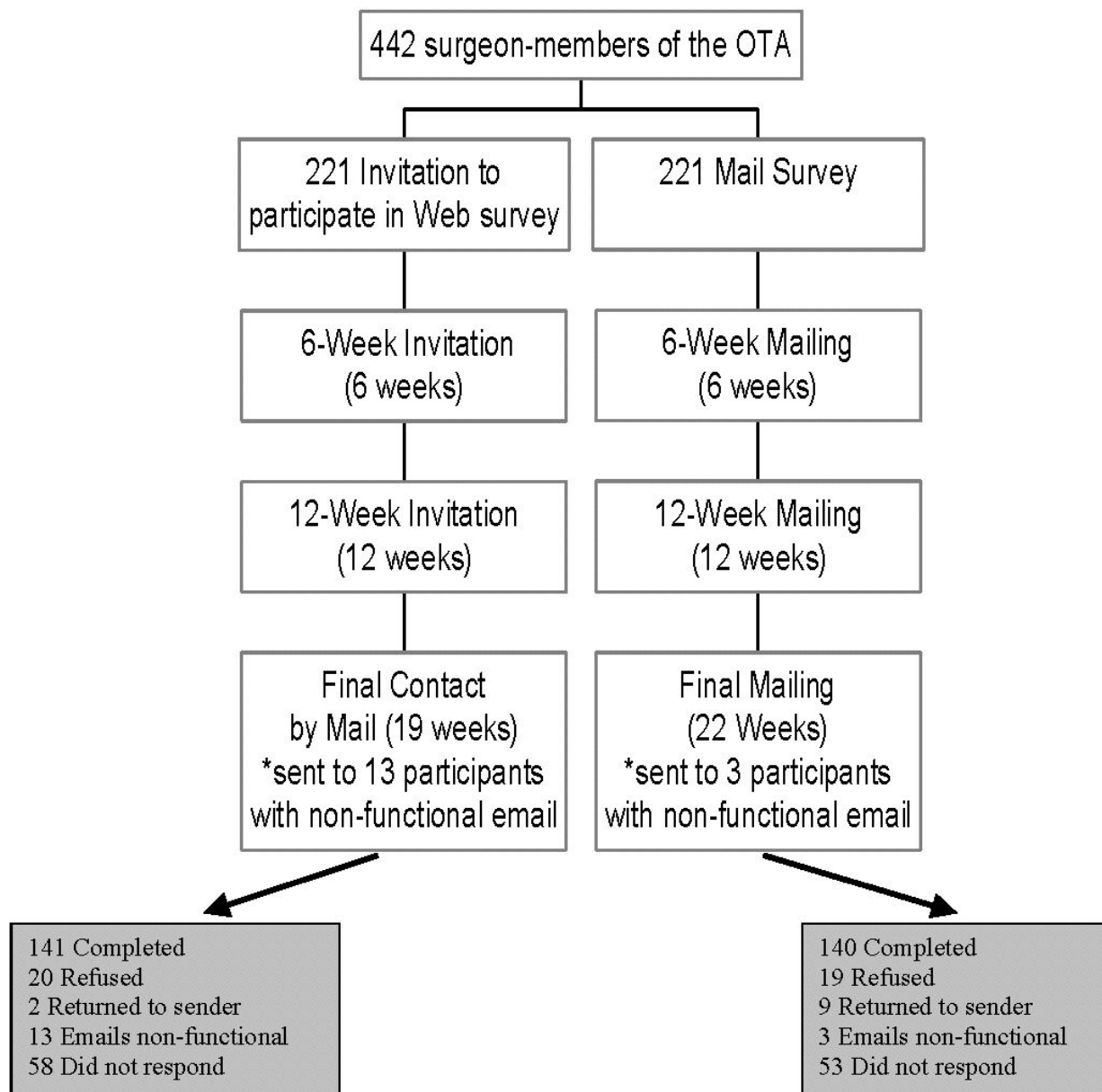
The surgeons who responded live in 17 countries on 6 continents; 80% of all respondents before the final mailing lived in the USA (Table 2).

In the original mail group, 9 surveys were returned to sender (ie, wrong address), 3 email addresses were non-functional, and 19 surgeons explicitly refused to participate by the time we closed the study. In the original Internet group, 2 surveys were returned to sender, 13 email addresses were non-functional, and 20 people explicitly refused to participate by the end of the study (Figure 2).

There was no significant difference between the proportion of respondents who switched from the mail to the Internet group and those who switched from the Internet to the mail group (27/45 vs 22/45, P=0.287).

Table 1. Characteristics of the surgeons who responded to the survey before the final mailing (Intention to Treat Analysis)

Physician Characteristic		Mail (n=128)	Internet (n=99)	P-Value
AGE	Under 41	26/128 (20%)	18/99 (18%)	0.69
	41-50	61/128 (48%)	45/99 (45%)	0.74
	51-60	30/128 (23%)	28/99 (28%)	0.41
	Over 60	10/128 (8%)	7/99 (7%)	0.83
Geographic Location (% North America)		104/128 (81%)	78/99 (79%)	0.65
Type of practice (% academic)		104/128 (81%)	73/99 (74%)	0.18
Trauma Fellowship (% yes)		88/128 (69%)	73/99 (74%)	0.41

Figure 2. Participant flow (Intention to Treat Analysis)

Figure 2: Participant Flow (Intention to Treat Analysis)

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                    442 surgeon-members of the OTA
                                   |
               _____
              |                                           |
    221 Invitation to                            221 Mail Survey
participate in Web survey
              |                                           |
       6-Week Invitation                          6-Week Mailing
        (6 weeks)                                  (6 weeks)
              |                                           |
       12-Week Invitation                         12-Week Mailing
        (12 weeks)                                 (12 weeks)
              |                                           |
       Final Contact                              Final Mailing
    by Mail (19 weeks)                             (22 Weeks)
    *sent to 13 participants                    *sent to 3 participants
    with non-functional email                  with non-functional email
              |                                           |
              v                                           v
   141 Completed                               140 Completed
   20 Refused                                  19 Refused
   2 Returned to sender                        9 Returned to sender
   13 Emails non-functional                    3 Emails non-functional
   58 Did not respond                          53 Did not respond
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Table 2. Geographical location of the surgeons who responded to the survey before the final mailing (Intention to Treat Analysis)

	Mail (n=129)	Internet (n=99)	Total (n=228)
Africa	1	0	1
Asia	4	3	7
Australia	0	1	1
Europe	19	16	35
North America	104	78	182
South America	0	1	1

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The overall primary response rate was 227/442 (51%). A significantly greater proportion of participants in the mail group responded (128/221, 58%) compared with the Internet group (99/221, 45%) (absolute difference 13%, 95% confidence interval: 4%-22%, P<0.01). The per protocol analysis similarly favored the mail group (absolute difference 14%, 95% confidence interval: 5%-23%).

The final response rate for the survey, after we had used a mixture of administration methods to raise the response rate, was 64% (281/442). Response rates did not differ significantly between the mail and Internet groups either in the intention to treat (Table 3) or per protocol analysis.

The Internet-based survey was more costly to implement than the mail survey (Can $3101.95 and Can $2739.40, respectively) (Table 4).

Table 3. Response rates over time (Intention to Treat Analysis)

		Mail (N=221)	Internet (N=221)	Overall (N=442)	P-Value
RESPONSES	6 weeks	83 (38%)	52 (24%)	135 (31%)	<0.01
	12 weeks	113 (51%)	77 (35%)	190 (43%)	<0.01
	22 weeks (mail) 19 weeks (Internet)	128 (58%)	99 (45%)	227 (51%)	<0.01
	32 weeks (mail) 29 weeks (Internet)	140 (63%)	141 (64%)	281 (64%)	0.92

Table 4. Cost of administering survey by group

	Mail (Can $)	Internet (Can $)
Survey mailing materials	1319.41	215.78
Web administration (programming and domain name)	N/A	2413.51
Labor for mailing/ emailing ($20/hr, 5 min per mailed survey, 1 min per emailed survey)	1181.66	392.68
Labor for data entry ($20/hr, 5 min per survey)	238.33	80.00
TOTAL	2739.40	3101.95

Had we utilized an existing Web site for developing surveys [19], the Internet costs could have been reduced to Can $968.46 for the Internet group; however, we would have been constricted in the format and design of the Web page.

Discussion

It is important to achieve the highest response rate possible to limit non-response bias in health-care surveys. Previous research has demonstrated that monetary incentives, stamped return envelopes, telephone reminders, shorter surveys, and high interest can sometimes increase response rates [1,2]. Currently, there are very few data comparing response rates between postal and Internet surveys.

We hypothesized that we might receive a higher response rate among surgeons to the Web questionnaire than to the conventional paper version. We expected that surgeons with busy schedules might find the Web questionnaire would take less time and eliminate the inconvenience of dealing with paper or mailing. Additionally, we believed that widely available Internet access throughout operating suites, hospital wards, and surgeons' offices would facilitate the early completion and return of Internet-based surveys. Finally, the novelty of participating in a Web questionnaire might have interested participants who would not have completed a mailed questionnaire.

Contrary to our hypothesis, but consistent with previous studies [14,17], we found a lower response rate to the Internet questionnaire. Raziano et al randomized 2 cohorts of geriatric division chiefs to receive a survey either by electronic mail (n = 57) or by conventional postal mail (n = 57) [17]. The aggregate response rate was 58% (n = 31) for the email group versus 77% (n = 44) for the postal mail group. In another study, Kim and colleagues sent postal or email surveys to 2502 members of the American Urological Association [15]. From the postal group (n = 1000), 419 responses were obtained (42%); from the email group (n = 1502), 160 (11%) responses were obtained [15]. McMahon and colleagues compared email and postal survey response rates in a survey of physicians listed in the membership directory of the Georgia Chapter of the American Academy of Pediatrics [14]. The response rate after the first 2 mailings (2 weeks and 4 weeks) was 41% (59/143) for postal and 26% (33/125) for email surveys [14]. Harewood distributed a survey to patients about their experience after routine outpatient endoscopy. Patients were randomized to receive the questionnaire by standard mail or email. The email version of

the survey resulted in a 15% lower response rate (70% vs 85%) (Table 5) [16].

Table 5. Response rates in previous surveys comparing mail and Internet surveys

Authors	Participants	Groups	Response
Raziano et al [17]	Geriatric division chiefs (n=114)	Email (n=57)	Email 58% (31/53)*
		Mail (n=57)	Mail 77% (44/57)
Kim et al [15]	American Urological Association (n=2502)	Email (n=1502)	Email 11% (160/1502)
		Mail (n=1000)	Mail 42% (419/1000)
McMahon et al [14]	Georgia Chapter of the American Academy of Pediatrics (n=268)	Email (n=125)	Email 26% (33/125)
		Mail (n=143)	Mail 41% (59/143)
Harewood et al [16]	Patients after routine outpatient endoscopy (n=43)	Email (n=23)	Email 70% (16/23)
		Mail (n=20)	Mail 85% (17/20)
Present study	Orthopaedic surgeon– members of the Orthopaedic Trauma Association (n=442)	Email (n=221)	Email 45% (99/221)
		Mail (n=221)	Mail 58% (128/221)*
			after final mailing to all:
			Email 64% (141/221)
			Mail 63% (140/221)

* 4 individuals had incorrect or no email address

This is also consistent with Couper's caution that for using a probability-based method, with a list-based sample of high-coverage populations, non-response remains a concern. People will usually choose a paper version over an Internet version of a survey [12].

We found a lower response rate to the Internet questionnaire despite efforts to make the Internet version of our questionnaire easy to use, and despite the inclusion of a link to the Web site in the invitation email. We followed closely the recommendations for conducting Web surveys made by Dillman, who reported comparable electronic and postal mail response rates [9]. We have also avoided many of the common problems with Internet surveys noted by Zhang: our design used a population that has easy access to the Internet and that is relatively comfortable with it; we eliminated self-selection bias and increased the validity of responses by using ID; we used a personalized survey; and we blocked participants from entering multiple responses [20].

However, we were probably able to achieve similar final response rates for those who originally received the survey by Internet only because we used mixed modes (ie, sent by email, offered PDF, and finally sent a paper copy by mail), as shown by our response rates up until the final reminders (Table 3).

There are several possible explanations for why the response rate was lower for the Web questionnaire. It may be that participants tend to be worried about computer viruses and delete emails that are unsolicited or from someone they do not know. In fact, it may be easier to delete an email than it is to ignore a mailed survey. It may also be that more paper surveys sent to the incorrect address may have been forwarded to participants, whereas emails would not be re-directed (however, we did not find a significant difference in the number of returned emails versus paper surveys). Having to enter a user ID and PIN to access the Internet questionnaire may have deterred participants. Several participants who used Netscape as their browser contacted us to report that they had trouble navigating through the pages of the survey. We expected that the level of computer literacy in this group would be quite high, although this may not have been the case. The use of different versions or types of browsers and different operating platforms can result in the questionnaire being displayed differently on the designer's computer and the respondent's computer [9]. Other differences in the respondent's computer equipment can affect the appearance of the questionnaire or the ease of using it. Differences include the configuration of the user's screen resolution, Internet connection speed, memory resources, and software applications [9].

In the end, the cost of using the Web site was higher than mailing the survey (Can $3101.95 vs Can $2739.40) because of the cost of Web programming and the monthly cost of the domain name. Our decision to design a custom Web page for the survey led to the increased cost of the Internet survey. Had our sample size been larger, the cost of the Web survey would have been less than the cost of the mailed survey: set-up costs for the Web survey were high, but the cost per additional participant was low [21].

In retrospect, excluding those without email addresses and randomizing the remainder represents a superior design to the one we chose, which requires separate consideration of per protocol and intention-to-treat analyses. However, results were very similar in the two analyses. Our allocation method was "pseudo-random" because we did not use a random number generator to allocate participants to each group. However, our method probably produced the same effect as randomization because we alternately assigned participants to groups using an alphabetical list. Therefore, the assignment of participants was not based on any factor that could plausibly affect their inclination to respond.

We also did not pre-determine whether participants were regular Internet users, or ask non-responders why they did not complete our questionnaire. Thus, it remains possible that more selective use of Internet users would lead to higher response rates. We

do not feel that the email group's receiving the final mail-out three weeks later than the mail survey group had much effect on the response rates. Because email communication is much faster than postal mail, we found that after each reminder, responses from the Internet group stopped coming in much earlier than those from the postal mail group. Although one might also challenge the generalizability of our results to surgeons beyond the membership of the OTA, the similar findings of other studies suggest the results may be broadly generalizable. Another limitation of this study is that we cannot precisely measure the reception of the survey by mail and Internet: if the reception differs by the mode, the response rate could be confounded if those who did not receive the survey were included in the denominator. To be conservative we have included in the denominator all those we tried to reach.

We conclude that postal surveys still result in higher initial response rates than Internet-based surveys. Researchers should not assume that the widespread availability and potential ease of Internet-based surveys will translate into higher response rates. Future research should focus on how to refine our techniques in conducting Internet surveys so that they are more accessible and easier to use. Asking non-respondents to Internet-based surveys why they did not respond will inform this work. As our expertise increases in the area of conducting Internet surveys, we will be able to make a more informed evaluation of whether they constitute a valuable tool for conducting health research.

Acknowledgments

Conflicts of Interest

None declared.

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