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Contents

<u>Editorial</u>

Multimedia Formats for Patient Education and Health Communication: Does User Preference Matter?

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Introduction

Since technology has given us new methods of delivering education to patients and health care providers, the availability of resources, formats and approaches has increased dramatically. The variety of choices is certainly reflected in the scope of Bader and Stein's valuable study comparing 5 different formats for delivering patient information [1]: a text paperback booklet, paperback booklet formatted in HTML on the Web, spoken audio files, audio files synchronized with a text Web page, and Flash multimedia (animation, spoken audio, and text).

Selecting the right resources and making the most of limited educational budgets is becoming more and more challenging. Education is also playing an increasingly-important role in cancer care since patients and their families are faced with many difficult decisions that can potentially have an enormous impact on their health and quality of life [2]. Placing patients at the center of their own care is a challenging endeavor in a system fundamentally perceived and conceptualized from the clinician-centered vantage point [3- 5]. This change requires a profound shift in the way the day-to-day business of health care is performed. The cornerstone for this change is the commitment to place patients at the center of their care, by supporting, by educating, and by empowering patients to become partners in their care.

The quantity and quality of available evidence about the efficacy of many resources and programs for patient education in cancer care is severely limited. Having to decide about providing and developing educational resources raises difficult questions for providers, educators, and administrators in health care organizations: What kind of resources should be provided? What resources will result in the best outcomes? What are the key outcomes we should be measuring? In the face of this myriad of questions, we need more data and evidence to make

better and more-timely decisions [6]. Bader and Stein have made a significant contribution to the slowly-growing body of available evidence. However, the body of evidence is still inconclusive and at times contradictory. The fear of making costly errors that can impact patient care looms large.

In Bader and Stein's study, it is interesting — but not surprising — to learn that users prefer a multimedia presentation of the content. Because of the costs and resources involved in implementing multimedia and other types of software, the finding that the media itself did not have an impact on "learning" ignores the question of whether preference is a worthwhile basis for investing valuable, finite, and limited resources. Within the framework of this particular study, one might be tempted to say that the investment in multimedia does not provide a sufficient return. However, within a broader framework, the investment in multimedia programs begins to make sense from a variety of perspectives.

Efficacy of Multimedia for Learning

Before we consider the broader perspective, note that the results of Bader and Stein's study about the efficacy of multimedia are not what one would have expected based on existing data. Within the framework of the study, Bader and Stein investigate whether a particular piece of information presented in different formats has a measurable outcome on learning and understanding, and conclude that learning occurred equally in all formats. The authors explored several potential reasons for these conclusions, including the possibility that: format does not affect learning, the technology was not optimized, the sample size was not large enough, or the pre-test and post-test instrument was not effective.

There is a growing body of evidence that demonstrates the beneficial effects of multimedia on learning [7]. In certain

circumstances, cognitive theorists and researchers have demonstrated improved learning outcomes with the use of multimedia tools. Richard E. Mayer has created several learning experiments and has shown "that multimedia works — that is, at least in the case of scientific explanations, adding illustrations to text or adding animation to narration can help students to better understand the presented explanation" [7]. Bader and Stein investigated resources that met Mayer's criteria and, therefore, according to Mayer's findings should have demonstrated some positive benefits. The issue of the efficacy of different types of multimedia to enhance learning requires further research studies that will examine the merits and possible benefits of educational multimedia resources.

Patient Preference and Patient-Centered Care

Even if learning does remain the same in all the formats of information, how do we evaluate the importance of patient preference within our decision-making framework? Does the preference for the multimedia format suggest other outcome measures that we should consider? Within a patient-centered model of care, patient preference is a core value [3,5]. Supporting a patient-centered model does not imply that all patients must prefer it or that all pertinent information should be given to patients. Rather, the system should be prepared to respond in a holistic fashion to the needs and requests of individual patients and their families; multimedia can support this.

Patient satisfaction is enormously important in most hospital organizations and creating educational resources that can contribute significantly to patient satisfaction has obvious benefits that can go a long way towards justifying the initial investment. However, we would argue that even patient satisfaction is too narrow to be used as a measure to determine the relative value of educational multimedia resources compared with more-traditional methods. The relative value of individual preferences in the context of emerging patient-centered care models must be carefully considered. Given the potential of multimedia to play a large role in many aspects of patient education and care, we believe a much-wider net is required to begin to capture the value and importance of a comprehensive multimedia program.

Evaluating the Patient Experience

In developing resources for patients and providers, the challenges of the health care system require that we do far more than provide information. Understanding is a valuable outcome to measure, but we must consider other potential outcomes and their merits. In looking for more outcomes and measurement tools, we can draw on several models for patient-centered care for evaluating the patient experience. The Picker Institute, for example, argues that given the holistic nature of patient-centered care, patient satisfaction is not a sufficiently-broad outcome measurement; the institute has developed a patient-experience framework for measuring outcomes based on the 8 dimensions of care [8].

Based on the Picker model for measuring patient experience, we could perhaps evaluate multimedia resources based on a broader approach by considering issues such as: the quality of information and efficacy of the educational content; access to information and resources; respect for patient's values; linguistic needs and learning preferences; integration with other educational services; comfort and ease of use; and levels of emotional support (including alleviation of fear and anxiety). There is a growing body of evidence that suggests involvement in decision making leads to increased patient participation in health care [9]. Because of this, we are interested in the role that effective and well-designed multimedia resources can play in encouraging a greater participation by patients in decision making.

Merits of Multimedia

One advantage of well-designed multimedia is flexibility. Within the context of patient-centered cancer education, the flexibility of multimedia to meet diverse challenges begins to show its real potential. Although Bader and Stein refer to the advantage of multimedia for users with different learning styles, this is only part of the total equation. Multimedia can also assist educators in overcoming linguistic, cultural, and physical barriers; in addressing different learning levels; in providing the unique experiences of patients and heath care professionals; in presenting materials in different formats and from different perspectives; in providing feedback and decision-making resources; and in tailoring and customizing information to the needs of individual patients and providers [10,11]. It is only within the broader educational, cognitive, cultural, clinical, social, ethical, financial, and personal landscape that the context for user preference emerges and the value of multimedia can truly be evaluated.

Our experience with developing a multimedia program — the Oncology Interactive Education Series (OIES) — at Princess Margaret Hospital taught us that these kinds of tools have the potential to impact many aspects of education and care. Our program covers education across the continuum of care, including: information on managing side effects, detailed information on how to do self-examinations and certain kinds of exercises, and avenues for patients to learn from other patient experiences through patient testimony.

Patients have strongly endorsed the Oncology Interactive Education Series [12] and in a survey of 105 patients, 80% stated that they would use it again, and many of them prefer it to other resources [13]. This series puts a great value on communicating not only with words, but also with images. Perhaps more importantly as far as preference is concerned, patients can access key types of information in any number of ways. Users can find basic information, view an animation, explore key elements interactively, or explore the content developed for health care professionals. They can also explore beyond the resource and find more in-depth information on vetted resources on the Internet. It has been our experience that as part of a patient-centered program, multimedia can go a long way towards supporting patients and in improving their overall experience.

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Future Directions

As we continue to gather data from studies like that of Bader and Stein and to develop more-comprehensive approaches to measuring outcomes, we can further reveal the meaning and importance of preference when developing multimedia resources and delivering patient-centered care services. The importance of multimedia for cancer education needs to be examined more thoroughly. It is no longer sufficient to investigate the efficacy of computer-based tools. We must now look carefully at the quality of the software and investigate a set of evaluative criteria that helps us understand the options for and the benefits of developing new resources. As Bader and Stein point out, Mayer and other researchers have clearly demonstrated that not all multimedia are created equal. When evaluating multimedia, we must be careful to move beyond the question of whether it is useful. The question of what makes a useful multimedia program, although much more difficult to determine, will ultimately move our discussion forward and will help us immensely to make decisions about what kinds of resources to develop and how best to implement those resources.

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Tutorial

Just-in-time Database-Driven Web Applications

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Abstract

"Just-in-time" database-driven Web applications are inexpensive, quickly-developed software that can be put to many uses within a health care organization. Database-driven Web applications garnered 73873 hits on our system-wide intranet in 2002. They enabled collaboration and communication via user-friendly Web browser-based interfaces for both mission-critical and patient-care-critical functions. Nineteen database-driven Web applications were developed. The application categories that comprised 80% of the hits were results reporting (27%), graduate medical education (26%), research (20%), and bed availability (8%). The mean number of hits per application was 3888 (SD = 5598; range, 14-19879). A model is described for just-in-time database-driven Web application development and an example given with a popular HTML editor and database program.

Introduction

Content management for intranet managers and developers can be challenging. Updating content on static HTML pages can be time consuming. Database-driven Web applications (DDWA) are one significant methodology that can be used to empower end users to change content dynamically without knowledge of HTML or an HTML editor. This tutorial poses a design-and-development model for "just-in-time" DDWA that can quickly develop applications. An example is given with a popular HTML editor and database program.

Intranets in and outside of health care organizations commonly provide access to policies, procedures, document archives, manuals, and other information [1,2]. In a first-generation intranet, such content is static and requires skill with HTML or an HTML editor. Any alterations of, additions to, or deletions from content require a Web developer. Maintaining such a site can be daunting when faced with ongoing requests to change content. Turn-around time for posting new content may be compromised. Information critical to the business or to patient care may be delayed with attendant affects.

Adding dynamic information that can be managed directly by delegated managers or superusers can enhance the value of intranets and eliminate the time and effort that would otherwise be needed to deliver the same content using the services of a Web developer. DDWA can enable managers to post information and knowledge directly to an intranet without having to know HTML or an HTML editor. DDWA are the means to the "content management" that characterizes the current generation of intranets. Content management is offered either as third-party software or as fee-for-service programming — the costs of these may be a barrier for many not-for-profit health care organizations. The decision to "buy or build" has several considerations (Table 1). Return-on-investment or payback period analyses often have difficulty demonstrating convincing hard returns on such investments regardless of the size of the organization. In-house-built DDWA are an alternative to third-party solutions. Vendor services are often expensive and subsequent modifications or new applications incur additional expense. Shrink-wrapped software for content management may not be flexible enough to adapt easily and the learning curve required to master the software can be even more demanding than learning the Active Server Page (ASP) script itself needed to build DDWA. (An Active Server Page is an HTML page that includes one or more small embedded programs that are processed on a Web server before the page is sent to the user.) Yet, the aphorism still applies, "buy when you can, build when you must" [3].

Table 1. Factors to consider when deciding to buy or build software

Buy	Build
• Shorter time to implementation	• Control over design, development, and implementation
• Reduced risk	• Full control over code
• Greater resources and skills for development	• Time and costs of developing or acquiring resources and skills in-house
• One-time costs for startup may be greater	• Upgrade at time of your choosing
• Product less flexible	• Not susceptible to the marketplace changes that a vendor is subject to

Database-driven Web applications have changed the face of software development. Prior to the Web and DDWA, rapid application development (RAD) methodology and software had reduced the software cycle from years to months. DDWA have reduced the development cycle even further, from months to hours. Database-driven Web applications are the latest evolution of rapid application development [4]. DDWA have been described in the medical literature for procedure logs [5]. This paper describes an aggressive version of DDWA development we have labeled "just-in-time DDWA."

Methods

Database-driven Web Applications on an Integrated Delivery System's Intranet

Saint Vincent Catholic Medical Centers (SVCMC) is one of the New York metropolitan-area's larger health care systems, serving over 500000 people annually. It was established in 2000 as a result of the merger of Catholic Medical Centers of Brooklyn and Queens, Saint Vincent's Hospital and Medical Center of New York, and Sisters of Charity Healthcare in Staten Island. Saint Vincent Catholic Medical Centers serves as the academic medical center of New York Medical College in New York City. The system includes 8 hospitals. Over 3000 physicians are affiliated with the system, which includes 4 skilled nursing facilities, 3 home care agencies, a hospice, and over 60 ambulatory care clinics. The trauma center in Manhattan was the major trauma center for the World Trade Center on September 11, 2001.

Table 2. List of just-in-time database-driven Web applications

Category	Application	Description
Bed availability	Nursing home	One staff person centrally administers the application for 4 facilities
Bed availability	Behavioral health	One staff person at each of 5 facilities administers application
Continuing medical education	Anthrax update	Pilot project for continuing medical education on the intranet
Finance	Expense code, expense list, and item master	Three applications for finance-related data (read-only access)
Graduate medical education	Sign-out roster and resident evaluation	The online intern patient sign-out roster, faculty evaluations, and a nondatabase-related ASP file upload application comprise a suite of applications for the internal-medicine residency training programs
Graduate medical education	Scholarly activity	Offering and tracking clinical research opportunities for residents
Human resources	Job description and performance appraisal	An application designed to facilitate standardization of job descriptions and performance-appraisal forms from 3 service divisions
Human resources	Online staff training: class scheduling and post-tests	Two applications for behavioral-health staff training, one to schedule instructor-led classes, the other to test online self-learning classes
Payer relations	Announcement regarding managed care plans	Updates from the Payer Relations Office regarding managed care. The 6 most-recent notices are posted on their intranet page via a server side include
Pharmacy	Formulary	As per Joint Commission on Accreditation of Healthcare Organizations (JCAHO) guidelines, an online formulary merges the separate formularies of 3 service divisions into 1 searchable database. Pharmacy can update, delete, and add medications to the database
Phone directory	System-wide, behavioral health, and success agenda contact list	Three applications: 3 separate databases for the system, the behavioral health product line, and a managerial work group, respectively
Physician credentialing	Delineation of privileges	A read-only view of one service division's physician credentialing
Research	Prostate cancer screening	A database for the summer prostate cancer screening campaigns started in 1999
Results reporting	HIV viral load	Intranet-based patient results reporting of HIV viral loads from the organization's centralized virology laboratory to the system

Table 3. Applications with Web-server security groups

Web Server Security Groups	Members
Behavioral health beds	5
Behavioral health phone	4
Board	1
Available nursing home beds	1
Faculty Manhattan	120
Faculty Staten Island	44
Faculty Brooklyn-Queens	27
Graduate Medical Education (GME) Director's Office	17
Homecare	5
Post-graduate Year (PGY) 2002	28
Post-graduate Year (PGY) 2003	45
Post-graduate Year (PGY) 2004	81
Post-graduate Year (PGY) 2005	118
Pharmacy Directors	5
Prostate cancer screening	6
Scholar	1
Behavioral health training & staff development	2
HIV laboratory	26
Total	536

The Saint Vincent Catholic Medical Centers intranet was developed in 2000 at the time of the organization's merger and is described in detail elsewhere [6]. Intranet development seeks to serve both the business and patient-care missions of the organization. The intranet can facilitate system-wide collaboration and integration. It serves as the conduit for more than 200 online medical-knowledge resources, dozens of manuals, patient education, forms, training, and patient-results reporting. Physicians, managers, nurses, and other Saint Vincent Catholic Medical Centers associates have access to the intranet. Its resources are particularized for the various niche markets and communities within this audience.

The intranet is carried over a wide-area network connecting more than 6000 workstations. The same software is installed on all workstations, eg, Microsoft Office 2000, Internet Explorer 5, and Adobe Reader.

In calendar year 2002, the intranet garnered 1505865 hits, of which 160014 were to Active Server Pages. Of the Active Server Page hits, nearly half (73873) were to database-driven Web applications. The remaining hits to active-server pages include pages dedicated to restricted, intranet-file uploads and directories [7], and pages with server-side includes [8] that generate database-results views, like the payer-relations managed-care announcements. (Server side includes are the facility provided by an HTTP server to replace certain HTML tags in one HTML file with the contents of another file at the time the file is sent out by the server.)

Nineteen DDWA were developed (Table 2). In 2002, of the 73873 hits to DDWA, the application categories that comprised 81% of the hits were results reporting (27%), graduate medical education (26%), research (20%), and bed availability (8%) (Figure 1, in Multimedia Appendix 1). The mean number of hits per application was 3888 (SD = 5598; range, 14-19879).

The number of records in each database ranged widely, from 2 in the anthrax-update continuing-medical-education application to 23137 in the prostate-cancer screening application (mean = 2586; SD, 2319).

There were 35 separate Web server security groups (Table 3). An application may have up to 3 levels of security. Some read-only pages may be open to all and other pages may be open to a restricted group of individuals. Pages that permit updating records in, adding records to, or deleting records from a database are open only to application administrators. The average number of individuals in each group was 29.8 (SD = 14.8; range, 1-120). Each group is assigned either read-only or read-write access to a restricted sub-Web on the intranet. When an end user selects a hyperlink to a page on a restricted sub-Web, Windows 2000 queries the end user for the end-user's logon — ie, user name, password, and, if relevant, domain. The 272 internal-medicine residents across the system are grouped by year of graduation, facilitating entry of new interns and the departure of graduating residents each year.

Phase 1: Project Selection and Planning

Just-in-time (JIT) DDWA development is a short but iterative process. Like other software-development cycles, just-in-time

DDWA development includes at least 4 phases: (1) planning and design, (2) development, (3) testing, and (4) implementation. The process is distinctive for its short turn-around time and commitment to iterative cycles.

Choosing the right projects will improve the likelihood of success. The scope of the project should be limited to the possible. DDWA cannot meet the demands of a complex clinical-information system, such as a system for electronic medical records, a laboratory, or a pharmacy. If the estimated time to develop a project exceeds 8 hours, proceed cautiously, if at all. A project proposal that requires an interface falls outside the scope of a DDWA. Although the resources may be cost neutral, DDWA should serve interdivisional, product-line, or system-wide initiatives. A database with but one or two users would not usually justify a DDWA.

DDWA development teams are leaner and require greater collaboration and communication than traditional application-development teams. Planning and design involves the developer and 1 to 5 end users. Each application has a designated project sponsor who serves as the liaison for the given department or office. The project sponsor and/or superuser is committed to assisting in design, planning, testing, implementing, and, if need be, iterative cycles of testing and debugging. Contrary to earlier models for rapid application development, neither formal committee nor work groups nor multiple milestones are needed.

Team communication should incorporate a combination of one or more conference calls, meetings, e-mails, and "hallway consultations." All stakeholders in the process are aware that multiple cycles may be needed to arrive at an application that will satisfy the requirements of the project sponsor or the project sponsor's designee. The developer should anticipate multiple cycles of iterative testing and debugging. Yet, the developer should hope that the resulting creation, when appropriate, may inevitably be replaced by more-robust, more-efficient, and more-effective shrink-wrapped software.

Phase 2: Server Administration

The server administrator is usually responsible for managing the server folders, creating the data connections, and defining security.

The tasks required to build DDWA include:

- Create new folders on the Web server with FrontPage or Windows 2000. If the application is to offer read-write access to a database, create another folder restricted to those with administrative rights.
- Define interim (or final) security on the access-control list of the folder with Windows 2000 (NTFS — the native file system of Windows NT) or a new server security group with Windows 2000 Server (MMC — Microsoft Management Console).
- Configure FrontPage Server Extensions, with Internet Information Server (IIS), to the new folder to create a new sub-Web. Managing security and recalculating links from the Active Server Pages to the database is quicker and easier in the microenvironment of a sub-Web than in a folder within the larger context of a parent Web.

- Create a new application, with IIS/MMC (Internet Information Server/Microsoft Management Console), with "script & executables" enabled with "Level I" security.
- Utilize "DSN-less" ("Data Source Name-less") data connection, which can simplify development and eliminate the task of building data-source names for the server administrator. Alternatively, the server administrator can create a data connection (system data-source name) on the Web server with Windows 2000 Server's Open Database Connections (ODBC).

If resources permit, a staging server for development is desirable. If not, a separate Web page on the intranet with hyperlinks to applications under development should suffice.

Full backup should occur weekly and incremental backups daily.

Phase 3: Web Development

Our software development environment includes at a minimum FrontPage 2000, Notepad, Access 2000, and Adobe Photoshop 7. Other database and development software that typically require advanced skills are used infrequently in our DDWA development. SQL Server 2000 use was limited to its Data Transformation Services function to convert tables to Access or ASCII-delimited files. Visual InterDev was not used in development. The Web developer need not make a full-time commitment. The Web developer in our organization is its director of medical informatics, a full-time position that includes other information-systems responsibilities like health-care-provider liaison, system-software selection and implementation, and strategic planning. Site development and maintenance of both the Web and intranet sites constitute no greater than half his time in any given week.

Design and development for each DDWA typically requires 4 to 12 hours. DDWA that offer read-write access to a database require more time than read-only views.

Before creating the Active Server Pages that will comprise the DDWA, create a database in Microsoft Access with the data fields specified during planning and design. In the "Design" view of Access, define a primary key; make the data type of all data fields text; and set "Required" to "No."

Except for database applications that only require read-only access, a database-driven Web application will require Active Server Pages (ASP) devoted to adding, updating, deleting, and querying the database. Web pages devoted to the first 3 functions should reside in an administrative folder with restricted access.

The absolutely-essential requirement of rapid application development is programming software that will expedite the build process. HTML editors like FrontPage, Dreamweaver UltraDev, and others can serve but do require some rudimentary knowledge of HTML and ASP.

FrontPage's tool for creating ASPs is its Database Results Wizard. Most development is done in the "Normal" or WYSIWYG ("What You See Is What You Get") view of FrontPage.

To Create a Page to Add a Record to the Database

- Insert a form (Figure 2, in Multimedia Appendix 1).

- Insert a table into the form (Figure 3, in Multimedia Appendix 1).
- Create a name for each form field, the data field, and, if a field is validated, an error-message name for the data field (Figure 4 and Figure 5, in Multimedia Appendix 1).
- Right-click in the form to access the form properties (Figure 6, in Multimedia Appendix 1)
- Assign a name for the form field (Figure 7, in Multimedia Appendix 1)
- Send the Web page data fields to a selected database and table (Figure 8 and Figure 9, in Multimedia Appendix 1)
- Enter the URL of a confirmation page (Figure 10, in Multimedia Appendix 1)
- Map the saved Web-page data fields to their corresponding database data fields (Figure 11, in Multimedia Appendix 1).

Two Active Server Pages are Needed to Update a Record

First Page

In the first page, insert a database, which will evoke the Database Results Wizard (DRW) (Figure 12, in Multimedia Appendix 1).

The Database Results Wizard has 5 steps:

- Step 1 defines the database connection (Figure 13, in Multimedia Appendix 1).
- Step 2 selects the table or predefined query in the database (Figure 14, in Multimedia Appendix 1).
- Step 3 defines the data fields to be displayed, the selection criteria, the order in which the results are to be displayed, default values, the limit of records to be displayed, and an error message if no records that meet the selection criteria are found (Figure 15-Figure 17, in Multimedia Appendix 1).
- In step 4, select "List - one field per item" and "Table" as the list option (Figure 18, in Multimedia Appendix 1).
- In step 5, select "display all records together" (Figure 19, in Multimedia Appendix 1).

After finishing the Database Results Wizard:

- Select and cut the table, insert a form, and paste the table within the form (Figure 20 and Figure 21, in Multimedia Appendix 1).
- Add another column to provide input to modify the existing content (Figure 22, in Multimedia Appendix 1).
- The fields to be modified should have as their initial values "<%=FP_FieldVal(fp_rs,"Data field name")%>" (without the leading and trailing quotation marks) (Figure 23, in Multimedia Appendix 1).
- Remove the "reset" button and do not make the primary key data field updateable (Figure 24, in Multimedia Appendix 1).

Second Page

- In form properties post the form data to the second update page, ie, update2.asp, along with a primary key as the hidden value ("<%=Request("ID")%>") (without the leading and trailing quotation marks) (Figure 25-Figure 26, in Multimedia Appendix 1).

- For the second update page, invoke the Database Results Wizard (Figure 27, in Multimedia Appendix 1). Select "Custom Query" (Figure 28, in Multimedia Appendix 1) and "Edit" to enter the SQL (Structured Query Language) expression (Figure 29, in Multimedia Appendix 1):

```
UPDATE Database.Table
SET Databasefield1='::URLformfield1::',
Databasefield2='::URLformfield2::'
. . . Databasefieldn='::URLformfieldn::',
WHERE Primary key in database=::Primary key in
 database in URL form field::
```

- In step 3, select "More options" and enter a confirmation message (Figure 30, in Multimedia Appendix 1)
- Select "Next" in step 4 and "Finish" in step 5. Save the page as "update2.asp" (Figure 31, in Multimedia Appendix 1)
- If desired, a customized confirmation page can be created (Figure 32-Figure 37, in Multimedia Appendix 1). The page can be saved as "delete1.asp"
- The second delete page is created by the Database Results Wizard. In Step 2 (Figure 38-Figure 40, in Multimedia Appendix 1), select "Custom Query" and "Edit" to enter:

```
DELETE * FROM Results
WHERE (Primary key in database = ::Primary key
 in database in URL form field::)
```

- In Step 3, "More Options," add a message confirming record deletion, eg, "Record deleted" (Figure 41, in Multimedia Appendix 1). Select "Next" for Step 4. In Step 5, select "Display all records together" and ensure that the "Add search form" is not selected (Figure 41, in Multimedia Appendix 1). To send the end user back to the application's home page (or elsewhere), add the following line to the <HEAD> and </HEAD> tags of the delete page in the HTML view: <meta http-equiv="refresh" content="1;URL=Application home page">.

Advice

Use either Notepad or Access Query Builder to compose SQL statements. SQL copied from other word processing programs, like Microsoft Word, or copied directly from the Web can contain characters that are incompatible with SQL. For example, a perpendicular single quote (') is a reserved character in SQL that delimits a literal in Microsoft Access' version of SQL. In contrast, a slanted single quote or apostrophe (`) is not SQL compliant and will generate an error message. Pasting either into Notepad will prevent the error.

Filtered results can be generated with SQL in step 2 of the Database Results Wizard. The remaining steps in the Database Results Wizard define selection criteria, result order, and result format. A results page can generate reports in read-only views for the general end-user or serve as the portal for interactive, read-write administrative access. Hyperlinks with the appropriate parameters, like the primary-key database field, can direct the user to the update or delete pages, or a details view for individual records within a recordset.

As with any application, working code means little without sufficient attention to usability. To minimize needless duplicate-data entry, confirmation pages should be built to verify successful record entry and intentional deletion of a selected

record. Drop-down menus for database queries and pages that add a new record to the database speed data entry.

Navigation and font types and sizes should adhere to recognized usability guidelines. The National Institute on Aging and the National Library of Medicine provide a concise set of guidelines in pamphlet format [9]. Jakob Nielsen is a leading authority on Web usability and has authored 2 volumes on this topic [10,11]. Font size should be no smaller than 12 point. Navigation should always provide an escape to the end user's page of entry. Buttons for frequently-hit pages improve hyperlink visibility. Customized confirmation pages for adding a record, and confirm messages or pages prior to deleting a record are built as needed.

If new Windows NT logon accounts are created or a preexisting end-user logon has never been used before, provide training via phone or e-mail about logging on to restricted sub-Webs, ie, user-name conventions, case-sensitive passwords, and specific domains (if there is more than one domain). Forewarn your information-systems help desk of the new application and possible calls about logon issues.

Since we use Microsoft products enterprise wide, Microsoft Access was chosen as our database for DDWA. Any other database program should serve in other environments. Though blessed with a shorter learning curve and greater accessibility than its big-database siblings, Access does have acknowledged limitations. Though the documentation states that the size of the Access *.mdb file (where * represents file name and *mdb* indicates an Access file) can reach 2 gigabytes, anecdotal reports posted on the Internet suggest a working file size of 50000 records. The documentation suggests that the maximum number of users is 250. Practical experience suggests that no more than 15 to 20 concurrent users can use the application at any given time. However, a session via HTTP may only last seconds. Even if a given Web page is on a user's Web browser an entire day, the time actually spent calling that database is only seconds.

That said, if an Access database becomes corrupted or Internet Information Server (IIS) becomes unstable, moving to a more robust database, like SQL Server or Oracle, should be considered [12,13].

Discussion

Just-in-time database-driven Web applications are inexpensive, quickly-developed software that can be put to many uses within a health care organization regardless of its size.

Saint Vincent Catholic Medical Centers' DDWA

Although DDWA only constituted 5 percent (73873/1505865) of all intranet hits in 2002, they enabled collaboration and communication via user-friendly Web browser-based interfaces for both mission-critical and patient care-functions (Figure 42-Figure 73, in Multimedia Appendix 2). Screenshots of Saint Vincent Catholic Medical Centers-intranet home pages for the major sub-Webs are shown in Figure 74 to Figure 86, in Multimedia Appendix 2.

For the 19 DDWA in production mode in 2002, the benefits accrued included:

- improved continuity of care within the system from other settings of care to behavioral-health care and long-term care (reducing "leakage" from the integrated delivery system)
- transition of multiple financial systems to one system
- sign-out patient rosters, resident evaluations, and clinical-research opportunities in graduate medical education
- online scheduling for instructor-led classes and online testing for self-learning programs
- managed care-related announcements system wide without the time and expense associated with paper-based memoranda
- a system-wide formulary, a composite of different formularies from 3 service divisions
- updateable phone directories
- online physician-credentials checking
- online reporting to expedite access to patient results.

New just-in-time DDWA in 2003 include new applications that permit the pharmacy to post formulary changes and drug advisories; information systems to announce virus warnings and downtime notices; and an application to facilitate compliance with the new Joint Commission on Accreditation of Healthcare Organizations (JCAHO) Staffing Effectiveness standards.

Benefits of DDWA

Just-in-time DDWA can be developed for little-to-no expense. The development cycle can be measured in hours to days. DDWA can distribute information and knowledge across an enterprise intranet and eliminate the need to map shared directories on multiple workstations. Read and read-write interaction with a database does not require facility with database software. The rapid turn-around time from conception to implementation generates high end-user satisfaction, as suggested by what some in our organization call DDWA — "low tech gimmes." Customized DDWA often fulfill niche needs that are too small and/or too temporary to warrant the cost of purchasing a shrink-wrapped application.

DDWA are disposable software, built for a targeted purpose for a prescribed time. For example, the suite of finance-related DDWA was built to be a temporary "crosswalk" from legacy applications in 3 regions to 1 new, system-wide finance system (Lawson). The HIV-viral-load application provides intranet-based patient-results reporting while implementing the new system-wide laboratory software (Softlab). The physician-credentialing application to a static database anticipates a live data connection to the new system-wide physician credentialing software (Morrissey). The online formulary precedes the implementation of a system-wide pharmacy system (Cerner). The job-description performance-appraisal application ceased once the standardization process neared completion.

However, the life span of a "temporary" DDWA may be months or may even span years. In contrast to many shrink-wrapped software products, unscheduled extensions of a DDWA do not generate additional license and maintenance fees.

DDWA can serve as a quick-and-dirty means to test a proof of concept. Whereas online testing for self-assessment programs proved popular and successful for staff training in Saint Vincent Catholic Medical Centers' behavioral-health product line, online continuing medical education for physicians about anthrax was less than successful. This trial continuing medical education (CME) project was conducted without incurring the cost associated with purchasing an online continuing medical education service or CD-based product.

DDWA can be endlessly iterative. Look-and-feel can easily be manipulated with static HTML. Code can be repositioned or labeled to promote more-commonly-used or general-access functions and demote administrative or restricted functions. Most requests for reports can be met with the proper SQL queries.

Development of DDWA

Design should incorporate reusable components as much as possible. Directory structure should include, if needed, a separate folder with restricted access for administration. The essential database functions (add, delete, update, and query) apply to each application. The SQL syntax for delete and update, and queries (SQL select statements with where clauses) are the same for each application.

Testing is essential prior to general release of the application. The application should not be released until all discovered bugs have been rectified. The final version of the application should generate no error messages. Therefore, the more-complicated DDWA require prolonged testing. The bigger the project, the longer the development cycle. The resident-evaluation application remained untested and dormant until a medical student was assigned the task of testing the application. A project sponsor may be an early adopter but have no time to devote to the sometimes seemingly-perpetual cycle of testing and debugging. For example, it took multiple experiments with code over 2 weeks to finally determine that that the "NULL" or empty string values in SQL statements did not work predictably in creating a routing process for the resident evaluations.

As with larger software projects, if a DDWA loses its project sponsor the application may never finish the development cycle and may never be released. Since DDWA are only built upon request, the loss of the individual who drives a project may signal the demise of the application's further development. Project sponsors are often early adopters who, compared to their peers, better understand how information technology can promote more-efficient workflows or improve patient care. Unless a like-minded individual steps to the fore, the project will most likely cease prematurely.

As with any information technology project, scope creep can be a concern. Nevertheless, the very-transient nature of the just-in-time DDWA limits their scope. Applications that serve as temporary solutions to full-scale clinical or financial systems have circumscribed life spans. Purchasing a shrink-wrapped product should be reconsidered if an in-house application no longer meets growing requirements. The buy-versus-build decision can always be revisited.

Rapid application development presupposes the use of software to expedite coding. Although Web-development software like FrontPage and Dreamweaver Ultradev can facilitate DDWA, they do require some knowledge of HTML and ASP. The needed VBscript and Active Server Page resources, the requisite workarounds, and SQL can be found on the Web [14- 16]. Online forums and tutorials are also available, but assume both interest and time on the part of the novice developer [16- 20]. Given the resources, out-sourcing DDWA development to a vendor or purchasing specialized, shrink-wrapped DDWA may be easier albeit more expensive alternatives to in-house-developed DDWA. The decision is yet another shade of the classic dilemma of buy or build. If the wherewithal is generously provided, the former option usually prevails. However, given the current financial challenges faced by many not-for-profit health care organizations, buying may not always be an option.

Limitations of DDWA

Just-in-time database-driven Web applications do have limitations. Just-in-time, on-the-fly DDWA cannot supplant complex applications like the electronic medical record. Although the sign-out roster had 455 patients in its database at the end of 2002, no more than 12 residents out of more than 270 internal medicine residents throughout the system utilized the application. The absence of interfaces to pharmacy, laboratory, and the admissions-discharge-transfer systems (ADT) make manual key entry of patient data prohibitive. Though useful, templates and data-field validation alone cannot replace full-featured clinical decision support. Nevertheless, intranet-based, secure DDWA with personal health information do protect patient privacy and confidentiality in a HIPAA (Health Insurance Portability and Accountability Act)-compliant manner and offer a waypoint on the path to the computer-based patient record.

Development on-the-fly (ie, with a degree of haste and improvisation) can easily generate typographic errors and a host of bugs. Internet Explorer will identify the Web page address (URL) of a page whose code is too faulty to process. Error messages from Internet Explorer rarely identify a misspelled data-field name or even the correct line of code where the error resides. Debugging an Active Server Page with hundreds of lines can be daunting for a professional but even more so for the novice. Wizards like FrontPage's Database Results Wizard generate bloated code, with significant volumes of unnecessary lines that may prolong Web-page download times.

Conclusions

With all its limitations, just-in-time database-driven Web applications can provide remarkable value for selected projects for little-to-no cost.

Multimedia Appendix 1

Figure 1 - 41 [PPT File, 4,774KB - jmir_v5i3e18_app1.ppt]

Multimedia Appendix 2

Figure 42 - 86 [PPT File, 5,613KB - jmir_v5i3e18_app2.ppt]

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Abbreviations

ASP: Active Server Page
DDWA: Database-Driven Web Application(s)
SQL: Structured Query Language

Original Paper

A Web-Based Screening Instrument for Depression and Anxiety Disorders in Primary Care

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Abstract

Background: Major depressive disorder (MDD) and anxiety disorders are common and result in considerable suffering and economic loss. People suffering from major depressive disorder and/or anxiety disorders are commonly encountered in the primary care setting. Unfortunately, most people with these disorders remain either untreated or inadequately treated; current data suggest that general practitioners fail to diagnose up to half of cases of major depressive disorder or anxiety. There is a need for screening tools that will help physicians and other professionals in primary care recognize and adequately treat major depressive disorder and anxiety disorders. While the currently-available self-report screening instruments have been demonstrated to be reliable and valid, there remain considerable barriers to their widespread use in primary care.

Objective: The purpose of the present study is to report preliminary validation data for a freely-available, brief, Web-based, self-report screener for major depressive disorder and anxiety disorders.

Methods: The Web-Based Depression and Anxiety Test (WB-DAT) was administered to 193 subjects who presented for assessment and/or treatment in ongoing research projects being conducted at the Mood and Anxiety Program and Clinical Research Department at the Centre for Addiction and Mental Health in Toronto, Ontario, Canada. Subjects completed the Web-based screening instrument and were subsequently interviewed with the Structured Clinical Interview for the Diagnostic and Statistical Manual of Mental Disorders, fourth edition (DSM-IV) Axis I Disorders (SCID-I/P). The diagnostic data from the screening instrument were then compared with the data from the individual's SCID-I/P interview. Diagnostic concordance between SCID-I/P diagnoses and the Web-Based Depression and Anxiety Test were assessed using Cohen's kappa, sensitivity, specificity, positive predictive value, negative predictive value, and efficiency.

Results: Agreement ranged from acceptable to good (0.57-0.70) for major depressive disorder, panic disorder with and without agoraphobia (PD+/-AG), social phobia/social anxiety disorder, obsessive compulsive disorder (OCD), generalized anxiety disorder (GAD), and post traumatic stress disorder (PTSD). With the exception of generalized anxiety disorder, the sensitivity (0.71-0.95) and specificity (0.87-0.97) for the major diagnostic categories assessed by the Web-Based Depression and Anxiety Test were good. The sensitivity for generalized anxiety disorder was somewhat lower (0.63) but acceptable. Positive predictive values were good (0.60-0.75) for major depressive disorder, obsessive compulsive disorder, generalized anxiety disorder, and post traumatic stress disorder, and acceptable for panic disorder with and without agoraphobia and for social phobia/social anxiety disorder.

Conclusions: These preliminary data suggest that the Web-Based Depression and Anxiety Test is reliable for identifying patients with and without major depressive disorder and the anxiety disorders of panic disorder with and without agoraphobia, social phobia/social anxiety disorder, obsessive compulsive disorder, and post traumatic stress disorder. Further research is required in a larger sample in primary care.

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KEYWORDS

depression; anxiety disorders; assessment of health care needs; screening; web-based services; treatment; primary care; diagnosis; mental health

Introduction

Major Depressive Disorder, the Anxiety Disorders, and Their Prevalence

Major depressive disorder (MDD) and the anxiety disorders are common and result in significant suffering, lost opportunity, and economic loss. With a prevalence rate of approximately 5% worldwide, MDD is the most common mood disorder [1]. Estimates of lifetime risk for MDD have been reported as 12% for males and 20% for females [2,3]. The average age of onset of MDD is in the third and fourth decade of life. The average length of an untreated major depressive episode is from 6 to 24 months [1]. MDD is often a chronic illness that consists of several major depressive episodes, with the risk of recurrence increasing with each successive episode [4]. Depression profoundly affects quality of life and untreated or inadequately-treated depression is a major public health problem. MDD has become one of the leading causes of morbidity according to the World Health Organization (1997). MDD is projected to become the leading cause of disability and the second-leading contributor to the global burden of disease by the year 2020 [5].

The Diagnostic and Statistical Manual of Mental Disorders, fourth edition (DSM-IV) recognizes a number of distinct anxiety disorders, including specific phobias, social phobia/social anxiety disorder (SP), panic disorder (PD) with and without agoraphobia (PD+/-AG), AG without a history of panic, generalized anxiety disorder (GAD), obsessive-compulsive disorder (OCD), and post-traumatic stress disorder (PTSD). Anxiety disorders are among the most-prevalent psychiatric illnesses. According to the National Comorbidity Survey the lifetime prevalence for all categories of anxiety disorders in the United States is 24.9% [3]. Although anxiety disorders often have their onset in childhood or early adolescence, those afflicted typically do not seek treatment until well into adulthood. Adults with anxiety disorders are at risk for secondary psychiatric comorbidity; significant occupational, educational, and social impairment; and increased need for medical treatment, resulting in enormous economic costs to society [6- 9]. By 2020, PD, OCD, and PTSD will be second only to MDD, and ahead of schizophrenia and alcohol use as a cause of disability world wide [5].

Anxiety disorders have high rates of comorbidity with other psychiatric disorders including other anxiety disorders, MDD, and substance abuse/dependence. Anxiety disorders often occur with MDD. For example, MDD occurs in up to 60% of people with anxiety disorders [10]. Comorbid anxiety and depression is associated with more severe symptoms, impairment, subjective distress, and persistent course of illness than either depression or anxiety alone [11].

Assessment and Treatment of Major Depressive Disorder and the Anxiety Disorders

In North America, primary care/family medicine practitioners are the primary providers of first-line treatment for MDD and anxiety disorders [12]. People suffering from MDD and anxiety disorders are commonly encountered in the primary care setting, with a prevalence ranging from 5% to 50% [13- 15]. Approximately 50% of people suffering from MDD seek help from their primary care physician [16]. Unfortunately, a large proportion of people who suffer with MDD or an anxiety disorder in the community remain either untreated or inadequately treated [17,18]. Only one half of those with MDD and one third of those with anxiety disorders seek treatment for their illness [16]. More often, depressed and anxious people consult with their primary care physicians for other physical complaints, resulting in increased use of health care services [19,20].

Current data suggest that general practitioners fail to diagnose up to half of cases of depression or anxiety [14]. This situation is unfortunate on at least two counts. First, because it is becoming increasingly clear that people who are adequately treated earlier in their illness have a better prognosis [21]. Second, because once depression and anxiety are accurately recognized, most people with MDD or an anxiety disorder can successfully be managed in primary care using a variety of medications or psychotherapy. For example, cognitive behavioral therapy (CBT) is an effective treatment for both depression and anxiety disorders, and interpersonal psychotherapy (IPT) and cognitive behavioral analysis system of psychotherapy (CBASP) are effective treatments for MDD [13]. However, limited access to evidence-based psychotherapy outside of specialized clinics and research settings often renders pharmacotherapy the most practical first-line treatment option in primary care [22].

There are barriers to better assessment and treatment of MDD and the anxiety disorders in primary care, including a lack of recognition and adequate treatment in primary care, such as a lack of brief, sensitive, easy-to-administer, and easy-to-interpret self-report psychiatric-screening instruments. Without adequate detection and an accurate diagnosis, there cannot be adequate treatment. Establishing an accurate primary diagnosis is important in guiding the specific method and course of treatment [23]. Current evidence suggests that compared with usual care, feedback of depression screening results to providers generally increases recognition of depressive illness in adults [24].

In psychiatry, structured diagnostic interviews are the standard for diagnostic accuracy and are widely employed in research settings. Structured interviews such as the Structured Clinical Interview for DSM-IV Axis I Disorders (Version 2.0/Patient Form) (SCID-I/P) [25] and the Mini-International Neuropsychiatric Interview (MINI) [26] are designed to collect

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comprehensive data to establish precise diagnoses in the context of research studies. Such interviews take considerable time and must be administered and scored by an expert. As a result, such detailed interviews have not been widely adopted in clinical practice outside of the context of research.

In response to increasing demands for diagnostic precision and accountability in nonresearch clinical settings, there are now reliable and valid screening instruments available for use in primary care including the Primary Care Evaluation of Mental Disorders (PRIME-MD) [27], Symptom-Driven Diagnostic System (SDDS) [28], and MINI-Screen [26]. In general, these instruments are 1-page or 2-page, paper-and-pencil, screening instruments intended to be completed by patients, then hand-scored and interpreted by a health care professional.

While the currently-available self-report screening instruments have been demonstrated to be reliable and valid, there remain considerable barriers to their widespread use in primary care. First, many of the available instruments are narrow in their scope of assessment. For example, there are a large number of 1-page screening instruments designed to assess for the symptoms of MDD, PD, PD+/-AG, social anxiety disorder/social phobia, OCD, GAD, or PTSD. However, given the high rates of comorbidity among these disorders, instruments that assess for only 1 of them are of dubious utility. A major problem with all of the better and broadly-focused DSM-IV screening tools is that they are not freely available. In addition, these instruments all require laborious scoring and interpretation by a health care professional. Given these serious barriers to ease of use, they are unlikely to be widely adopted in primary care no matter how good they are.

Internet Screening for Major Depressive Disorder and the Anxiety Disorders

The Internet provides an excellent medium for providing patients and health care professionals in primary care access to a brief, algorithm-scored, easily-interpretable self-report screening test for MDD and the anxiety disorders. There are a large number of self-report screeners for anxiety and depression available on the Internet. Unfortunately, they are all subject to the same limitations as the currently-available paper-and-pencil tests insofar as they are all either too limited in scope, not easily scored or interpreted, and/or not freely available. None provide both a broad screen of MDD and the anxiety disorders and few provide any kind of print function that might facilitate a discussion of symptoms with a health care professional in primary care.

Van Mierlo Communications Consulting Inc has recently designed a screening test for MDD and the anxiety disorders that is freely available on the Internet. The screener is currently available as The Depression Test at The Depression Center (http://www.depressioncenter.net/depressiontest) [29], and slightly reconfigured (with questions regarding the anxiety disorders appearing first) as The Anxiety Test at The Panic Center (http://www.paniccenter.net/anxietytest) [30].

This test, the Web-Based Depression and Anxiety Test (WB-DAT) was designed to be a brief, freely-available, Web-based, self-report screening tool for MDD and the anxiety

disorders compatible with the DSM-IV and The International Classification of Diseases and Related Health Problems, tenth revision (ICD-10) diagnostic systems [31]. As a screening tool for primary care the instrument was designed to be highly sensitive (ie, to detect a high proportion of patients with a disorder) and reasonably specific (ie, screen out patients without disorders).

Based on their responses to 11 broad preliminary questions based on DSM-IV criteria central to the diagnoses of MDD and each of the anxiety disorders, users are presented with several additional questions for each disorder based on DSM-IV criteria. The result is an algorithm-generated personalized "final report," which summarizes the individual's responses relating to the major diagnostic categories. The final report was designed to be printed and shared with a health care professional.

The WB-DAT was designed to provide a summary of standard diagnostic information in order to initiate and encourage a discussion of specific anxiety and depression symptoms between patients and health care professionals. As a result, there are few diagnostic algorithms to limit the number of diagnoses a health care professional might query. Thus, for example, if a patient meets screening criteria for MDD, GAD, and OCD, the screener summary (final report) will report symptoms of MDD, GAD, and OCD, leaving the diagnostic decision regarding the primary diagnosis and focus of treatment to the health care professional.

In deciding what disorders to screen for in primary care, developers of the test were guided by the diagnostic criteria described in DSM-IV and ICD-10. As a result, the WB-DAT includes screening modules for MDD, PD+/-AG, AG without a history of panic, OCD, social phobia/social anxiety disorder, GAD, PTSD, and acute stress disorder (ASD). The focus of the WB-DAT is on current, rather than past (or lifetime), symptoms and distress/impairment.

Although the WB-DAT has considerable face validity, it is important that the instrument's operating characteristics be evaluated by determining the agreement between the WB-DAT screener diagnoses and diagnoses as made by SCID-I/P. Thus, the purpose of the present study is to report on the operating characteristics of the WB-DAT as compared with gold-standard diagnoses obtained by the SCID-I/P. The WB-DAT was also designed to include additional screening modules for agoraphobia without a history of panic, acute stress disorder, specific phobia, and a number of subsyndromal symptom profiles (for example, symptoms of agoraphobia without significant distress or impairment, dysthymia, and simple phobias) that may aid health care professionals in primary care to reach diagnostic conclusions. However, due to the relatively-small sample size in this study we report here only data for the major diagnostic categories (ie, MDD, PD+/-AG, OCD, SP, GAD, and PTSD).

Methods

Participants

The WB-DAT was administered to 193 subjects. All subjects were 18 years of age or older. The sample consisted of 79 (40.9%) men and 114 (59.1%) women. On average, subjects

were 40.92 (SD = 12.61) years of age. Subjects with dementia, mental retardation, or serious medical illnesses were excluded.

Procedure

Subjects were recruited from individuals who presented for assessment and/or treatment in ongoing research projects being conducted at the Mood and Anxiety Program and Clinical Research Department at the Centre for Addiction and Mental Health (CAMH) in Toronto, Ontario, Canada. Projects included 2 ongoing studies of the treatment of MDD, and a study of DSM-IV symptoms and personality in social and problem gamblers. In addition to the standard assessments conducted in the study, interested subjects were asked to consent to participate in the validation study of the WB-DAT.

Subjects completed the WB-DAT using a pseudonym and were subsequently interviewed with the SCID-I/P. The diagnostic data from the WB-DAT were then compared with the data from the individual's SCID-I/P interview. The SCID-I/P was administered by MA-level and PhD-level psychology graduate students who had received formal standardized training, including observing expert-conducted interviews and being observed conducting interviews. Such training has been reported to produce high diagnostic agreement for the DSM-IV Axis I disorders [25]. This study was approved by the Research Ethics Board at the Centre for Addiction and Mental Health, in accordance with applicable regulations, and informed consent was provided.

Statistical Analyses

Diagnostic concordance with the SCID-I/P was assessed for each Axis-I disorder assessed by the WB-DAT using Cohen's kappa, sensitivity, specificity, positive predictive value, negative predictive value, and efficiency [32- 34]. Cohen's kappa is a correlation of agreement that includes a correction for chance agreement. Sensitivity is the proportion of subjects with a diagnosis by SCID-I/P who receive a positive WB-DAT result (true positives). Specificity, in contrast with sensitivity, is the proportion of subjects without the diagnosis by SCID-I/P who also have a negative WB-DAT result (true negatives). Positive predictive value is the probability of receiving a SCID-I/P diagnosis when restricted to those cases that meet criteria according to the WB-DAT. Negative predictive value is the probability of not receiving a SCID-I/P diagnosis when restricted to all cases that do not receive a WB-DAT diagnosis. Efficiency is a measure of the overall accuracy of the WB-DAT—the number of cases correctly classified by the WB-DAT divided by the sample size.

Results

Subjects received an average of 0.99 (SD = 1.45) diagnoses according to the WB-DAT and 0.79 (SD = 1.17) diagnoses according to the SCID-I/P. However, only 79/193 (40.9%) of the sample met WB-DAT criteria for 1 or more disorders, and only 78/193 (40.4%) met SCID-I/P criteria for 1 or more disorders. The base rates for both acute stress disorder and AG without a history of panic were too low to permit evaluation of the performance of the WB-DAT for these disorders. The prevalence rates for MDD, any anxiety disorder, and any disorder according to the WB-DAT and the SCID-I/P for the sample are shown in Table 1.

Table 1. Prevalence of disorders according to the Web-Based Depression and Anxiety Test and SCID-I/P (n = 193)

	Web-Based Depression and Anxiety Test	SCID-I/P
Major depressive disorder	51 (26.4%)	48 (24.9%)
Any anxiety disorder	66 (34.2%)	61 (31.6%)
Any disorder	79 (40.9%)	78 (40.4%)

Table 2. Operating characteristics of the Web-Based Depression and Anxiety Test compared with SCID-I/P Diagnosis as the gold standard (n = 193)

	Number Meeting SCID-I/P Criteria	Cohen's Kappa	Sensitivity	Specificity	Positive Predictive Value	Negative Predictive Value	Efficiency
Major depressive disorder	48	0.68	0.79	0.89	0.75	0.93	0.89
Panic disorder +/-agoraphobia	16	0.57	0.75	0.94	0.52	0.98	0.93
Social phobia/social anxiety disorder	19	0.59	0.74	0.94	0.56	0.96	0.93
Obsessive-compulsive disorder	14	0.66	0.71	0.97	0.67	0.98	0.96
Generalized anxiety disorder	32	0.58	0.63	0.94	0.67	0.93	0.90
Post-traumatic stress disorder	19	0.70	0.95	0.93	0.60	0.99	0.94
Any anxiety disorder	61	0.72	0.89	0.86	0.76	0.94	0.88
Any disorder	78	0.72	0.86	0.86	0.81	0.90	0.87

The measures of agreement for the WB-DAT as compared with the SCID-I/P criterion for the DSM-IV Axis I disorders assessed are shown in Table 2. The Cohen's kappa measure of agreement ranged from acceptable to good (0.57-0.70) for MDD, PD+/-Ag,

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social phobia/social anxiety disorder, OCD, GAD, and PTSD. With the exception of GAD, the sensitivity (0.71-0.95) and specificity (0.87-0.97) for the major diagnostic categories assessed by the Web-Based Depression and Anxiety Test ranged were good. The sensitivity for GAD was somewhat lower (0.63) but acceptable. Positive predictive values were good (0.60-0.75) for MDD, OCD, GAD, and PTSD, and acceptable for PD+/-Ag and social phobia/social anxiety disorder.

Discussion

These are preliminary data from a sample of subjects drawn from 2 studies of the treatment of MDD and from a community study of social and problem gamblers. Thus, the results of this study should be interpreted with some caution. However, these preliminary data suggest that the WB-DAT was reasonably accurate in identifying patients who met SCID-I/P criteria for MDD, SP, OCD, and PTSD. The WB-DAT was somewhat less accurate in identifying subjects with GAD, although this is likely due to the small sample size and the considerable comorbidity between MDD and GAD, as 35.41% of subjects

who met SCID-I/P criteria for MDD also met SCID-I/P criteria for GAD.

Given the relatively small sample size in this study it is important to note that the Cohen's kappa, sensitivity, and specificity measures for the diagnoses of "any anxiety disorder" and "any disorder" were excellent. Thus, given that the true purpose of the WB-DAT is to produce output that can help initiate and encourage a discussion of symptoms and concerns between patients and health care providers in primary care, it appears to have the potential to be a useful tool in primary care.

In summary, the WB-DAT appears to do a reasonably good job of identifying people with MDD and/or an anxiety disorder. However, the results of this study require support from a larger validation study in primary care. The use of Web-based technology allows for constant improvements in screening modules and diagnostic algorithms in response to feedback from the results of validation studies. With the potential for continued development and validation, the WB-DAT provides a unique opportunity to make an important contribution to increasing recognition of MDD and the anxiety disorders in primary care.

Conflicts of Interest

Dr. Farvolden has a potential conflict of interest in the publication of this paper in that he has acted as a paid consultant to Van Mierlo Communications Consulting Inc, the owner of Web-Based Depression and Anxiety Test content and software.

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Abbreviations

AG: Agoraphobia
DSM-IV: Diagnostic and Statistical Manual of Mental Disorders, fourth edition
GAD: Generalized Anxiety Disorder
ICD-10: The International Classification of Diseases and Related Health Problems, tenth edition
MDD: Major Depressive Disorder
MINI: Mini-International Neuropsychiatric Interview

OCD: Obsessive-Compulsive Disorder
PD: Panic Disorder
PD+/-AG: Panic Disorder With and Without Agoraphobia
PTSD: Post-Traumatic Stress Disorder
SCID-I/P: Structured Clinical Interview for DSM-IV Axis I Disorders (Version 2.0/Patient Form)
SP: Social Phobia/Social Anxiety Disorder
WB-DAT: Web-Based Depression and Anxiety Test

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The Impact of Health Information on the Internet on Health Care and the Physician-Patient Relationship: National U.S. Survey among 1.050 U.S. Physicians

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Abstract

Background: Public use of the Internet for health information is increasing but its effect on health care is unclear. We studied physicians' experience of patients looking for health information on the Internet and their perceptions of the impact of this information on the physician-patient relationship, health care, and workload.

Methods: Cross-sectional survey of a nationally-representative sample of United States physicians (1050 respondents; response rate 53%).

Results: Eighty-five percent of respondents had experienced a patient bringing Internet information to a visit. The quality of information was important: accurate, relevant information benefited, while inaccurate or irrelevant information harmed health care, health outcomes, and the physician-patient relationship. However, the physician's feeling that the patient was challenging his or her authority was the most consistent predictor of a perceived deterioration in the physician-patient relationship (OR = 14.9; 95% CI, 5.5-40.5), in the quality of health care (OR = 3.4; 95% CI, 1.1-10.9), or health outcomes (OR = 5.6; 95% CI, 1.7-18.7). Thirty-eight percent of physicians believed that the patient bringing in information made the visit less time efficient, particularly if the patient wanted something inappropriate (OR = 2.5; 95% CI, 1.5-4.4), or the physician felt challenged (OR = 3.6; 95% CI, 1.8-7.2).

Conclusions: The quality of information on the Internet is paramount: accurate relevant information is beneficial, while inaccurate information is harmful. Physicians appear to acquiesce to clinically-inappropriate requests generated by information from the Internet, either for fear of damaging the physician-patient relationship or because of the negative effect on time efficiency of not doing so. A minority of physicians feels challenged by patients bringing health information to the visit; reasons for this require further research.

KEYWORDS

Physicians; Internet; physician-patient relations

Introduction

An increasing proportion of the public is using the Internet for health information [1]. This is expected to have a "profound effect on medicine" [2], but it is unclear whether this effect will be beneficial or harmful. The advantages of the Internet as a source of health information include convenient access to a massive volume of information, ease of updating information, and the potential for interactive formats that promote understanding and retention of information. Health information on the Internet may make patients better informed, leading to better health outcomes, more appropriate use of health service resources, and a stronger physician-patient relationship [2]. However, health information on the Internet may be misleading or misinterpreted, compromising health behaviors and health outcomes, or resulting in inappropriate requests for clinical interventions [3]. Physicians may accede to inappropriate requests, either because refusal is time consuming, or because they fear refusal would weaken the physician-patient relationship [4,5]. Responding to inappropriate patient requests may be particularly difficult in managed care, where patients may believe that physician refusals may be motivated by the need to control costs [6]. Some physicians may have difficulty adjusting to a more-equal role with patients [7] or may experience conflict with more-assertive patients [8]. There is little information on physicians' experience with patients who have sought health information on the Internet.

We surveyed a nationally-representative sample of physicians about their experience with patients bringing health information from the Internet to office visits. Our aims were to determine physicians' perceptions of the effects of patients bringing health information from the Internet on the physician-patient relationship; time efficiency of the visit; quality of care received by the patient; and patient's health outcomes.
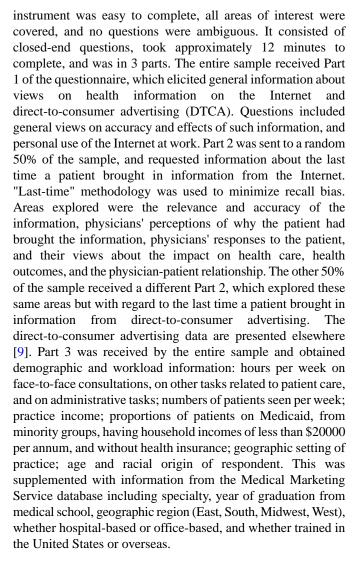
Methods

Sample

Two thousand physicians were randomly selected from the national list of physicians provided by the Medical Marketing Service, Inc (MMS). The Medical Marketing Service list is based on the national database of the American Medical Association (AMA) which includes both members and nonmembers of the American Medical Association, and is updated weekly. The American Medical Association database contains over 650000 physicians, and is the most-complete list of physicians available in the United States. Physicians who currently spent over 20 hours a week on direct patient care were included in the survey. The sample was stratified by specialty: primary care, medical specialty, or surgical specialty. Primary care included family practice, general practice, internal medicine, and pediatrics. Ob-Gyn was classified as a surgical specialty.

Questionnaire

The questionnaire was developed following literature review and focus-group discussions. It was pretested to ensure that the instrument was easy to complete, all areas of interest were covered, and no questions were ambiguous. It consisted of closed-end questions, took approximately 12 minutes to complete, and was in 3 parts. The entire sample received Part 1 of the questionnaire, which elicited general information about views on health information on the Internet and direct-to-consumer advertising (DTCA). Questions included general views on accuracy and effects of such information, and personal use of the Internet at work. Part 2 was sent to a random 50% of the sample, and requested information about the last time a patient brought in information from the Internet. "Last-time" methodology was used to minimize recall bias. Areas explored were the relevance and accuracy of the information, physicians' perceptions of why the patient had brought the information, physicians' responses to the patient, and their views about the impact on health care, health outcomes, and the physician-patient relationship. The other 50% of the sample received a different Part 2, which explored these same areas but with regard to the last time a patient brought in information from direct-to-consumer advertising. The direct-to-consumer advertising data are presented elsewhere [9]. Part 3 was received by the entire sample and obtained demographic and workload information: hours per week on face-to-face consultations, on other tasks related to patient care, and on administrative tasks; numbers of patients seen per week; practice income; proportions of patients on Medicaid, from minority groups, having household incomes of less than $20000 per annum, and without health insurance; geographic setting of practice; age and racial origin of respondent. This was supplemented with information from the Medical Marketing Service database including specialty, year of graduation from medical school, geographic region (East, South, Midwest, West), whether hospital-based or office-based, and whether trained in the United States or overseas.

Response Rate

Data collection was undertaken between November 2000 and February 2001. The questionnaire was mailed to the selected physicians with a check for US $35 as a token of appreciation for completing the questionnaire. Up to 3 reminders were sent and additional telephone contact made with nonresponders. Of the original 2000 physicians sent the survey, 38 were ineligible because they were deceased, retired, or no longer in practice; and 1050 physicians completed the questionnaire (response rate 53%). Of these, 515 received the Internet version of the questionnaire, and 535 the direct-to-consumer advertising version.

Analysis

Data were weighted to represent the national population of physicians in the Medical Marketing Service database who spend 20 or more hours per week on direct patient care, using the Medical Marketing Service variables mentioned above. As can be seen in Table 1, there is little difference between weighted and unweighted data, confirming that respondents were representative of US (United States) physicians.

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Table 1. Demographic, workload, and practice characteristics of respondents

Demographic and practice characteristics	Unweighted No. (%)	Weighted No. (%)
Age		
<39	222 (22)	198 (20)
40-49	360 (36)	363 (36)
50-59	248 (25)	248 (25)
60+	169 (17)	188 (19)
Gender		
Female	228 (22)	223 (22)
Male	808 (78)	812 (78)
1999 Income from practice		
$100000 or less	177 (19)	179 (19)
$100001-$150000	298 (31)	297 (31)
$151001-$200000	194 (20)	195 (20)
$200001-$250000	128 (13)	126 (13)
$250001+	162 (17)	160 (17)
Geographic setting		
Urban	342 (34)	346 (34)
Suburban	334 (33)	333 (33)
Small town	275 (27)	273 (27)
Rural	67 (7)	66 (7)
Geographic region		
East	288 (27)	298 (28)
South	316 (30)	310 (30)
Midwest	231 (22)	230 (22)
West	215 (21)	213 (20)
Type of medical specialty		
Primary care	404 (39)	406 (39)
Medical specialty	350 (33)	355 (34)
Surgical specialty	296 (28)	289 (28)
Office-based or Hospital-based		
Office-based	942 (90)	937 (89)
Hospital-based	108 (10)	113 (11)
Country of training		
United States	946 (90)	937 (89)
Foreign	104 (10)	113 (11)

Respondents best estimate of the percentage of their patients who were	Unweighted Percentiles			Weighted Percentiles		
	25th	50th	75th	25th	50th	75th
Uninsured	3	5	13	3	5	13
On Medicaid	5	10	25	5	10	25
From a minority group	10	20	40	10	20	40
Had an annual household income of $20000 or less	10	15	30	9	15	30
Respondents best estimate of:						

| Number of hours spent per week in face-to-face contact with patients | 24 | 32 | 40 | 24 | 32 | 40 |
| Number of patients seen per week | 50 | 80 | 105 | 50 | 80 | 104 |

The analytic approach focused on evaluating univariate and multivariate relationships with 4 clinically-important outcomes — change in physician-patient relationship; time efficiency; quality of care; and patient health outcome — each of which was assessed on a 3-point scale (improved vs no difference vs worsened). All the demographic, workload, and practice variables listed in Table 1 were run against each of these 4 outcome variables. Univariate relationships were calculated using the chi-square statistic or Fisher exact test as appropriate. In addition, univariate relationships were also investigated for an intermediate outcome: whether or not the physician did what the patient requested (yes completely vs yes partially vs no), a variable which in turn is evaluated for its relationship with the 4 main outcome variables.

Although several of the workload and practice characteristics were assessed as continuous variables (eg, percentage of patients who were uninsured, average number of patients seen per week), most were highly skewed, so medians and interquartile ranges are reported for these data. These variables were split at the 75th percentile for analysis of univariate relationships to test for the influence of these factors. This split was chosen over a median split to maximize the opportunity for an effect to be visible.

Separately for each outcome variable, correlates with chi-square statistics achieving $P < .20$ were analyzed using a stepwise multiple-logistic regression procedure to determine the "most-important" correlates, where importance is defined solely by statistical criteria. Each analysis went through several iterations, with each new iteration employing successively more-stringent statistical criteria for inclusion in the model. Each iteration included consideration of a model yielded by a forward-stepwise procedure and a model yielded by a backward-stepwise procedure. Final models include all correlates with a significant ($P < .05$) or near-significant ($.05 < P < .10$) likelihood ratio test while still achieving adequate fit, operationalized as $P > .20$ on the Hosmer-Lemeshow goodness-of-fit test.

As all data were weighted (except where specified), the appropriate procedures to correct P values and standard errors were undertaken. We used the SVYTAB procedure in STATA to obtain the Rao and Scott F-test P-values [10], and the SVYLOGIT procedure in STATA to obtain corrected standard errors for parameter estimates.

Results

Demographic and Other Characteristics of the Sample

The characteristics of the respondents before and after weighting are presented in Table 1. Weighting made only minimal difference to the characteristics of the sample, confirming that respondents were representative of US physicians. From this point on, all data presented are weighted.

Personal Use of the Internet

Sixty-one percent (n = 639; 95% CI, 58%-64%) of all respondents used the Internet in their own practice. In this group, the most-frequent uses were to obtain scientific information such as articles or guidelines (88%; 95% CI, 86%-91%) or to e-mail colleagues (63%; 95% CI, 59%-67%). Obtaining clinical information about patients, such as lab results (28%; 95% CI, 25%-32%), and e-mailing patients (16%; 95% CI, 13%-18%) were much less common uses of the Internet by physicians.

Views About Health Information on the Internet.

Overall, respondents were positive about the recent increase in health information on the Internet, with 75% (95% CI, 72%-77%) of the total sample thinking that it was a good or very-good thing. Only 15% (95% CI, 13%-17%) believed that it was a bad thing, and the remainder were neutral. Similarly, most physicians (77%; 95% CI, 74%-79%) stated that they had encouraged patients to look for information, although only 35% (95% CI, 32%-38%) had referred patients to Web sites.

Views About Patient Responses to the Internet

Eighty-five percent (95% CI, 82%-87%) of all respondents had experienced an occasion when a patient brought information from the Internet to a visit. For most physicians this is still a relatively-rare event; 59% (95% CI, 56%-62%) of respondents stated that less than one fifth of their patients had done this. 87% (95% CI, 85%-89%) of physicians perceived their patients as being concerned about the quality of information on the Internet, and 84% (95% CI, 82%-86%) of respondents rated their patients as only fair or poor (rather than good, very good, or excellent) at appraising the quality of information on a Web site .

Results From Respondents Whose Patients Brought Health Information on the Internet to a Consultation

Last Consultation With a Patient Who Had Brought in Information on the Internet

A random subsample (n = 519) was asked about the last time a patient had brought in health information on the Internet to a consultation and 430 reported that a patient had done so. The remaining data are from these 430 respondents.

Quality of Information

Most respondents believed that the last time a patient had brought in health information from the Internet, the information had been very (18%; 95% CI, 15%-22%) or somewhat (64%; 95% CI, 59%-68%) relevant to that patient's problems and very (8%; 95% CI, 5%-11%) or somewhat (66%; 95% CI, 61%-71%) accurate.

Reasons for Bringing Information to the Visit and Response to Requests for Interventions

Respondents perceived that the majority of these patients (90%; 95% CI, 87%-93%) had brought them the information because they wanted the physician's opinion on it. Physicians reported

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that patients sometimes also wanted a change in medication (31%; 95% CI, 27%-36%), a test (26%; 95% CI, 22%-31%), or a referral to a specialist (13%; 95% CI, 10%-17%).

Physicians usually did what the patient wanted, either completely (23%; 95% CI, 19%-28%) or partially (59%; 95% CI, 54%-63%). Univariate associations are shown in Table 2.

Table 2. Did you do what the patient wanted?

	No.	Yes, completely %	Yes, partially %	No %	*P*
Total	400	23	59	18	
Medical specialty					.004
Surgical specialty	112	29	59	13	
Primary care	152	21	66	14	
Medical specialty	136	22	50	28	
How relevant did you feel the information was to the patient?					.002
Very / somewhat relevant	327	24	61	15	
Not very / not at all relevant	73	19	48	33	
How accurate was the information?					.001<.001
Very / Somewhat	291	27	62	11	
Not very / Not at all	107	14	48	38	
: Patient wanted:					.001<.001
Test / Referral / Medication change	184	9	69	22	
Your opinion only	206	37	50	13	
Did you think that the patient's request was not appropriate for their health?					.001<.001
Yes	128	4	59	37	
No	273	32	59	9	
Did you have enough time to discuss the information?					.001<.001
Yes	253	29	53	17	
No	147	13	68	19	
Did you feel the patient was taking responsibility for their health?					.121
Yes	308	25	59	16	
No	89	18	57	24	
Did you feel the patient was challenging your authority?					.001<.001
Yes	69	6	60	34	
No	329	27	58	15	

On multivariate analysis, only 3 factors independently predicted not doing what the patient wanted. Thinking that the patient's request was not appropriate for their health was the most important factor (OR = 4.4; 95% CI, 2.4-8.0), followed by thinking the information that the patient brought in was not accurate (OR = 3.0; 95% CI, 1.6-5.5) and the type of specialty the physician was in. Medical specialists were more likely than primary care physicians and surgical specialists not to do what the patient wanted (for medical specialist compared to primary care physician OR = 2.8; 95% CI, 1.4-5.5, and for medical specialist compared to surgical specialist OR = 2.0; 95% CI, 1.02-4.1).

Effect on Physician-Patient Relationship

Most physicians believed that the patient bringing information to the visit had had a beneficial (38%; 95% CI, 33%-43%) or neutral (54%; 95% CI, 49%-59%) effect on the physician-patient relationship. Univariate associations are shown in Table 3.

Table 3. Effect on the physician-patient relationship of the patient bringing information from the Internet

	No.	Improved%	No difference%	Worsened%	P
Total	406	38	54	8	
How relevant did you feel the information was to the patient?					.001<.001
Very / somewhat relevant	331	44	51	5	
Not very / not at all relevant	74	11	66	23	
How accurate was the information?					.001<.001
Very / Somewhat	298	44	52	5	
Not very / Not at all	106	22	59	19	
Did the patient want:					.001<.001
Test / Referral / Medication change	183	36	50	14	
Your opinion only	212	42	55	3	
Did you do what the patient wanted?					.001<.001
Yes, completely	94	53	47	0	
Yes, partially	234	39	55	6	
No	71	15	57	27	
Did you think that the patient request was not appropriate for their health?					.001<.001
Yes	126	27	48	25	
No	280	43	56	1	
Did you have enough time to discuss the information?					.010
Yes	257	40	55	5	
No	148	34	52	14	
Did you feel the patient was taking responsibility for their health?					.001<.001
Yes	313	43	51	6	
No	89	23	62	15	
Did you feel the patient was challenging your authority?					.001<.001
Yes	68	24	40	35	
No	337	41	56	3	

Multivariate analysis yielded 4 factors that were independently associated with a worsening of the physician-patient relationship. The physician feeling that the patient was challenging their authority was the strongest predictor (OR = 14.9; 95% CI, 5.5-40.5) followed by the physician believing that the patient's request was not appropriate for their health (OR = 9.9; 95% CI, 2.7-36.4). Not feeling that the patient was taking responsibility for their health was independently associated with a worsening of the physician-patient relationship (OR = 4.6; 95% CI, 1.7-12.5), as was not doing what the patient wanted (OR = 4.0; 95% CI, 1.7-9.7).

Effect on Time Efficiency

Thirty-eight percent (95% CI, 34%-43%) of physicians believed that the effect of the patient bringing information to the consultation harmed their time efficiency while only 16% (95% CI, 13%-20%) believed that it had helped it. Univariate associations are shown in Table 4.

Table 4. Effect on time efficiency of the patient bringing information from the Internet to a visit

	No.	Improved%	No differ-ence%	Worsened%	P
Total	408	16	45	38	
Workload and practice characteristics:					
Country of training					.018
United States	376	15	45	40	
Overseas	32	33	46	20	
Proportion of patients on Medicaid					.014
25% or less	307	14	46	40	
> 25%	72	28	44	28	
Number of patients seen per week					.117
100 or fewer	273	18	47	35	
> 100	125	13	41	46	
Did you have enough time to discuss the information?					<.001
Yes	259	19	52	29	
No	148	12	33	55	
Information characteristics:					
How relevant did you feel the information was to the patient?					<.001
Very / Somewhat	333	20	47	34	
Not very / Not at all	75	3	40	57	
How accurate was the information?					<.001
Very / Somewhat	299	20	49	31	
Not very / Not at all	108	6	35	58	
Patient characteristics:					
Did the patient want:					.087
Test / Referral / Medication change	183	12	44	44	
Your opinion	212	21	46	33	
Did you do what the patient wanted?					<.001
Yes, completely	94	24	48	27	
Yes, partially	233	16	48	36	
No	72	8	33	59	
Did you think that the patient's request was not appropriate for their health?					<.001
Yes	127	12	27	61	
No	281	18	53	28	
Did you feel the patient was taking responsibility for their health?					.016
Yes	315	19	46	35	
No	89	8	43	49	
Did you feel the patient was challenging your authority?					<.001
Yes	69	8	21	71	
No	339	18	50	32	

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Multivariate analysis showed that many of these factors were independently associated. Physicians trained in the United States were more likely than physicians trained overseas to feel that time efficiency was worsened (OR = 5.8; 95% CI, 2.0-17.0). Other independently-associated workload factors were not having enough time to discuss the information (OR = 2.6; 95% CI, 1.6-4.3) and seeing over 100 patients per week (OR = 1.8; 95% CI, 1.1-3.0). The physician thinking that the request was not appropriate for the patients health (OR = 2.5; 95% CI, 1.5-4.4), feeling that the patient was challenging their authority (OR = 3.6; 95% CI, 1.8-7.2), or not thinking that the patient was taking responsibility for their health (OR = 2.2; 95% CI, 1.3-3.8) were also independently associated with worsened time efficiency.

Effect on Quality of Care

Most physicians believed that the information made no difference to the quality of care the patient received (70%; 95% CI, 66%-74%). More physicians believed that it had been beneficial (25%; 95% CI, 21%-29%) than deleterious (5%; 95% CI, 3%-8%) (Table 5). Logistic regression revealed that the only factor independently associated with a worsening of quality of care was the physician perceiving that the patient was challenging their authority (OR = 3.4; 95% CI, 1.1-10.9).

Table 5. Effect of the patient bringing information from the Internet to a visit on quality of care

	No.	Improved%	No differ-ence%	Worsened%	P
Total	408	25	70	5	
How relevant did you feel the information was to the patient?					<<.001
Very / somewhat relevant	331	29	68	3	
Not very / not at all relevant	75	4	82	14	
How accurate was the information?					<<.001
Very / somewhat accurate	298	29	67	3	
Not very / not at all accurate	108	11	78	11	
Did the patient want:					<<.001
Test / Referral / Medication change	182	22	69	9	
Your opinion	212	28	71	1	
Did you do what the patient wanted?					<<.001
Yes, completely	94	31	68	1	
Yes, partially	232	26	70	4	
No	73	14	72	15	
Did you think that the patient's request was not appropriate for their health?					<<.001
Yes	126	15	71	14	
No	280	29	70	1	
Did you have enough time to discuss the information?					.138
Yes	258	27	69	4	
No	147	20	73	7	
Did you feel the patient was taking responsibility for their health?					.006
Yes	315	28	67	4	
No	89	12	80	8	
Did you feel the patient was challenging your authority?					<<.001
Yes	68	15	68	17	
No	338	26	71	3	

Effect on Health Outcomes

Seventy-five percent (95% CI, 71%-79%) of physicians believed that the information had made no difference to the patient's health outcome, 21% (95% CI, 17%-25%) believed that it had improved the health outcome, and only 4% (95% CI, 2%-6%) believed that it had been deleterious (Table 6). On multivariate analysis, only 2 factors were independently associated with the

physician's perception of a worsened health outcome: information that was inaccurate (OR = 5.7; 95% CI, 1.6-20.5), or the physician feeling that the patient was challenging their authority (OR = 5.6; 95% CI, 1.7-18.7). Workload and practice characteristics were not associated with effect on health outcomes.

Table 6. Effect of the patient bringing information from the Internet to a visit on health outcomes

	No.	Improved%	No difference%	Worsened%	*P*
Total	406	21	75	4	
How relevant did you feel the information was to the patient?					<<.001
Very / somewhat relevant	330	25	73	2	
Not very / not at all relevant	75	5	85	10	
How accurate was the information?					<<.001
Very / somewhat accurate	296	26	73	1	
Not very / not at all accurate	107	7	83	10	
Did patient want:					.002
Test / Referral / Medication change	180	20	74	6	
Your opinion	212	23	76	1	
Did you do what the patient wanted?					<<.001
Yes, completely	92	26	72	1	
Yes, partially	232	23	75	2	
No	73	7	80	13	
Did you think that the patient's request was not appropriate for their health?					<<.001
Yes	126	16	74	10	
No	278	23	76	1	
Did you feel the patient was taking responsibility for their health?					.001
Yes	313	24	74	2	
No	89	10	82	8	
Did you feel the patient was challenging your authority?					<<.001
Yes	69	13	74	13	
No	336	22	76	2	

Discussion

This is the first large nationally-representative sample of physicians to study physician perceptions of the impact of health information on the Internet on quality of health care, health outcomes, health service utilization, and the physician-patient relationship that we could find by searching MEDLINE. We found evidence of both good and bad effects. Our findings have implications for practicing clinicians, policy makers, and researchers.

Implications

The Quality of Online Information is Paramount

Physicians believed that patients bringing in accurate, relevant online information is beneficial and welcomed it. Conversely, physicians believed that inaccurate or irrelevant information harms the quality of care, health outcomes, time efficiency, and the physician-patient relationship. Thus improving the accuracy and relevance of online information available to patients may improve outcomes of interest to health care providers, payers, and consumers. The policy challenge is how to improve the quality of online health information, given the large number of health-related Web sites and the ease with which sites can be updated. Suggestions include "kitemarks" (seals of approval) for quality Web sites, codes of conduct for development and content of Web sites, market forces, directing users to trusted Web sites, filters, rating instruments for users, and public education in evaluating the quality of online information [11-14]. The effectiveness and practicality of these suggestions remain unproven [15- 18].

Responding to Patient Requests for Clinically Inappropriate Interventions

US physicians may feel in a quandary when patients request an inappropriate clinical intervention that they learned about online. Ethically, physicians should refuse inappropriate requests in order to avoid harming the patient and to use health service resources prudently. However, previous studies have suggested that refusing patient requests will reduce patient satisfaction [5,19]. Physicians may be reluctant to jeopardize patient satisfaction because it is used as an index of quality, and can impact on physician income. This dilemma may be particularly acute in managed care, where patients believe that physicians refuse requests on financial grounds rather than clinical grounds [20]. Physicians also perceive that refusing clinically-inappropriate requests is damaging to time efficiency. This perception, or reality, may make physicians unwilling to engage in such discussions, and may, in turn, lead to more inappropriate requests being filled, with subsequent upward pressure on health care costs.

Physicians Who Feel Challenged

Seventeen percent of physicians felt that patients were challenging their authority during the visit. This reaction was strongly associated with harms to the physician-patient relationship, quality of care, health outcomes, and time efficiency. Our study cannot determine why physicians feel challenged. Some physicians may be having difficulty adjusting to a more-equal relationship, where the patient has greater access to medical information [7]. Alternatively, some patients may fail to acknowledge the physician's clinical expertise. This is an area for further research.

Methodological Considerations

Although our response rate is only moderate at 53%, it compares well to other surveys of Internet use by physicians. Because our sample was representative of all US physicians in terms of age, gender, specialty, location of practice, and practice income our results are likely to generalize to all US physicians. In contrast, previous surveys have examined specific branches of medicine [21], used convenience samples [22] or Internet-literate samples [23], had unacceptably-low (21%) response rates [24], or had very-small samples [25]. Response rates in other recent surveys of US physicians are lower than ours [26- 29], and the absence of substantive differences between responders and nonresponders argues against the presence of systematic selection bias.

As with all cross-sectional studies, we cannot determine causality, nor do we have objective data on whether patient requests were truly inappropriate or on quality of care or health outcomes. However, our measures are plausible because physicians address the appropriateness of care and outcomes daily on a professional basis. Patient perceptions of these consultations may have been different, but our results from a population survey of public perceptions of the effects of health information on the Internet are not dissimilar [30].

Conclusions

Health care organizations, payers, and providers have a strong interest in ensuring both that health information on the Internet is accurate and that physicians have the necessary skills to respond to patients who bring in such information. Vigorous leadership in these areas will be needed if the effect of the Internet on medicine is to be truly beneficial.

Conflicts of Interest

Karen Donelan was Medical Vice-Director of a company providing health information and advice through the Internet. She took up this post after completing the protocol for the study and design of the survey instruments, and had no further input into the fieldwork or analysis of the data.

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Abbreviations

US: United States

<u>Original Paper</u>

Evaluation of New Multimedia Formats for Cancer Communications

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Abstract

Background: Providing quality, current cancer information to cancer patients and their families is a key function of the National Cancer Institute (NCI) Web site. This information is now provided in predominantly-text format, but could be provided in formats using multimedia, including animation and sound. Since users have many choices about where to get their information, it is important to provide the information in a format that is helpful and that they prefer.

Objective: To pilot and evaluate multimedia strategies for future cancer-information program formats for lay users, the National Cancer Institute created new multimedia versions of existing text programs. We sought to evaluate user performance and preference on these 3 new formats and on the 2 existing text formats.

Methods: The National Cancer Institute's "What You Need to Know About Lung Cancer" program was the test vehicle. There were 5 testing sessions, 1 dedicated to each format. Each session lasted about 1 hour, with 9 participants per session and 45 users overall. Users were exposed to the assigned cancer program from beginning to end in 1 of 5 formats: text paperback booklet, paperback booklet formatted in HTML on the Web, spoken audio alone, spoken audio synchronized with a text Web page, and Flash multimedia (animation, spoken audio, and text). Immediately thereafter, the features and design of the 4 alternative formats were demonstrated in detail. A multiple-choice pre-test and post-test quiz on the cancer content was used to assess user learning (performance) before and after experiencing the assigned program. The quiz was administered using an Authorware software interface writing to an Access database. Users were asked to rank from 1 to 5 their preference for the 5 program formats, and provide structured and open-ended comments about usability of the 5 formats.

Results: Significant improvement in scores from pre-test to post-test was seen for the total study population. Average scores for users in each of the 5 format groups improved significantly. Increments in improvement, however, were not statistically different between any of the format groups. Significant improvements in quiz scores were seen irrespective of age group or education level. Of the users, 71.1% ranked the Flash program first among the 5 formats, and 84.4% rated Flash as their first or second choice. Audio was the least-preferred format, ranking fifth among 46.7% of users and first among none. Flash was ranked first among users regardless of education level, age group, or format group to which the user was assigned.

Conclusions: Under the pilot study conditions, users overwhelmingly preferred the Flash format to the other 4 formats. Learning occurred equally in all formats. Use of multimedia should be considered as communication strategies are developed for updating cancer content and attracting new users.

Introduction

Seeking personal health information online is an increasingly-popular goal of Internet users [1,2], particularly cancer patients [3]. Providing critical but basic information in lay vocabulary to cancer patients and their families to help them make important personal health decisions is a key function of the National Cancer Institute's (NCI) Internet Web site [4]. Providing this information in the format users prefer and can learn from is also a priority, given the plethora of options and choices now available to consumers. To help develop and pilot strategies for developing content for this audience in the future, we sought to evaluate user experience with 5 different media formats of identical content. Three new media formats were created and evaluated as part of strategic decisions being made about how to offer content to the increasing number of users of broadband Internet connections.

Our hypotheses were that compared to users of the 2 existing, traditional, predominantly-text formats, users of newer media formats would (1) demonstrate more "learning" of complex cancer information and (2) prefer the learning experience.

This report describes (1) the initial pilot project creating 3 new media formats from previously-existing predominantly-text content, and (2) formal comparison of user learning (performance) and preference for the 3 new and 2 existing program formats.

The 5 media formats evaluated for this study were:

1. Paper (existing: paperback booklet, predominantly text)
2. Web (existing: paperback booklet in HTML format on the Web)
3. Audio (new: spoken audio files available for streaming or download)
4. Audio plus Web (new: spoken audio synchronized with existing Web page)
5. Flash (new: animation loops, graphics, synchronized sound, dictionary).

Methods

As the vehicle for format comparisons, we selected NCI's booklet "What You Need to Know About Lung Cancer" [5], which is part of the "What You Need to Know About Cancer" program series [6], authored by NCI's Cancer Information Service [7]. This 26-booklet series provides basic information about cancer in general and information about 25 specific cancer sites information (causes, statistics, diagnosis, testing, treatment, outcomes, follow-up, clinical trials). It is targeted for readers with an 8th-grade to 10th-grade education. The series, originally published as mostly text in paperback booklet format, has recently been offered online in HTML format, duplicating the design and content of the paperbacks.

The "What You Need to Know About Lung Cancer" program was selected for this pilot for several reasons:

1. The annual incidence of new lung cancers is high [8].
2. The NCI lung cancer booklet seemed especially suitable for multimedia [6].

3. Other common cancers like breast [9] and prostate [10] already had many prominent portals on other Web sites.
4. NCI lung cancer content was not scheduled for rewrite for 2 years.
5. Other major patient-oriented online lung cancer Web sites [11- 13], including our own [5], do not take full advantage of multimedia features, even if multimedia software is used [14].
6. Recent data on newly-diagnosed lung cancer patients of all education and social strata demonstrated that they frequently search the Web to get information about their diagnosis [15].

Flash [16] software was selected as the format to create a program with animation loops, spoken audio, and text because about 92% of US computers have the Flash Player plug-in already installed [17]. NCI contracted with Medicom Digital, Inc [18] to create the Flash program, in collaboration with NCI content experts [19]. The joint team used existing program text (word for word) but created a new user interface, selected various features to include in the program, tested the program interface in formal usability tests, and rebuilt the interface based on testing results.

Audible, Inc was selected to create and host the newly-created spoken-audio files of the existing lung program, as well as other programs in the series [20]. The audio files recorded the existing program text word for word. Audio navigation links were added to offer users the option to jump to specific sections or listen from beginning to end. Users could listen by streaming or downloading content to a desktop computer or a personal digital assistant (PDA). For this study, files downloaded to the desktop computer were used.

The synchronized audio plus Web version combined the existing Web page and the new audio files.

The Web version of the text program [5] and the paperback booklet (available free by mail) [7] are both available through the NCI Web site [4].

A demonstration of the "look and feel" of each of the 5 formats is in Multimedia Appendix 1.

To test and compare how well prototypical users "learned" cancer content from each of the 5 formats, the development team used Authorware [21] software to create and present a 16-item multiple-choice test [Appendixes 2,3]. NCI staff prepared the quiz questions and answers based on the content in the text program. The Authorware interface also elicited and recorded demographic information, recorded and graded quiz answers, recorded time on each question, and recorded usability test information. All data were written to a Microsoft Access database.

To evaluate the individual programs before formal testing, an experienced facilitator, using a formal script, tested several users on each of the 5 program formats. Users were tested one at a time for an hour each, to evaluate usability and effect of the media programs and the quiz instruments, including the Authorware modules. Users of various ages, education levels, and Internet experience were included. These sessions found that almost all users showed learning from pre-test to post-test.

This preliminary testing confirmed that participants were able to use the media-program software itself and the test software. Although this was not formal instrument validation, it does suggest that our data are reliable.

For final testing, there were 5 user testing sessions, with each session featuring 1 of the 5 format types. There were 9 users per session, and each session lasted about 1 hour. The procedure was the same for each session. In each of the 5 sessions, all 9 users took the Authorware pre-test on the cancer content. All 9 were then required to experience the entire lung cancer program from beginning to end in only 1 of the 5 formats — paper, Web, audio files, Web plus audio, or Flash. (In the testing version of the Flash program, the quiz questions were disabled.) After experiencing the entire program in that format, all 9 users viewed/heard a detailed demonstration of the key features and the look and feel of the other 4 formats. Then, each of the 9 users was asked to provide their answer to the following question: "If you needed to learn this lung cancer content for yourself and could get access to only 1 format, list in order from 1 to 5 your personal choices and tell us why you picked this order." Then users took the 16-item post-test quiz on the content. The quiz question order was the same between pre-test and post-test, but the order in which the answers were displayed was changed between the pre-test and post-test. At the conclusion of the session, users supplied additional usability

data based on the primary format they experienced in the session. These data will be reported elsewhere.

As is typical for usability testing, 45 paid volunteers were selected by a nongovernmental market-research recruiting firm, based on a screening document supplied by the NCI research team. Balance among the groups for relevant parameters was requested. No recruit could have experienced cancer personally, had a close relative with lung cancer, or worked in medical science professions. English fluency was required. Balance of age, gender, formal education, and Internet computer experience among the groups was requested. The recruiting firm found and assigned all volunteer users to 1 of 5 groups, not knowing what media format they would be testing. The testing order of the media format groups was decided in advance by the research team without knowledge of who had been recruited for the groups. Strict randomization of users was not performed, but the search firm's recruits were generally balanced for the parameters requested by the research team (Table 1). Users signed the standard NCI consent to participate in usability testing of Web sites. To comply with US Office of Management and Budget restrictions on federal surveys, only 9 users could be recruited for each of the 5 program formats tested. Testing took place at NCI's new Communication Technologies Research Center, where each user had his/her own computer.

Table 1. Demographic characteristics of users by format to which each was assigned

Assigned Media Format	Number of Users	Number of Users in Each Age group			Average Age	Age Range	Male:Female	Highest Education Level			
		41-54	55-64	65-77				High School	Some College	College Graduate	Post College
Paper	9	4	3	2	57.1	41-74	4:5	1	3	4	1
Web page	9	4	3	2	56.2	45-69	4:5	0	5	2	2
Audio	9	1	3	5	63.4	48-76	4:5	1	3	3	2
Audio plus Web	9	3	4	2	57.3	42-77	5:4	3	2	1	3
Flash	9	2	5	2	58.6	47-65	5:4	1	3	1	4
Total or Range	45	14	18	13	58.5	41-77	22:23	6	16	11	12

Statistical Analyses

Paired *t*-tests and ANOVA were performed to assess the relationships between pre-tests and post-tests of content knowledge among the users of each media format. One-way ANOVA and Fisher's Least Significant Difference (LSD) post-hoc tests were performed to assess differences in performance from pre-test quiz scores to post-test quiz scores between the different media-format groups. Chi-square tests were performed to assess the association between media preference both by age group and by education level.

Results

Demographics of Study Participants

Table 1 summarizes the demographic characteristics of the 45 users according to the format to which they were assigned for the main presentation. Mean age was 58. Gender was equally distributed among the groups. Only 6 of 45 users had a highest-education level of high school and 12 had post-college education. Characteristics among the 5 groups reflect the demographics of Montgomery County, Maryland, where the testing occurred.

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Quiz Scores (Performance)

To assess how well users learned the cancer content presented by the media format to which they were assigned, a 16-item multiple-choice Authorware pre-test and post-test quiz was administered to each user. Sixteen was a perfect score. No differences in pre-test scores were seen between groups at baseline. Table 2 summarizes the pre-test and post-test scores for each of the 5 groups to which users were assigned, and for the group as a whole. Significant improvement was seen within each group. Only 4 users did not improve their scores: a 47-year-old high school graduate assigned to paper, a 74-year-old with some college education assigned to audio, a 56-year-old with a college education assigned to audio, and a 77-year-old with post-college education assigned to audio plus Web. No trend is apparent based on these 4 users.

Table 2. Quiz scores tabulated by assigned media format group*

Assigned media format	MeanPre-test Score	MeanPost-test Score	t(df)	P
Paper	7.78	10.56	3.49 (8)	<< .01
Web	6.89	10.00	3.97 (8)	<< .01
Audio	7.67	10.67	3.34 (8)	.01
Audio plus Web	8.00	11.40	5.00 (8)	<< .01
Flash	7.60	11.80	4.18 (8)	<< .01
Total	7.44	10.91	8.72 (44)	<< .01

* An analysis of variance indicated no differences in improvements between the different groups ($F_{4,40}$= 0.598, P=.67).

Quiz Scores Among Special User Groups

Because of NCI's special interest in older users and those with less formal education, quiz scores for these groups were analyzed separately. Thirteen participants were age ≥65. The mean pre-quiz score for this group was 7.23, while the mean post-test score was 10.62. This represents a significant improvement (t_{12}= 6.03, P< .001). Significant improvements in pre-test to post-test scores were seen for each of the age groups (41-54, 55-64, ≥65). However, the increments in improvement were not significantly different between any of the 3 age groups ($F_{2,42}$= 0.266, P= .77). There were too few study participants to compare statistical improvement in scores by age group and assigned format.

Six participants had a high school education. The mean pre-test score for this group was 6.50, while the mean post-test score was 10.50. This represents a significant improvement (t_5= 3.38, P= .02). Significant improvements in pre-test to post-test scores were seen for each of the 4 education levels defined in Table 1. However, the increments in improvement were not significantly different between any of the 4 education levels ($F_{3,41}$= 0.872, P= .47). There were too few study participants to compare statistical improvement in scores by education level and assigned format.

User Format Preferences

Each of 45 users was asked to provide a ranking from 1 to 5 of the format they preferred for the lung cancer program. Preference data are shown in Table 3. Participants overwhelmingly preferred the Flash format. Thirty-two of 45 users (71.1%) selected Flash as their first choice, and 38 of 45 (84.4%) rated Flash as either their first or second choice. Five individuals selected Flash as their fifth choice (11.1%). Audio was the least preferred format, ranking 5th among 21 of 45 (46.7%) users. Audio was not the first or second choice for any participant.

Table 3. Format choices for each of 45 users

Format Choices	Number of Users Selecting Each Ranking				
	1st	2nd	3rd	4th	5th
Flash	32	6	1	1	5
Paper	4	12	9	10	10
Web	4	8	17	13	3
Audio plus Web	5	19	10	5	6
Audio	0	0	8	16	21

User choices were also evaluated by the format to which users were assigned (Table 4). Flash was selected first by 8 of 9 users in the Flash group, 6 of 9 users in the Web group, 6 of 9 users in the paper group, 4 of 9 users in the audio group, and 8 of 9 users in the audio plus Web group.

Table 4. User choices of media by assigned format

9 Multimedia Users Choices

Choice	1st	2nd	3rd	4th	5th
Flash	8	0	0	1	0
Paper	0	4	0	2	3
Web	1	1	5	2	0
Audio plus Web	0	4	2	1	2
Audio	0	0	2	3	4

9 Paper Users Choices

Choice	1st	2nd	3rd	4th	5th
Flash	6	2	0	0	1
Paper	1	0	4	1	3
Web	1	3	1	4	0
Audio plus Web	1	4	3	1	0
Audio	0	0	1	3	5

9 Web Users Choices

Choice	1st	2nd	3rd	4th	5th
Flash	6	3	0	0	0
Paper	1	1	3	2	2
Web	2	2	3	2	0
Audio plus Web	0	3	2	2	2
Audio	0	0	1	3	5

9 Audio plus Web Users Choices

Choice	1st	2nd	3rd	4th	5th
Flash	8	0	0	0	1
Paper	0	4	1	3	1
Web	0	1	4	2	2
Audio plus Web	1	4	3	1	0
Audio	0	0	1	3	5

9 Audio Users Choices

Choice	1st	2nd	3rd	4th	5th
Flash	4	1	1	0	3
Paper	2	3	1	2	1
Web	0	1	4	3	1
Audio plus Web	3	4	0	0	2
Audio	0	0	3	4	2

Totals for All 45 Users

Choice	1st	2nd	3rd	4th	5th	Totals
Flash	32	6	1	1	5	45
Paper	4	12	9	10	10	45
Web	4	8	17	13	3	45
Audio plus Web	5	19	10	5	6	45
Audio	0	0	8	16	21	45
Totals:	45	45	45	45	45	

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Open-ended comments by users typically indicated they liked the Flash format because of its rich visual content, because they considered themselves "visual" learners, and because they thought it would be easiest to learn the complex content when animations, pictures, and sound were used instead of just text. Users who liked the paperback format typically noted its portability and independence from the computer. Users who liked the Web version said that they liked this version because they were familiar with how Web pages worked and knew how to print them out. Users who liked the audio plus Web format said they thought it helped them learn by reading and having the material read to them at the same time. Users said they "disliked" the audio alone format generally because it was hard to remain attentive for the entire program from beginning to end as required by the study methodology, and they found it difficult to navigate among program sections. Others suggested that downloaded audio might be useful while traveling, in a car or other vehicle, where Internet connections are not available. Users also commented that their elderly relatives might have

preferred the audio format, because it was "like radio," something with which they were very familiar and comfortable. Regardless of the format group users were exposed to, they liked the content, felt they learned from it, and appreciated that it was made available to them by the NCI.

Because of NCI's special interest in older users and those with less education, preference data for these groups were analyzed separately.

Format Preference by Age Group

All age groups reliably selected Flash as their first choice of media format. Table 5 demonstrates that participants from the youngest, middle, and oldest age categories overwhelmingly preferred the Flash format. Although a higher proportion of participants ages 55 to 64 selected Flash as their first choice for format, this proportion was not significantly different than reported by those in the other age group categories (X^2_6= 8.32, P= .216). No users picked audio as their first or second choice.

Table 5. First choice of format by age group

| Age Group | First Choice of Format | | | |
	PaperNo. (%)	WebNo. (%)	Audio plus WebNo. (%)	FlashNo. (%)
41-54	0 (0.0)	2 (14.3)	3 (21.4)	9 (64.3)
55-64	1 (5.6)	2 (11.1)	1 (5.6)	14 (77.7)
65+	3 (23.1)	0 (0.0)	1 (7.7)	9 (69.2)
Total	4 (8.9)	4 (8.9)	5 (11.1)	32 (71.1)

Format Preference by Education Level

Table 6 illustrates first choice of formats by education level. Participants with a high school education level tended to prefer the Flash format. Four of 6 (66.7%) chose Flash as their first choice. Five of the 6 (83.3%) chose Flash as either their first or

second choice of format. These data illustrate that the participants preferred the Flash format regardless of their personal education level. No significant differences in format preference were seen between the different education levels (χ^2_9= 8.32, P= .216). No users selected audio as their first or second choice.

Table 6. First choice of format by education levels

| EducationLevel | First Choice of Format | | | |
	PaperNo. (%)	WebNo. (%)	Audio plus WebNo. (%)	FlashNo. (%)
High school	0 (0.0)	0 (0.0)	2 (33.3)	4 (66.7)
Some college	1 (6.3)	1 (6.3)	2 (12.5)	12 (75.0)
College	2 (18.2)	1 (9.1)	1 (9.1)	7 (63.6)
Post college	1 (8.3)	2 (16.7)	0 (0.0)	9(75.0)
Total	4 (8.9)	4 (8.9)	5 (11.1)	32 (71.1)

Discussion

This study evaluated user performance and preference on 5 formats of identical NCI lung cancer content. The most-significant findings were that (1) users in every format group improved their test scores significantly and (2) users overwhelmingly preferred the Flash format for this content. These findings were true regardless of age or education level. The pre-test and post-test quiz score data suggest that the content was useful and valuable, which corresponds with users' open-ended comments.

We had hoped to find, but did not find, a significant improvement in learning (quiz performance) with Flash users compared to other formats. There are several possible reasons:

1. There was no significant difference in learning due to media format.
2. The Flash format we created did not optimize the teaching potential of that format.
3. There were too few users overall, or too few users with specific learning styles to detect small but significant learning differences favoring Flash.

4. The multiple choice quiz used was an inadequate instrument to detect real learning differences among the formats tested.

5. Requiring users to experience the lung cancer program from beginning to end did not replicate normal user learning behavior with any of the various formats.

6. Test participants may not have reflected learning that would have occurred among a different and more highly-motivated group of actual cancer patients and their families.

Summarizing considerable research on multimedia and e-learning, Mayer has suggested that "questions about which medium is best (for teaching) are somewhat unproductive." He states that "in general, media effects are small . . . it is not possible to separate the effects of the medium from the effects of instructional method . . . learning outcomes depend on the *quality of the instructional method rather than on the medium per se*(emphasis added)" [22]. Dillon and Babbard, in an extensive review of educational research, indicate that the benefits of hypermedia learning are "differently distributed across learners depending on their ability and preferred learning style" [23]. Najjar's review of multimedia and learning suggests that multimedia information is most effective when "presented to learners with low prior knowledge or aptitude in the domain being learned" [24]. Most newly-diagnosed cancer patients fit this profile. Mayer's data also confirm differential effects of specific multimedia formats on learners with specific learning styles [25].

Complex health information can be very difficult to convey to patients newly diagnosed with serious illnesses, such as cancer. The message may be difficult to transmit in a meaningful way, individuals do not always want to receive the message, and anxiety may interfere with learning. The strong preference data supporting Flash suggest that information seekers may be more receptive to a cancer message using this format, which would potentially have an advantage in attracting and keeping user interest.

Our study data confirm other findings that older adults are receptive to learning through multimedia formats [26]. On the other hand, our data also show that learning is independent of format. Therefore, offering the same content in audio alone or audio plus Web, although less popular in our study, might still be preferred by a large number of users, given the absolute number of newly-diagnosed cancer patients annually who seek basic information.

Research has also shown that cancer patients often desire more information than they receive and that the format in which they receive the information should be based on their preference [27].

The fact that no differences were detected in either quiz performance or format preference by personal education levels further emphasizes the potential global appeal of the Flash multimedia approach. This is consistent with other findings that education level does not predict reading ability, and that the desire for information is the critical component [28].

Over 150 Flash multimedia tutorials on many health topics [29], including lung cancer [14], are available online from MEDLINEplus, a service of the National Library of Medicine

(NLM) [30]. These tutorials are smaller files, and may be accessible with smaller bandwidth than ours, but they do not provide as much content depth as our pilot [19]. We are unaware of any data published by NLM about effectiveness of these tutorials as teaching instruments, although internal data have suggested that they are very popular (:Elliot Siegel, PhD; NLM; oral communication, 2003).

Having validated ease of program use during the development of the Flash program interface and preference for Flash during this study, we suggest that there is value in continuing to use and improve the interface. User testing revealed appreciation of specific program features including animation loops, spoken dictionary, selective printing of graphics and chapters, internal quizzes for review, chapter outlines, and a full audio text in addition to the graphic features.

Considering users' strong preference for the new Flash program, we can envision other uses for the Flash interface in cancer education such as augmenting pure-text informed consents, teaching about clinical trials, explaining medical procedures, teaching about healthy behaviors, engaging children in content learning, and non-English language presentations. The interface could also be helpful to groups other than the general public. Currently, complex NCI content for genetics professionals is being programmed using our Flash interface.

We hope to continue to test additional multimedia prototypes among various user groups, including those with accessibility issues. In the future, we hope to perform usability testing on low-vision users to assess their reaction to the new spoken-audio files, which we suspect may be more pleasant to listen to than a synthesized screen reader. We also hope to test the Flash program with low-hearing users because it has a complete and synchronized audio-text option available as users watch the animations. Federal regulations require compliance with accessibility regulations. Offering the programs in multiple formats ensures that we remain compliant.

One potential problem with the current Flash program is its large file size, making it available only to those with a broadband Internet connection. For this reason, consideration is being given to making it available on CD. According to recent data, wide bandwidth is available at home to 17% to 28% of users and the number is increasing [17,31]. Users in the workplace, including those in medical offices and hospital cancer-resource centers for patients, probably have access to higher bandwidth [17,31]. Users clearly need and search for cancer information online [1,2]. As more users acquire access to the Internet via wide-bandwidth connections, it becomes increasingly important to provide the content users want in the format they prefer, especially given the wide number of choices of cancer content online. We are aware of excellent commercially-produced anatomical site-based cancer multimedia programs using sound, animation, and film clips [32]. At present, the file sizes are so large that the programs are available only on CD, and their content is targeted at a much-higher reading level than ours.

Accessibility of multimedia programs is an issue with respect to Section 508 guidelines for US government Web sites [33] and compliance with http://www.w3.org/WAI/(WAI) guidelines

[34]. Complex multimedia offerings like ours, if offered in isolation, could fail to comply with the published guidelines. It is our hope to offer multiple links to the same content in different media formats on the same Web page. With compliant programming techniques and proper link labels both to and within the multiple media program options for the lung cancer content on the appropriate cancer.gov Web page, we expect that those with visual, auditory, or motor disabilities could choose the format that works best for them, and the spirit of compliance would be fulfilled. Additional testing of the multimedia formats with various disabled user groups is planned.

Our study could be faulted for its small numbers. From the outset, we intended the project as a small pilot study. In addition, the US Office of Management and Budget (OMB) regulations restrict any survey of citizens to ≤9 users per project without a special OMB waiver which is generally difficult and time consuming to obtain for a study of this type. Furthermore, the content would potentially need to change before the waiver was obtained. To comply with these restrictions, we were allowed to survey only 9 users for each format. Recruiting users online would have been the most-efficient and cheapest way to recruit large numbers of users. Even with an OMB waiver, we did not think it would be feasible to ask Internet users, even compensated, to compare online by themselves all 5 formats of the identical program. Most importantly, it was the format comparison data which was of special interest in the planning for future NCI communication products. Although we would have liked to survey additional users with less formal education and older age, the data gathered did suggest very-specific user preferences and significant learning with both new and older media formats. Nonetheless, the study was able to evaluate improvements in knowledge and performance for each of the 5 media formats, 4 education levels, and 3 age groups. The sample size was not large enough, however, to detect statistically-significant differences in improvements between any of the media groups, either alone or by subgroup stratum. Relatively-uniform increases in improvements were seen among all participants, and therefore the detected differences in our study were too small to be considered educationally important. Therefore, the benefit from increasing the sample size would not have resulted in improved overall results. However, an increased sample size would have allowed for the analysis of media formats by the different strata of age and education.

In conclusion, evaluation of 5 formats of identical NCI lung cancer content targeted for the general public in this pilot study suggested that users learned well with all 5 formats but preferred the new Flash multimedia tutorial format overwhelmingly. Multimedia content using animation and sound need not be created in Flash, but it should take advantage of sound and useful graphics and animation loops to communicate effectively and interestingly with users. Embedding Flash movies or other multimedia animation loops inside text Web pages might also provide learning assistance without having to create entirely-new stand-alone programs, and the components may be reusable in many programs. Given the large number of newly-diagnosed cancer patients annually, providing choices of media formats would allow learners of many different styles to maximize their chance of learning the information they need. By providing valuable content and maintaining user interest, new media options show promise in fulfilling the NCI mission of educating citizens about what they need to know about cancer in the format they prefer.

Conflicts of Interest

None declared.

Multimedia Appendix 1

Multimedia Demonstration of 5 Media Formats

[PowerPoint file, 1666 KB - jmir_v5i3e16_app1.ppt]

Multimedia Appendix 2

Content quiz questions andanswers (correct answer is indicated with an asterisk)

Quiz Questions

Question 1:

Benign lung tumors:

a.   Usually require treatment with chemotherapy

b.   Spread slowly to distant organs
c.   Grow through a process called metastasis
d.   Can often be removed *

Question 2:

Small cell lung cancer:

a.   Usually grows more slowly than non-small cell cancers
b.   Is also called oat cell cancer *
c.   Is less likely to spread to other organs than non-small cellcancer
d.   Is more common than non-small cell cancers

Question 3:

Each of the following increases the chance ofgetting lung cancer EXCEPT:

a.   Exposure to radon
b.   Smoking pipes
c.   Exposure to people who have lung cancer *
d.   Exposure to asbestos

Question 4:

All of the following are common symptoms of lungcancer EXCEPT:

a.   Difficulty swallowing *
b.   Weight loss
c.   Persistent cough
d.   Chest pain

Question 5:

A biopsy for lung cancer usually involves thefollowing:

a.   Lung scan
b.   Removal of tissue from the lung *
c.   Microscopic examination of sputum
d.   Internal radiation

Question 6:

All of the following are useful diagnostic tests forlung cancer EXCEPT:

a.   Needle aspiration
b.   Bronchoscopy
c.   Thoracentesis
d.   Internal radiation *

Question 7:

Lung cancer staging is done to:

a.   Determine if and where the cancer has spread *
b.   Decide which diagnostic tests to perform
c.   Evaluate the biopsy report
d.   Determine if the cancer will respond to treatment

Question 8:

All of the following are commonly used imaging testsfor lung cancer EXCEPT:

a.   MRI
b.   CAT scan
c.   External radiation *
d.   Bone scan

Question 9:

Mediastinoscopy and mediastinotomy are proceduresthat:

a. Remove a sample of the fluid that surrounds the lungs tocheck for cancer cells
b. Help show whether cancer has spread to the lymph nodes in thechest *
c. Remove a portion of the tissue inside the lung
d. Insert a needle into the tumor in the chest to remove asample of lung tissue

Question 10:

All of the following are types of surgery used totreat lung cancer EXCEPT:

a. Wedge resection
b. Lobectomy
c. Segmental resection
d. Mediastinotomy *

Question 11:

Chemotherapy for patients with lung cancer:

a. Is most effective when injected directly into the lung
b. Has very limited side effects
c. Affects both normal and cancer cells *
d. Is only administered into a vein

Question 12:

All of the following are true about radiationtherapy for patients with lung cancer EXCEPT:

a. Affects cancer cells inside and outside the treated area*
b. Can be given internally
c. May be used before or after lung surgery
d. Can be given with other kinds of treatments for lungcancer

Question 13:

All of the following are commonly caused bytreatment for lung cancer EXCEPT:

a. Mouth sores
b. Nausea and vomiting
c. Weight gain *
d. Fatigue

Question 14:

All of the following accurately describe clinicaltrials for lung cancer EXCEPT:

a. Locate lung cancer clinics *
b. Are described on the National Cancer Institute's website
c. Can compare a new therapy to a standard therapy
d. Are appropriate for patients with non-small cell lungcancer

Question 15:

All of the following are common treatments for smallcell lung cancer EXCEPT:

a. Chemotherapy
b. Radiation therapy to the lung
c. Radiation therapy to the brain
d. Surgery *

Question 16:

All of the following are common treatments fornon-small cell lung cancer EXCEPT:

a. Bronchoscopy *
b. Thoracentesis
c. Radiation therapy
d. Chemotherapy

Multimedia Appendix 3

Interface of Authorware quiz

[JPEG file, 80KB - jmir_v5i3e16_app3.jpg]

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Abbreviations

NCI: National Cancer Institute
NLM: National Library of Medicine
OMB: Office of Management and Budget

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Original Paper

Information Gathering Over Time by Breast Cancer Patients

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Abstract

Background: Unlike many patients of the past, today's health-care users want to become more informed about their illnesses, and they want the most current information. The Internet has become a popular way to access current information, and since its introduction more people are turning to it to find medical information. Studies report that anywhere from 36% to 55% of the American population that use the Internet is using the Internet to research medical information, and these percentages have been rising. Cancer is 1 of the top 2 diseases about which people seek information on the Internet. Some studies have specifically asked whether breast cancer patients access the Internet for medical information; estimates range from 10% to 43% of breast cancer patients who use the Internet, with higher usage being associated with more education, greater income, and younger age.

Objective: To identify where breast cancer patients find medical information about their illness and to track changes over time, from active treatment to survivorship status.

Methods: Participants were 224 women who had been recently diagnosed with Stage I, Stage II, or Stage III breast cancer. Each woman was contacted approximately 8 months and 16 months after diagnosis and was asked about 10 different information sources they could have used to obtain information or support about their breast cancer.

Results: Eight months after diagnosis, the top 3 information sources used by women were books (64%), the Internet (49%), and videos (41%). However, at follow-up (16 months after diagnosis), the most frequently cited information source was the Internet (40%), followed by books (33%), and the American Cancer Society (17%). We found that women continued to use the Internet as a means of gathering information even after their treatment ended. Significant unique predictors of Internet use were more years of formal education and younger ages. Cancer stage was not a significant predictor of Internet use.

Conclusions: Previous research has been mixed about the percentage of cancer patients who use the Internet to gather information about their illnesses. The results of the present study corroborate 2 other data sets of breast cancer patients, as just over 44% of the women reported using the Internet after diagnosis. Sixteen months after diagnosis, the percentage of women using the Internet dropped slightly, but other chief sources dropped sharply at that time. The Internet continues to play an important role for cancer survivors after medical treatment has ended, and health professionals can use this knowledge to provide their patients with Internet advice.

Introduction

Patients of the 21st century are not like patients of the past — many want to become more informed about their illness, and they want the most current information [1- 5]. The increased desire to acquire information has been accompanied by dramatic increases in the proportion of people in the population who have Internet access. Thus, we are starting to see a shift in how patients obtain medical information [6]. In the past, consumers sought information from health professionals, books, media (eg, videos), and support networks (eg, the American Cancer

Society). Now the information source of first choice may be the Internet.

Internet access has continually increased since the Internet was introduced. In 2002, 169 million people in the United States had current access, an increase of 10% over the previous year [7]. When people were asked why they use the Internet, the most-important reason was to quickly obtain information [8]. The Internet offers several advantages in addition to rapid information acquisition: finding information online is relatively easy, people can share their experiences with others, and they can research anything in privacy. However, finding information online has its drawbacks. Some people are still unable to access the Internet easily, and finding reliable, credible sources may be difficult [5,9- 11]. In a recent review of studies evaluating the quality of Web sites, Eysenbach et al [12] reported that 70% of the studies concluded that quality is a problem on the Web, and only 9% of the studies evaluated the quality of sites positively. These data suggest that searchers are typically unlikely to find reliable and credible sources. However, Fogel et al [13] found that breast cancer patients chose as their favorite Web sites those containing reliable and credible information.

Some studies have examined whether people are using the Internet to obtain medical information. Lebo reported that 36% of Internet users accessed medical information on the Web [8]. A similar estimate was obtained from a representative sample of the US population, in which 40% of the respondents with Internet access said they looked for health care advice or information [14]. However, Baker et al [14] also reported that the Internet had little effect on health care utilization, as indexed by the number of physician visits or telephone contacts. In 2000, the Pew Internet & American Life Project reported that 55% of Americans with access to the Internet used it for medical purposes [11]. In that study, individuals who used the Internet for medical information, identified as "health seekers," were reinterviewed to obtain more detailed data. More women (63%) than men (46%) consulted the Web for health information. Approximately 30% of the health seekers reported using the Internet to seek advice about health about once a month, and 29% reported using the Internet about once a week. Less-healthy individuals reported greater weekly use (32%) than individuals in excellent health (23%). Additional findings were that Internet users liked the idea that they could access medical information any time of the day and could do so anonymously.

Cancer is 1 of the top 2 diseases about which people seek information on the Internet, with approximately 35% of Americans using the Internet to gather information about cancer [15]. Several studies have been conducted to determine whether and how cancer patients use the Internet to research their disease. Mills and Davidson asked cancer patients (colorectal, lung, breast, prostate, gynecological, or gastric) where they obtained information and found that fewer than 10% reported using the Internet [16]. The main source of information used by patients was the hospital consultant, followed by the general practitioner. Diefenbach et al [6] examined the explanations that men diagnosed with prostate cancer gave for their for treatment decisions, finding that only 7% of the patients reported using the Internet to make their decisions. Similarly, Raupach et al [17] found that fewer than 7% of women diagnosed with breast

cancer used the Internet as a means of gathering information about their cancer.

Pereira et al asked a similar question of breast cancer patients and reported much higher Internet use [5]. Nearly half (43%) of the women said they used the Internet to look for information related to their cancer. Of those who used the Internet, over 90% used it to find more information about their cancer and its treatment. Breast cancer Internet users were younger and more educated than nonusers. Fogel et al also asked whether breast cancer patients used the Internet as an information-gathering source, and reported results similar to those of Pereira et al [3,5]. Fogel et al found that 42% of the women used the Internet for medical information, and that Internet users tended to be younger with a higher education level [3]. Internet users had higher incomes and were more likely to be white. No differences were found for the stage of breast cancer.

Given the rapid expansion of Internet use, the number of cancer patients who use the resource, and how they do so, is likely to change rapidly. It is important to assess where patients are seeking information about their disease and to track changes over time. The data in the present study come from a clinical trial of telephone therapy for newly-diagnosed cancer patients [18]. We provide data about 2 important comparisons that add to prior research. First, we asked patients to describe their use of many different information sources, so we could compare Internet use to other possible ways of gathering information. Second, we followed patients over time, from active treatment to survivorship status. The longitudinal design allowed for a characterization of how breast cancer patients obtain information during different phases of their disease.

Methods

Participants

We report data obtained in the context of a clinical trial testing 2 interventions to help women cope with breast cancer. The results of the intervention study are reported elsewhere [18]. Participants, recruited from 2 regional cancer treatment centers, were 224 women who had been recently diagnosed with Stage I (n = 110), Stage II (n = 85), or Stage III (n = 29) breast cancer. Women with Stage 0 or Stage IV diagnoses were excluded from the study. Sixty-nine women (22.5% of those asked) declined to participate, with the most common reason being "not interested." Because initial analyses showed no treatment differences between conditions on the types of information gathered at either interval, the data presented are collapsed across conditions. Most of the women were married (77%) and Caucasian (96%), and they ranged in ages from 30 to 84 (mean = 54.5).

Procedure

Approximately 9 weeks (mean = 9.0) after diagnosis, women were recruited to take part in the current study. After consent was obtained, we conducted baseline telephone interviews. Eight months after diagnosis (mean = 8.4), women were reinterviewed and asked about their information-gathering behaviors since they had been diagnosed with breast cancer. At nearly 16 months after diagnosis (mean = 15.6), the women

were contacted a final time and asked whether or not they had used any of the same information sources since the last time we had talked to them. All data collection took place between August 1999 and September 2002.

We began the study with 237 participants. The 224 participants described above were retained at the first follow-up period (95% of the original 237) and the data from 217 participants (92% of the original 237) were available at the second follow-up period. The small number of dropouts would have little impact on the overall Internet use statistics presented here. On 2 background variables, however, the dropouts at the 16-month interval did differ slightly from those participants who stayed in the study until the end. Specifically, dropouts were more likely to have a higher stage of cancer (means = 1.90 and 1.59, t_{235}= 1.89, P= .06) and a lower income (means = 2.15 and 2.78, t_{228}= 2.02, P= .05). As reported below, neither of these 2 variables predicted Internet use in the logistic regression equation at the 16-month interval.

Measures

Participants reported whether they used 10 different sources to obtain information or support about their breast cancer. Three of the information sources were followed by an open-ended question to allow the participant to expand on "yes" answers. Participants were asked whether they had:

1. read any books about breast cancer (and, if yes, to provide the title)
2. taken part in a support group
3. participated in "I Can Cope," an educational program sponsored by the American Cancer Society (ACS) that provides support to breast cancer survivors
4. met a "Reach to Recovery" volunteer, another program sponsored by the American Cancer Society, in which persons diagnosed with breast cancer can talk with a trained volunteer about their cancer
5. participated in the "Look Good, Feel Good" program, an American Cancer Society program that teaches female cancer patients beauty techniques to reduce appearance-related side effects of cancer and cancer treatments
6. watched any videos (and, if yes, to provide the title)
7. called the National Cancer Institute Information Service
8. contacted the American Cancer Society
9. contacted the Y-Me National Hotline, a 24-hour hotline in which trained breast cancer survivors answer questions and provide support to women who have questions about breast cancer and/or
10. used the Internet to gather any information (and, if yes, the topics that you researched).

When contacted for the second interview, women were not asked about the "I Can Cope" program, because it did not generate enough responses at the first interview.

Results

Data Analyses

We conducted 3 kinds of analyses. First, descriptive statistics were used to describe Internet use data. Second, individual chi-square analyses were used to test differences in Internet use over time. Third, tests of association between background variables (eg, age) and Internet use were conducted in 2 ways: (1) using individual chi-square tests or point-biserial correlations, and (2) using logistic regression to test the unique contributions of the background variables to Internet use.

Table 1 shows the percentages of women who said that they used each of the 10 information sources. After diagnosis, the top 3 sources used by the women were books, the Internet, and videos. The most frequently cited book read by the women was "Dr. Susan Love's Breast Book" [19,20]. Infrequently used sources were the Y-Me National Hotline and the "I Can Cope" program. At follow-up (16 months), the most frequently cited information source was the Internet, followed by books, and the American Cancer Society (see Table 1). Women continued to use the Internet as a major means of gathering information even after their treatment ended. The other top cited sources declined dramatically over that time, a significant drop for both books, χ^2_1= 32.43, P< .001 and videos, χ^2_1= 8.32, P= .004.

Table 1. Information sources used by patients 8 months and 16 months after diagnosis

Information Source	Women Who Said They Used Information Source(%)	
	8 Months(n = 224)	16 Months(n = 217)
Books	64	33
Internet	49	40
Videos*	41	13
Reach a Recovery Volunteer*	39	11
American Cancer Society	25	17
Look Good Feel Good	14	12
Support groups	9	10
National Cancer Information Service	9	8
Y-Me National Hotline	4	1
I Can Cope	2	NA

* Significant changes were observed between the periods after diagnosis and at follow-up, χ^2 $P < .01$.

Table 2 shows the types of information women were seeking while using the Internet. These data were generated in response to an open-ended question the interviewers asked when patients said that they used the Internet to gather information (ie, "Can you tell me the topics that you researched?"). Six general topics appeared most frequently in patients' responses to the open-ended questions. Eight months after diagnosis, the 2 topics mentioned by the most women were treatment information and specific breast cancer information. At follow-up (16 months), the 2 topics mentioned by the most women were specific breast cancer information and medications.

Table 2. Most common topics of information sought on the internet 8 months and 16 months after diagnosis

Topic	Women who said they sought information on the topic(%)	
	8 Months(n = 110)	16 Months(n = 86)
Treatment information	26	14
Specific breast cancer information	26	21
Medications	23	20
Medical institutions/resources	15	5
General cancer information	14	14
Tamoxifen	13	9

Given the rapid expansion of the Internet, one might expect that Internet use would differ from when our first participants were assessed (1999) to when our last participants were assessed (2002). We tested this possibility by dividing our sample into 4 approximately-equal groups, differing by an earlier vs later diagnosis date. No significant differences in Internet usage were observed for these groups at either measurement interval, although the trend was for greater use by women who were diagnosed most recently (eg, at the 8-month follow-up, the percentage using the Internet was 46% during the earliest diagnosis period and 56% during the latest period), $\chi^2_3 = 1.74$, $P = .42$.

Predictors of Internet Use

We tested several predictors of Internet use during the interval after diagnosis. Cancer stage was not a significant predictor, $\chi^2_2 = 1.74$, $P = .42$. However, more years of formal education, higher income levels, and younger age were significantly related to greater Internet use after diagnosis ($r = 0.28$, $r = 0.18$, and $r = -0.36$ respectively; for all three, $P < .01$). At follow-up, cancer stage again failed to predict Internet use, $\chi^2_2 = .12$, $P = .94$. More years of formal education, higher income levels, and younger age all remained significantly associated with greater internet use ($r = 0.26$, $r = 0.20$, and $r = -0.25$ respectively; for all 3, $P < .01$).

To assess the relative importance of the predictors of Internet use, we conducted logistic regression analyses for both time intervals, entering cancer stage, education, income, and age simultaneously. Table 3 presents the results of those analyses. The data are similar for both intervals and differ in only one way from the reported individual associations. Similar to the individual reports, cancer stage was unrelated to Internet use, but younger age and more years of education were significantly related to use at the 8-month and 16-month intervals. However, unlike the individual associations, income was no longer a significant predictor of use in the logistic regressions. This result may be at least partly attributed to the shared variance between years of education and income ($r = 0.25$); once education entered

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the regression equation, income no longer predicted unique variance in Internet use.

Table 3. Summary of logistic regression analyses predicting Internet use at both follow-up intervals

Variable	Odds Ratio	95% Confidence Interval	P
8-month interval			
Cancer stage	0.93	0.60-1.42	.72
Age	0.94	0.92-0.97	<<.001
Education	1.25	1.08-1.44	.002
Income	1.09	0.87-1.37	.47
16-month interval			
Cancer stage	0.88	0.57-1.36	.57
Age	0.97	0.94-0.99	.016
Education	1.21	1.06-1.39	.006
Income	1.19	0.93-1.52	.17

Discussion

Previous research has been mixed about the percentage of cancer patients who use the Internet to gather information about their illness. Mills and Davidson [16] reported that fewer than 10% of cancer patients use the Internet, but Fogel et al and Pereira et al found that 43% of breast cancer patients use the Internet [3,5]. The results of the present study corroborate the latter findings, as just over 44% of the women reported using the Internet. The percentage of women using the Internet after diagnosis was 49%, declining slightly to 40% at follow-up. In contrast, the use of videos dropped sharply — 68% at follow-up. Similarly, the use of books dropped by 48%. It is important to know that the Internet continues to play an important role for cancer survivors after medical treatment has ended, a finding that is best identified using the sort of longitudinal design employed here.

Reported Internet use was measured only from retrospective recall of patients involved in our study, which is a methodological limitation. However, several findings were consistent with other investigations, providing some confidence in the data collection method and in the possibility that we can generalize from this study to other people and places. As just noted, for example, the overall level of reported Internet use was nearly identical to levels reported in 2 recent studies of breast cancer patients: just less than half of patients say they use the Internet. In addition, correlational data fit with earlier findings, in that Internet use was higher among better educated, younger, and wealthier women. These data probably reflect ease of access and perhaps confidence in using the Internet as an information source.

Although the reliance on self-report may not detract much from the study findings, other limitations should be noted. Because we used open-ended questioning, the data concerning exactly what women learned from the Internet are sketchy. They appeared to search for specific treatment information (eg, data concerning Tamoxifen, treatment regimens) as well as general cancer information. However, to obtain more-precise information about Internet searching, it would be preferable to collect diary data and to report the specific sites that patients use to obtain information. The use of a diary would also help solve another limitation of the present study — reliance on long-term recall. Women recalled activities from several months earlier in describing their Internet searching, and we know that a better data collection strategy would avoid depending on such long-term memories. Finally, we did not ask about one very important source of information: health professionals, especially physicians. It would have been good to know about patients' perceptions of whether they obtained their most-important information from their own health-care providers.

Despite the study limitations, the present findings have implications for future research and practice. Follow-up research could explore the role that health providers play in Internet use. Do physicians encourage Internet use? Do patients who are using the Internet have different kinds of interactions with their health-care team? Do some patients rely more on the Internet for information than on what they learn from their own health-care team? These sorts of questions are likely to become increasingly relevant as more patients turn to the Internet for health information. But the questions are already important, given that nearly half of patients appear to be using the Internet and because, according to our results, over time the Internet becomes the most-frequently used information source. The latter finding also points to the need to investigate the exact sites that patients are using to obtain information. Are they sites that contain accurate information? How do patients explore the Internet to find accurate and useful information?

Efforts to evaluate cancer information on the Internet have already begun [12]. Biermann et al [1] conducted a systematic evaluation of Web sites identified when searching for the topic of "Ewing's Sarcoma" using 4 search engines. The searches often generated irrelevant Web sites and dead ends, and many patients spent numerous hours searching but were unable to find specific and reliable information they needed. In a different study, researchers provided Internet training sessions to cancer patients and their family members about how to access specific information related to their cancer [2]. All the patients found the sessions to be helpful, and they were interested in

participating in additional sessions. Given the value that many patients appear to be finding in the Internet as an information source, it is incumbent on health professionals to explore ways to facilitate best use of the resource to ensure that patients are obtaining quality information.

Acknowledgments

Conflicts of Interest

None declared.

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<u>Original Paper</u>

Designing Tailored Web-Based Instruction to Improve Practicing Physicians' Preventive Practices

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Abstract

Background: The World Wide Web has led to the rapid growth of medical information and continuing medical educational offerings. Ease of access and availability at any time are advantages of the World Wide Web. Existing physician-education sites have often been designed and developed without systematic application of evidence and cognitive-educational theories; little rigorous evaluation has been conducted to determine which design factors are most effective in facilitating improvements in physician performance and patient-health outcomes that might occur as a result of physician participation in Web-based education. Theory and evidence-based Web design principles include the use of: needs assessment, multimodal strategies, interactivity, clinical cases, tailoring, credible evidence-based content, audit and feedback, and patient-education materials. Ease of use and design to support the lowest common technology denominator are also important.

Objective: Using these principles, design and develop a Web site including multimodal strategies for improving chlamydial-screening rates among primary care physicians.

Methods: We used office-practice data in needs assessment and as an audit/feedback tool. In the intervention introduced in 4 phases over 11 months, we provided a series of interactive, tailored, case vignettes with feedback on peer answers. We included a quality-improvement toolbox including clinical practice guidelines and printable patient education materials.

Results: In the formative evaluation of the first 2 chlamydia modules, data regarding the recruitment, enrollment, participation, and reminders have been examined. Preliminary evaluation data from a randomized, controlled trial has tested the effectiveness of this intervention in improving chlamydia screening rates with a significant increase in intervention physicians' chlamydia knowledge, attitude, and skills compared to those of a control group.

Conclusions: The application of theory in the development and evaluation of a Web-based continuing medical education intervention offers valuable insight into World Wide Web technology's influence on physician performance and the quality of medical care.

Introduction

The World Wide Web (Web) provides a delivery system for conveying complex, structured information to a large number of users without the barriers of time and geography [1]. Nearly all physicians have access to the Web, know how to use it, and access it for medical information [2]. Physicians reported most frequently using the Web for e-mail, medical information sources, travel information, product information, and professional association communications [3]. A particular patient problem was the most-common reason for seeking information through the Web. Credibility of the source, quick and 24-hour access to information, and ease of searching were most important to physicians [2]. Barriers to use included too much information to scan and too little specific information to respond to a defined question [2]. Many online medical resources lack design features that organize content and simplify usage; a dearth of well-designed applications in medical education has been noted [1].

In 2000, 96 continuing medical education sites were available; in 2001 this number had more than doubled to 209, with 18263 hours of continuing medical education credit offered online [4]. However, 28% of these sites contained only text. Only 17% of the sites were interactive, and 7% were guideline-based. Sklar noted that most online CME (Continuing Medical Education) offerings do not make use of unique computer capabilities to offer multiple pathways to learning and interactive responses [4]. Studies have shown that traditional CME lectures and simple information dissemination, similar to the text-only online sites, do not usually change physician practice patterns; although physicians may report that they intend to change their practice patterns after a traditional CME course, the evidence generally refutes this assertion [5- 7]. If the Web is to be used optimally as an intervention to improve physician performance and patient-health outcomes, physician interventions delivered through the Web must go beyond the simple posting of information. The design of these interventions will benefit from being informed by learning theories as well as the current evidence about which provider interventions are most effective in improving physician performance and patient-health outcomes.

Learning Theories

Because of the potentials for high costs and adverse consequences of poor performance, medical education represents a major category of lifelong education [8]. Kearsley has catalogued over 50 major learning theories applicable to adult lifelong learning [9]. In choosing and applying learning theories to medical education over the physician's lifetime, key characteristics of the discipline determine which learning theories are most relevant. Cognitive processes including skills such as decision making, reasoning, and problem solving are critical in medical practice, leading to a focus on cognitive learning theories. Cognitive theories such as situated learning theory and cognitive flexibility theory are examples of cognitive theories particularly relevant to medicine [9- 11].

Situated learning, andragogy, and cognitive flexibility theories are examples of cognitive learning theories relevant to the design of physician education. Situated learning focuses on the social nature of cognition and the importance of authentic situations to learning; specifically this requires settings and applications to be relevant to the daily life of the learner [11]. Similarly, andragogy theory proposes that instruction should be task-oriented and presented in the relevant context of common tasks performed, should take into account the learner's knowledge and experience, and should be problem-centered not content-focused [12]. Cognitive flexibility theory emphasizes a case-study approach involving context-dependent and realistic situations. This theory addresses the nature of learning in complex domains and focuses on the transfer of knowledge and skills beyond the learning situation [10,13]. In general, cognitive frameworks suggest that the sequence and pace of instruction be controlled by the learner, and that the instruction be tailored or individualized to participant needs.

Physician Change Theories

Several theorists have applied constructs specifically to the problem of how physicians in clinical practice learn and change.

First, motivation for physician learning has been linked to the nature of the problem, most frequently a specific patient problem as physicians seek information to deal with uncertainty in the clinical encounter: surprise, stress, and cognitive dissonance in this context may lead to information seeking [14].

Second, problem-based learning (PBL), a cognitive learning strategy, has been important in organizing undergraduate and graduate medical-education curricula but has not yet become the standard format for CME [15]. In problem-based learning, learners construct problem-oriented semantic networks (visually-depicted problem structures consisting of shapes or objects graphed to represent concepts with interconnecting lines indicative of relationships) that include cues from the context of professionally-relevant problems, fostering professional curiosity [16].

Third, application of a stages-of-change model to the question of how physicians learn and change has been suggested [17,18]. The stages of precontemplation, contemplation, preparation, action, and maintenance can be used to better understand a physician learner's development and readiness for learning [18].

Fourth, Schoen's model has described a process by which physicians reflect on their daily practice in order to continue to learn over time; practitioners engage in situated action until their expectations are not met and they experience a breakdown in their current work situation [19]. At that moment, practitioners stop and reflect, creating motivations to move beyond the breakdown through ongoing learning [19].

Finally, Fox and others have proposed that learning and change resulting from information-seeking behavior varies from stage to stage in a multistage process [20,21]. When information is sought that might indicate the need for complex changes in practice, other conditions of adoption must be met, including commitment to change, a conceptual basis for making the change, and time to deliberate over making the change. Information seeking might play various roles in this process accordingly [20].

Appropriate Educational Delivery Systems

Not only is it important to examine which learning theories are the most applicable to medical education, but also which media or educational delivery systems are most supportive of relevant theories. Since situated learning focuses on the social nature of cognition and the importance of authentic situations to learning, computer-assisted and Web-based instruction are ideal formats for CME since they can tailor the learning process to the individual student by providing teaching and support in response to the individual's immediate needs. These forms of instruction can also bring experts to the learner, demonstrating clinical reasoning skills.

Learning through the Web can also be enhanced by immediate repetition, which helps the learner make new knowledge and skills explicit. These aspects put the student at the center of the learning processes, as suggested by situated learning theory, and make many resources available through a large number of different learning pathways and possibilities [22]. Computer-based models for problem-oriented learning and clinical reasoning are simpler and less expensive to produce than those models that depend on live interaction and can be extremely effective [22]. In addition to situated learning theory, cognitive flexibility theory also strongly supports the use of interactive technology and the use of clinical cases to emphasize knowledge construction rather than the transmission of information [13].

While not specifically related to medical education, a recent investigation of research involving the development of Web-based instruction was conducted to determine which instructional design models or approaches had been adopted for the design of Web-based instruction [23]. The majority of Web-based instruction was designed following existing instructional design models, primarily grounded in behavioral, not cognitive, learning theories [23]. The most-frequently used model in developing Web-based instruction was the standard Dick and Carey instructional model (assess, design, develop, implement, and evaluate) [24].Within this model, the most-frequently-used elements of the model were to: analyze learning contexts, learning tasks, and learners, as well as to determine delivery strategies, and to write and produce instruction. E-mail was the medium used most frequently for interaction. About half of those surveyed believed the existing instructional-design models were not appropriate for designing and developing Web-based instruction [24]. This information may help to explain data collected by Sklar in his examination of CME sites, in which he found that of the 96 CME sites available in February 2000, 28% contained text only, and 38% contained text and graphics. Only 17% of the sites were interactive, and 7% were guideline based. Sklar noted that most online CME offerings do not make use of unique computer capabilities to offer multiple pathways to learning and interactive responses [4].

In considering the appropriate theoretical context for the design of an intervention to improve physician performance in screening for chlamydia, we drew on the work of cognitive theorists, specifically work on the processes of assimilation and accommodation, and on stages of learner's development and readiness for learning. Because of its direct application to problem solving, we also used cognitive theoretical frameworks that suggest the learner control the sequence and pace of instruction, and that the instruction be individualized to participant needs.

CME Interventions: Evidence of Effectiveness

As early as the 1970s, evidence suggested that traditional CME programming was not effective in facilitating changes in physician performance and changes in patient-health outcomes [25- 28]. Since that time, many well-designed research studies have only increased the evidence that traditional didactic teaching is not the most-effective method for influencing physician performance or patient-health outcomes [6,7,28- 32]. Many studies have demonstrated that CME conferences have little impact on improving professional practice or on improving patient-health outcomes. Didactic CME courses have also had weak effects on guideline adoption [5]. Interventions such as educational-outreach visits and patient-educational materials were more likely to improve physician performance and patient-health outcomes compared to single, episodic didactic sessions [5- 7].

Most recently, Davis and colleagues summarized the results of 14 randomized, controlled trials of physician education conducted between 1993 and January 1999, concluding, from this review at least, that didactic teaching sessions do not appear to be effective in changing physician performance [33]. There is evidence here that interactivity and sequencing of events (eg, 2 sessions held 1 month apart) increases learning effectiveness. Data from this study suggest that adding adequate needs assessments prior to the course, and/or adding enabling materials, such as patient-education materials or flow charts, to the material distributed during the course can improve course outcomes [33]. Peloso and Stakiw note that the ability to change practice is enhanced if the information presented is supported by published evidence, if the changes are endorsed by opinion leaders, and if there is opportunity for practice and feedback [34].

Across various reviews examining the effectiveness of interventions aimed at influencing physician behavior, the use of multiple interventions has been more successful than the use of a single episodic intervention [7,30,34- 36]. Hulscher and colleagues focused specifically on reviewing 55 studies involving more than 2000 health professionals and 99000 people; each of these trials tested interventions designed to improve prevention in primary care [37]. Evidence did not support the use of any specific strategy as the most-effective intervention to improve preventive practices in primary care. Reviewers concluded that tailoring interventions to address specific barriers to change in a particular setting is probably important, and that the effectiveness of multifaceted interventions over single interventions may be attributed, at least in part, to being able to address more barriers to change [37].

Others have used feedback to providers as an intervention to improve physician performance-with the assumption that knowledge of one's own performance, together with the ability to compare this performance against some reference level

(internal or external) will facilitate improvement [38- 42]. In a review of 37 randomized, controlled trials of audit and feedback that included 4977 physicians, 28 studies measured physician performance, 1 study measured patient-health outcomes, and 8 studies measured both [37]. In 4 trials of audit and feedback versus no intervention, prescribing practices changed significantly. In 10 of 15 trials using audit and feedback plus educational materials or meetings versus no intervention, statistically-significant changes as a result of audit and feedback were demonstrated [37]. In 6 of 11 studies that included audit and feedback as part of a multifaceted intervention, there were significant improvements in physician performance; 1 of 2 studies measuring patient outcomes showed significant improvement in patient outcomes [37]. The results from the meta-analyses lead our research group to conclude that audit and feedback methods may contribute to change in physician behavior.

Based on a MEDLINE literature search from June 2000 through June 2002, there have not yet been enough rigorous trials to determine the effectiveness of Web-based courses in improving physician performance and patient-health outcomes, therefore, meta-analyses have not been conducted. However, from the evidence of effectiveness in other reviews [5,6,27- 37,43] we have drawn the following design principles for our chlamydia Web-based intervention.

Design Principles

We abstracted the following Web-design principles for physician-education Web sites from learning and change theories, as well as from the evidence of what works in continuing medical education:

- Office-practice data as needs assessment
- Multimodal strategies
- A series of modules rather than one single, episodic educational event
- Contextual learning in the form of clinical cases
- Tailoring based on individual responses
- Interactivity
- Audit and feedback
- Evidence-based content
- Credibility of the organization providing the Web site and instruction and of any agency providing grant support for the education or site
- Patient-education materials
- Ease of use of the site and ease of navigation
- Design for the "lowest technological denominator" in hardware.

Evaluation of the Effectiveness of Online Courses

Although the Cochrane Collaborative has produced overall reviews of the effectiveness of CME interventions, audit and feedback, live conferences, and academic detailing, there has been too little overall evaluation using randomized, controlled trials of online-course interventions to produce a review of their effectiveness. Individual studies have tended to be descriptive and have focused on participant reactions rather than improvements in physician performance and changes in patient-health outcomes. For example, a descriptive study of online interactive pathology case studies details the interactive format of CME cases that allow participants to submit immediate comments or criticism to case authors and to receive immediate feedback on their own performance; these features are normally unavailable in traditional CME courses. The evaluators note that the dynamic environment of the Web allows development of flexible forms of CME for the physician [44].

A descriptive evaluation of a hybrid delivery system was conducted [45]. The system merged Web documents, multimedia including CD-ROMs, and asynchronous learning communications to enable self-paced instruction and collaborative learning. The course was effective in increasing knowledge (P= .05) and in improving self-reported competency (P= .05) in dermatologic office procedures. Participant satisfaction was high with self-paced instruction as well as with sharing information with colleagues.

A Web-based tutorial system was compared to a print tutorial system with residents for the management of care following acute myocardial infarction. Immediate post-test scores were similar in both groups, but Web users spent less time studying, producing greater learning efficiency (P= .04). Web users were more satisfied with the learning experience (P= .001). Knowledge decreased to the same extent in both groups at 4 to 6 months following the instruction. Authors commented that further research is needed to identify instructional features that motivate greater final learning and retention [46].

Examining the same Web-based system used with residents for the management of care following acute myocardial infarction, on average, users accessed less than half of the guideline passages and little of the graphic evidence. Greater use of guideline passages was correlated with greater immediate learning, but use of graphic evidence was not. Authors commented that further research is needed to integrate clinical-trial evidence with guideline-based education [46].

A pilot evaluation of a Web-based curriculum reviewed occupational and environmental health or medicine components of 2 undergraduate degree courses and 2 postgraduate courses including interactive components; 12 students achieved the main learning objectives. Participants valued the flexibility, timeliness, efficiency, and breadth of access to relevant information offered by the Web [47].

Most Web-based materials have not been subjected to external assessment for quality. An online questionnaire was developed covering general suitability, local suitability, user interface, educational style, and a general review-and was piloted in 3 subject areas: general chemistry, radiology, and medical physics, focusing on undergraduate teaching. The evaluation methodology was found to work well for highly-structured and formal content and may have value in helping those developing undergraduate curricula to identify appropriate Web-based materials for integration into the curricula [48].

While these studies are useful as formative evaluations of Web courses, rigorous summative evaluations are needed. Ward notes that the Web provides powerful tools for learning medical education and will alter how the discipline is taught; for the drive to incorporate such technologies threatens to outstrip an

overall understanding of how they can be used most effectively [22]. To avoid this, educational design must be sound and evaluation including cost-effectiveness must be rigorous [22].

Methods

Chlamydia Screening Web-Based Intervention Design

In collaboration with a large national health maintenance organization, a needs assessment of current practice patterns related to screening for chlamydia was conducted on a national sample of physicians from 16 states. A series of three 1-hour Web modules was designed to increase primary-care physician screening rates in the population of women ages 16 to 26 years. A physician was identified as eligible for participation if the physician's office participated in a specific health plan, if the physician's office had at least 10 sexually-active patients between the ages of 16 and 26 years, and if the physician had Internet and e-mail access. Physicians were recruited to participate by fax and FedEx communications. Physicians were notified of the online availability of each module by e-mail announcements as well as a series of e-mail reminders, all containing the link to the modules within the e-mail messages. The program invitation was received by 3067 physicians. Upon complete login, physicians were randomly assigned to either the intervention arm or the control arm of the study.

Adequate Needs Assessment

Baseline data demonstrated an average chlamydial screening rate of less than 20%, with the lowest rates in the group of sexually-active young women ages 21 to 26 years and higher rates in the 16 to 20 year-old group. Screening rates and the process used to abstract them from administrative data have previously been reviewed (Ray M, et al. Unpublished data, 2001).

Multimodal Intervention

Based on the evidence that single CME events are unlikely to improve physician performance and enhance patient-health outcomes, and evidence of the "decay effect" (a reduction of effect over time) of interventions, we used a series of 3 modules rather than 1. To enhance our theoretical chances of effect, each module would use a multimodal approach. Each module included the following components:

- Today's cases: vignette series of primary care cases of young women 16-26 years of age
- My screening data: audit and feedback at the office level of chlamydia screening data
- Help for my office: patient brochures and physician screening guidelines.

Figure 1 displays the course home page of the first module of the chlamydia intervention.

Figure 1. Chlamydia module I course home page

Problem-Based Learning

The section titled "Today's cases" was developed based: (1) on studies demonstrating that physician information seeking on the Web is most-frequently connected to searching for information related to a specific patient problem and (2) on adult learning principles that focus on the relevance of instruction to an adult's work and life. Theoretical constructs from problem-based learning and from situated learning theory are central to this design in creating an authentic contextual process through the use of cases and in putting the learner at the center of the learning processes. The Schoen cyclical model of action, breakdown, and reflection was selected as the central focus of the chlamydia intervention. This parallels a physician's motivation to seek information for purposes of patient problem-solving [19]. Each module includes one unfolding case, as well as a series of brief vignettes. The unfolding case at the beginning of each module allows physicians to obtain information on the patient's history, physical exam, and tests; learners are then asked questions concerning diagnosis and management of the presented patient.

Tailored Interactive Responses

More prominently featured in earlier forms of behavioral theory-based computer-assisted instruction, tailoring and branching of responses to meet individual needs has not been broadly applied to the development of Web-based instruction. Modules were developed with individualized responses to multiple case-based and practice-based questions, leading to over 300 possible permutations of pathways throughout individualized modules. Using methods reported by Kreuter et al [49], tailoring of responses is transparent to the user and occurs in real time as the physician accesses the program.

In addition to physician case responses as a means of tailoring and remediation, we used the theoretical constructs related to stages of change to develop tailored pathways throughout the modules. A series of attributes were attributed to various stages of change. For example, if a learner considered the overall prevalence of chlamydia to be less than 1% or if the learner did not take sexual histories, he or she would be categorized as precontemplative and branched to pathways designed to heighten awareness of the growing prevalence of chlamydia or the importance of taking a sexual history. If, however, the learner demonstrated skill in taking a sexual history and reported updating sexual histories at each visit with young female patients, the learner would be branched to pathways designed to reinforce current skills and evidence that supports the need to continue to focus on these activities [49].
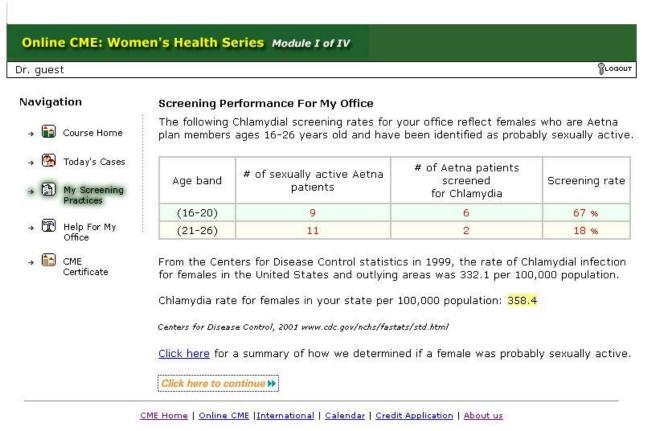
Dick and Carey have noted the frequent lack of emphasis in instructional design on practice and rehearsal of skills, resulting in a lack of transference of skills into practice [23]. Using the reflection on practice described by Anderson et al [50], participant responses to case questions in the chlamydia intervention, are graphed-so the learner can compare his or her response to that of other participants-and responses are followed by expert comment from the faculty based on current evidence and guidelines.

Audit and Feedback

The collaboration of a university medical center with a large national health maintenance organization has significantly enhanced the development of this Web-based intervention in several ways. First, administrative data provided a solid basis for needs assessment, as well as baseline measurement of physician performance in chlamydia screening, by identifying sexually-active women between the ages of 16 and 26 years. Second, a list of physicians was linked to patients as the primary care providers for these patients for the purposes of intervention. Administrative data can then be used to provide data, following the intervention, on its effectiveness. For the purposes of the intervention itself, data at the individual office level, as well as the regional level, could be provided to participants in the Web intervention. Using a Structured Query Language (SQL) database server and participant log-on criteria, each participant was able to access office-level data as a means of audit and feedback. A depiction of "Screening performance for my office" is in Figure 2.

Figure 2. Chlamydia module I "screening performance for my office" page

Initial data demonstrated that this page was the most-frequently visited page. In the evaluation survey, this module element was cited as the most useful.

Supporting Published Evidence

Core messages were developed based on a new set of guidelines developed by the US Preventive Task Force [51], as well as focus groups with clinical experts. Focus group discussions included a pediatrician, a general internist, and 2 infectious disease specialists. Three main points were stressed in each of the 3 modules:

- Sexually-active women between the ages of 16 and 26 years are at highest risk for chlamydial infections that can lead to pelvic inflammatory disease, increased risk of HIV infection, and infertility.
- New urine-based testing allows screening for chlamydial infection without a pelvic examination.
- Chlamydial infections can be effectively treated with a 1-dose antibiotic, increasing the likelihood of adherence to treatment [51].

Case answers were supported by evidence from the literature and were referenced to provide physicians with additional sources of information.

Enabling Materials

In the section labeled "Help for my office" the following materials have been included to support the physician in translating new knowledge and skills into the practice environment:

- Patient education brochures on sexually transmitted diseases (STDs) and chlamydia, including Spanish and English versions
- Brief summary of physician guidelines
- Access to full text of new screening guidelines
- Confidentiality policy regarding disclosure of teen information to parents.

Results

Preliminary Evaluation Data

In the formative evaluation of the first 2 chlamydia modules, data regarding the recruitment, enrollment, participation, and reminders have been examined. From the initial recruitment period (February 1, 2002, through October 2, 2002) there were 3067 primary care physicians in 1045 offices that received fax materials recruiting their participation. Of those, 463 physicians registered by fax for the course and provided their e-mail addresses. Although 210 physicians logged on, only 180 physicians completed the first module. Among the physicians completing the module, 92 were randomly assigned at the time

of log on to the intervention group and 89 to the control group. The second module was completed by 134 physicians. For the third and forth modules, 96 and 61 physicians participated, respectively.

Physicians were asked to assess the usefulness of particular course elements: cases, screening information, "My screening practices," and "Help for my office." Table 1 displays physician perceptions of usefulness corresponding to the aforementioned course elements included in the first 3 modules. Cases and screening information were found to be most useful across the first 3 modules.

Table 1. Intervention physician perceptions of "usefulness" of course elements

Usefulness of:	Module I	Module II	Module III	Module IV
Cases	41	31	31	NA*
Screening information	41	22	7	NA
My screening practices	5	7	3	NA
Help for my office	2	3	0	NA

* NA = Not Available

Chlamydia knowledge, attitudes, and skills of intervention physicians and control physicians were measured and compared following the intervention. A 21-item post-test was conducted following participation in the fourth module. The mean number of correct responses was calculated for each group. The mean number of correct answers to the content questions collected from module IV demonstrates a significant difference between physicians in the intervention and control groups. The control-group mean score of correct answers was 78.3 compared to 93.0 for the intervention group. A paired t test calculation determined the difference to be statistically significant at an alpha level of .0003.

We are conducting a further evaluation of the chlamydia screening Web-based intervention design. Additional outcomes are the differential improvement in screening rates of the 2 study arms as ascertained from administrative data. Patient-level multivariable analyses will adjust for the extrabinomial variation resulting from patients being nested within physician offices from the group randomized design. Screening rates from the calendar year of 2001 will be compared with those from 2002 to determine both within-group and between-group differences.

Analyses are scheduled to be complete by the end of 2003. Two other evaluation studies of this intervention have been initiated; the intervention is being adapted to a project designed to improve the diagnosis and management of glucocorticoid-induced osteoporosis and a second project with the goal of increasing the adoption of multiple secondary prevention guidelines for the post myocardial infarction patient.

Discussion

While traditional instructional design models have been applied to the creation and development of Web activities, the failure to apply cognitive learning theory to Web design creates a challenge for those developing Web-based instruction for physicians. The need for rigorous evaluation of Web-based interventions has been well documented but has yet to produce enough evidence to create a performance benchmark. Application of theory and rigorous evaluation will be crucial over the next decade to those who wish to use the Web to influence physician performance and the quality of medical care.

Acknowledgments

Conflicts of Interest

None declared.

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Original Paper

Use and Utility of Web-Based Residency Program Information: A Survey of Residency Applicants

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Abstract

Background: The Internet has become essential to the residency application process. In recent years, applicants and residency programs have used the Internet-based tools of the National Residency Matching Program (NRMP, the Match) and the Electronic Residency Application Service (ERAS) to process and manage application and Match information. In addition, many residency programs have moved their recruitment information from printed brochures to Web sites. Despite this change, little is known about how applicants use residency program Web sites and what constitutes optimal residency Web site content, information that is critical to developing and maintaining such sites.

Objective: To study the use and perceived utility of Web-based residency program information by surveying applicants to an internal medicine program.

Methods: Our sample population was the applicants to the Oregon Health & Science University Internal Medicine Residency Program who were invited for an interview. We solicited participation using the group e-mail feature available through the Electronic Residency Application Service Post-Office application. To minimize the possibility for biased responses, the study was confined to the period between submission of National Residency Matching Program rank-order lists and release of Match results. Applicants could respond using an anonymous Web-based form or by reply to the e-mail solicitation. We tabulated responses, calculated percentages for each, and performed a qualitative analysis of comments.

Results: Of the 431 potential participants, 218 responded (51%) during the study period. Ninety-nine percent reported comfort browsing the Web; 52% accessed the Web primarily from home. Sixty-nine percent learned about residency Web sites primarily from residency-specific directories while 19% relied on general directories. Eighty percent found these sites helpful when deciding where to apply, 69% when deciding where to interview, and 36% when deciding how to rank order programs for the Match. Forty-nine percent found sites most useful in deciding where to apply, while 40% found them most useful while preparing for their interviews. Seventy-two percent felt that a "complete" Web site could substitute for a mailed printed brochure. Qualitative analysis identified additional important information needs.

Conclusions: Applicants are turning to residency Web sites for information during critical phases of the application process. Though usually helpful, many of these sites are felt to be incomplete and may not be meeting important applicant information needs. These findings should be useful to those involved in residency recruitment efforts and in counseling applicants.

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Introduction

The Internet has dramatically changed the residency application process. The process, which used to rely exclusively on the exchange of printed materials between applicants and residency programs, has become largely Web-based.
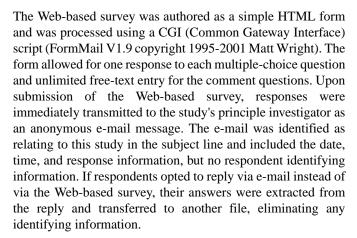
Starting in 1995, applicants participating in the National Residency Matching Program (NRMP) have used the Electronic Residency Application Service (ERAS) to complete and submit their residency applications, initially via Dean's Office Workstations and currently via a Web-based system (MyERAS). Similarly, applicants and programs submit and receive their Match information via the NRMP's Web-based system. In addition to its growing role in the management of the application and matching process, the Web is changing another significant aspect of the application process: the distribution of residency program information.

Little is known about how applicants currently obtain and use residency program information. In the pre-Web era, the principle sources of such information were printed brochures and the AMA-FREIDA (American Medical Association-Fellowship and Residency Electronic Interactive Database Access) database [1]. With the advent of the Web, residency programs began to place their program information on Web sites, and many ceased to provide printed materials [2,3]. Despite this, a recent MEDLINE/PubMed search identified only one other study that evaluated the usefulness of these sites to applicants [4]. To better understand how applicants use residency Web sites and what information would be most helpful to them as they progress through the application process, we studied the use and utility of Web-based residency program information by surveying applicants to an internal medicine program.

Methods

Our sample population consisted of the 431 applicants to the Oregon Health & Science University Internal Medicine Residency Program who were invited for an interview. To minimize the potential for bias due to participants' perception that their responses might influence their NRMP rank by the residency program, we conducted the survey during an 18-day interval between the deadline for submission of NRMP rank-order lists and the date that the NRMP results were released.

We developed a survey containing a series of multiple-choice and free-text-entry questions and conducted it via the Internet. There were two reasons for conducting the survey using an Internet-based method. First, we knew that all subjects were e-mail and Web users as this was a requirement of engaging in the NRMP application process. Second, by conducting the survey via the Internet, we assured data collection precisely during the defined narrow window of time referred to above, a feat that would have been impossible using a traditional mail survey. Considering the preferences or limitations of Internet-based survey participants, we provided the option of responding to the survey via e-mail or via the Web in the hope of maximizing responses [5].

The Web-based survey was authored as a simple HTML form and was processed using a CGI (Common Gateway Interface) script (FormMail V1.9 copyright 1995-2001 Matt Wright). The form allowed for one response to each multiple-choice question and unlimited free-text entry for the comment questions. Upon submission of the Web-based survey, responses were immediately transmitted to the study's principle investigator as an anonymous e-mail message. The e-mail was identified as relating to this study in the subject line and included the date, time, and response information, but no respondent identifying information. If respondents opted to reply via e-mail instead of via the Web-based survey, their answers were extracted from the reply and transferred to another file, eliminating any identifying information.

Before deploying the survey, we solicited feedback from current residents at our program. We also tested the Web page's display characteristics and functionality using various computer operating systems (Microsoft Windows 95, 98, NT; and Mac OS 8.6, 9.0), Web browsers (Microsoft Internet Explorer 4.0, Netscape Communicator 4.5), and types of Internet access (modem dial-up, cable-modem broadband, high-speed local area network). The pilot tests did not uncover any technical problems, and reviewers reported that the survey and its instructions were clear and easy to use.

As is the case with all applicants to accredited US internal medicine residency programs, our sample population used the ERAS system throughout the NRMP application process. We used the group e-mail feature in the ERAS Post Office system to send the selected applicants an e-mail message. The message included a brief explanation of the survey's purpose, a request to take part in the survey, an assurance of anonymity, instructions describing the two ways participants could respond, and the survey itself. Respondents could either follow the included hyperlink to a Web-based version of the survey or they could reply to the e-mail message with their answers typed alongside the survey questions.

The initial e-mail message was sent on March 5, 2001, and two follow-up messages were sent to all subjects during the study period. On March 22, 2001, the day residency match results were released, we removed the survey from the Web site and ignored any subsequent e-mail replies received.

Survey responses were transferred to a spreadsheet (Microsoft Excel) for tabulation and we calculated percentages for each response based on the total number of responses to each question. Two of the study's investigators performed a qualitative analysis of the free text comments, assigning each comment to a category. A third reviewer resolved any discrepancies.

Results

Table 1 describes the characteristics of those invited to interview and participate in the study compared to the national cohort of applicants who applied through ERAS to internal medicine residency programs (Teresa Bay, AAMC-Association of American Medical Colleges-personal communication, 2001). Of the 431 potential subjects contacted, 218 responded to the

survey (51%). Eighty-nine percent of our participants responded through the Web-based survey while the other 11% responded directly by e-mail. The majority of applicants to our institution were US citizens, mostly from US schools, evenly split between males and females. Thirty-eight percent of our invited applicants were from western states (165/431). On the national level, applicants to internal medicine residency programs included more international applicants (54%), a male to female predominance (59% vs 41%) and a larger percentage of applicants from the US Northeast.

Table 1. Internal medicine applicant demographics

	Study Population	National ERAS Population
Gender	216 (50.1%)	9353 (59.3%)
Male	215 (49.9%)	6422 (40.7%)
Female		
Citizenship	412 (95.6%)	9040 (57.1%)
US citizen	7 (1.6%)	3442 (21.7%)
Foreign national	11 (2.6%)	3075 (19.4%)
Permanent resident	1 (0.2%)	275 (1.7%)
Conditional permanent		
Medical school type	271 (62.9%)	3536 (22.3%)
US public	151 (35.0%)	3004 (19.0%)
US private	2 (0.5%)	47 (0.3%)
Canadian	3 (0.7%)	605 (3.8%)
Osteopathic	0 (0.0%)	58 (0.4%)
Fifth Pathway	4 (0.9%)	8582 (54.2%)
International		
Home regions	165 (38.3%)	662 (4.2%)
West	98 (22.7%)	1505 (9.5%)
Midwest	85 (19.7%)	3388 (21.5%)
South	72 (16.7%)	5022 (31.8%)
Northeast	3 (0.7%)	41 (0.3%)
Quebec	8 (0.2%)	
None listed		

Survey responses are summarized in Table 2. There were no notable differences in the responses of those replying via the Web versus those replying via e-mail. Most respondents were very comfortable browsing the Web (85.6%). The majority of respondents (78.1%) reported conducting at least some of their Web browsing from home while a substantial minority (20.9%) accessed the Web primarily from school/hospital. Of the applicants, 68.7% learned about residency program Web sites from residency specific directories like those found on organizational Web sites or AMA-FREIDA, while 18.9% discovered them using general Web directories. Only 4.1% of the participants learned of residency Web sites directly from the residency programs and 6.4% from colleagues or resources at their schools.

A majority of respondents found the Web sites helpful in deciding where to apply (79.6%) and where to interview (68.5%), and a substantial minority (35.8%) found them useful when rank-ordering programs for the NRMP Match. Web sites were most helpful in deciding where to apply (48.8%) and in preparing for the visit/interview (39.6%). About half of the respondents found a mailed program brochure unnecessary if the program had what was described simply as a "complete" Web site. An additional 21.3% indicated no need for a mailed brochure if the Web site provided a printable version of their program information. Of the respondents, 28.3% considered most (76%-100%) of the residency programs to have a "complete" Web site, while 25.4% reported that 50% or fewer Web sites were "complete."

Table 3 summarizes the information applicants would like to see added to residency Web sites, based on a qualitative analysis of their comments. Major information needs included: schedule information, career/fellowship placement, resident information, benefits information, contact information, and city information.

Comments included this typical quote from a respondent who reported wanting, "just all the details residency schedules, vacation times, information about their interview and ranking process. The nuts-and-bolts. It's frustrating when you can find some but not all of those basic details which are scattered on 15 pages." Another wrote, "more information regarding typical intern schedules, policy on admission caps, research, bench and clinical."

Table 2. Residency Web site survey responses

Survey Questions	Response	Percentages
1. How comfortable are you at browsing the World Wide Web?	Very	85.6%
	Somewhat	13.4%
	Uncomfortable	0.9%
2. From where do you usually access the Web?	Home	52.1%
	School/Hospital	20.9%
	Equal home/school	26.0%
	Other	0.9%
"3. How did you most commonly learn about residency programs" Web sites?	Colleagues/School resources	5.9%
	General Web directory/search engines	18.9%
	Residency/Medicine directories	68.7%
	Information from residency programs	4.1%
	Other	2.3%
4. Did you find the residency program Web sites helpful when deciding where to apply?	Yes	79.6%
	No	20.4%
5. Did you find the residency program Web sites helpful when deciding where to interview?	Yes	68.5%
	No	31.5%
6. Did you find the residency program Web sites helpful when deciding how to rank-order programs in the "Match"?	Yes	35.8%
	No	64.1%
7. At what point in the application process did you find program Web sites most useful?	""Deciding where to apply	48.8%
	Deciding where to interview	6.9%
	Preparing for visit/interview	39.6%
	Deciding rank-order for the "Match"	3.2%
	Other	1.4%
8. If a program has a "complete" Web site, do you feel that an additional printed brochure is necessary?	Printing from web site adequate	21.3%
	Mailed printed brochure	28.2%
	Complete web site sufficient	50.5%
9. Of the residency programs to which you applied, how many had "complete" Web sites?	1%-25% of residency Web sites	4.2%
	26%-50% of residency Web sites	21.2%
	51%-75% of residency Web sites	46.2%
	76%-100% of residency Web sites	28.3%

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Table 3. Qualitative analysis of respondent comments to the question: "What kind of information would you like to see added to residency program Web sites, in general?"

Comments	Number of Responses
1. Schedule information/schedule access	34
2. Career/fellowship placement	19
3. Resident information (medical school, biographical, etc)	19
4. Residency benefits information	11
5. Residency contact information (program, residents, faculty, interviewer)	11
6. City information (general info, housing, cost of living)	11
7. Research information	6
8. Residency elective information	6
9. Program vision/goals (philosophy)	4
10. Unique program features	4
11. Testimonials (resident, faculty)	4
12. Board pass rate	3
13. Differentiation primary care/categorical	3
14. Rotation/medical service details	3
15. Hospital information	3
16. Faculty profiles	3
17. Frequently asked questions/answers	3
18. Photos of facility/personnel	2
19. Area jobs information	2
20. Printable program information	2
21. Detailed map of campus/directions	2
22. Conference information	2
23. Workload/cap information	2
24. Optimizing Web site design/organization	2
25. Access to actual program information resources	1
26. Detailed application information	1
27. Details of interview/ranking process	1
28. FREIDA-like information	1

Discussion

Residency applicants and programs are increasingly using the World Wide Web for information gathering and dissemination during the residency application process. Until now, there has been little data available in the published literature to inform those developing residency program Web sites about the needs and usage patterns of prospective residency applicants. These findings offer some insight into how applicants use these sites and what they expect from them, information that should be useful to those engaged in applicant counseling and recruitment efforts.

As part of the application process, all applicants must use the Internet, so it is not surprising that most respondents to our survey were very comfortable browsing the Web. Our finding that most applicants primarily browse the Web from home

should be taken into consideration by residency programs as they design content for their Web sites. While applicants' home connection speeds will likely improve as more households adopt faster broadband Internet connections, most are likely still accessing the Web via slower dial-up modem connections and may therefore be limited in the size of data files that can be efficiently downloaded and viewed [6].

These findings also provide insight into how applicants learn about program Web sites. While most relied on residency and specialty-specific directories, a significant minority used general Web directories and search engines. This suggests that residency programs can maximize the likelihood that prospective applicants will discover their Web site by listing and keeping updated links to their sites on such Web-based directories and search engines.

Once applicants reach residency Web sites, they use the sites to varying degrees during virtually every stage in the application process, from initial consideration of programs to creation of rank-order lists. Respondents found the sites most useful when deciding where to apply and when preparing for program visits; considering what information is pertinent to those aspects of the application process may help programs determine the Web site content to enhance.

As residency programs move toward displaying their information on Web sites, many are abandoning their printed brochures for Web-only offerings [7]. This can certainly yield benefits, including cost-savings and timelier updating of content, but the consequences of moving away from traditional methods of disseminating information to prospective applicants are not fully known [2]. While our finding that most respondents felt a "complete" Web site or the ability to print program information obviated the need for a printed brochure, 28.2% still wanted to receive a printed brochure by mail. This appears to be an improvement over the 50% level noted in the other published survey of a similar population, which was conducted during the 1997-1998 interview season, a finding that may indicate that the preference for printed brochures is declining over time [4]. Nevertheless, some programs may wish to consider these findings as they contemplate whether to abandon printed brochures.

While the meaning of Web site "completeness" remains ill defined, fewer than one third of respondents perceived most (76%-100%) residency Websites to be "complete." This reinforces the observation noted by other researchers that residency Web sites vary widely in their content and thus usefulness, and suggests that Web site content managers should consider enhancing their online residency information offerings [7].

Providing optimally-useful information on residency Web sites requires an understanding of applicants' information needs. Our qualitative analysis helps illuminate what applicants perceive to be their current unmet information needs on such sites. Their comments focused on a range of academic, financial, career, and personal information, further reinforcing the contention that, while certainly helpful, residency Web sites on the whole still have room to improve in meeting applicants' information needs.

As noted above, our literature review identified only one other study that attempted to assess how residency applicants access or utilize information at any stage of the application process [4]. The current study's findings improve our understanding of this area, but this is clearly an area in need of further research given the remaining unanswered questions, the dynamic nature of the Web, and the impacts that such shifts in information exchange can have on a process as important as residency selection and recruitment.

Our study has limitations. First, it was limited to the invited applicants of one specialty program. Our population differed from the national cohort in that there were far fewer international graduates and a greater percentage of our invited applicants were from the western United States. Second, because we elected to use an anonymous response strategy, we cannot determine if responders differed from nonresponders. Third, because we used e-mail and a Web-based survey, it is possible that we selected for a population more favorably inclined toward use of electronic resources.

Conclusions

Residency applicants and programs increasingly rely on the Web to gather and receive information during the application process. Little data has been available in the published literature to inform those managing residency Web sites about the needs and usage patterns of applicants. While further study in this area is needed, these findings provide much needed insight into how applicants use these sites and what they expect from them, information that should be considered by those engaged in residency promotion and recruitment efforts.

Conflicts of Interest

None declared.

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Abbreviations

AMA: American Medical Association
ERAS: Electronic Residency Application Service
FREIDA: Fellowship and Residency Electronic Interactive Database Access
NRMP: National Residency Matching Program

Trusted Online Sources of Health Information: Differences in Demographics, Health Beliefs, and Health-Information Orientation

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Abstract

Background: The recent surge in online health information and consumer use of such information has led to expert speculations and prescriptions about the credibility of health information on the World Wide Web. In spite of the growing concern over online health information sources, existing research reveals a lacuna in the realm of consumer evaluations of trustworthiness of different health information sources on the Internet.

Objective: This study examines consumer evaluation of sources of health information on the World Wide Web, comparing the demographic, attitudinal, and cognitive differences between individuals that most trust a particular source of information and individuals that do not trust the specific source of health information. Comparisons are made across a variety of sources.

Methods: The Porter Novelli HealthStyles database, collected annually since 1995, is based on the results of nationally-representative postal-mail surveys. In 1999, 2636 respondents provided usable data for the HealthStyles database. Independent sample t tests were conducted to compare the respondents in the realm of demographic, attitudinal, and cognitive variables.

Results: The most trusted sources of online health information included the personal doctor, medical university, and federal government. The results demonstrated significant differences in demographic and health-oriented variables when respondents who trusted a particular online source were compared with respondents that did not trust the source, suggesting the need for a segmented approach to research and application. Individuals trusting the local doctor were younger ($t_{2634}= 4.02$, $P< .001$) and held stronger health beliefs ($F_1= 5.65$, $P= .018$); individuals trusting the local hospital were less educated ($t_{2634}= 3.83$, $P< .001$), low health information oriented ($F_1= 6.41$, $P= .011$), and held weaker health beliefs ($F_1= 5.56$, $P= .018$). Respondents with greater trust in health insurance companies as online health information sources were less educated ($t_{2634}= 1.90$, $P= .05$) and less health information oriented ($F_1= 4.30$, $P= .04$). Trust in medical universities was positively associated with education ($t_{2634}= 11.83$, $P< .001$), income ($t_{2634}= 10.19$, $P< .001$), and health information orientation ($F_1= 10.32$, $P<.001$). Similar results were observed in the realm of federal information credibility, with individuals with greater trust in federal sources being more educated ($t_{2634}= 7.45$, $P< .001$) and health information oriented ($F_1= 4.45$, $P= .04$) than their counterparts.

Conclusions: The results suggest systematic differences in the consumer segment based on the different sources of health information trusted by the consumer. While certain sources such as the local hospital and the health insurance company might serve as credible sources of health information for the lower socioeconomic and less health-oriented consumer segment, sources such as medical universities and federal Web sites might serve as trustworthy sources for the higher socioeconomic and more health-oriented groups.
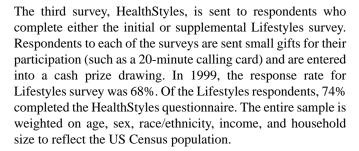
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Introduction

With the rapid explosion of the Internet, one of the critical issues raised by experts involves the credibility of health Web sites [1]. This concern relates to the extent to which consumers are getting their information from Web sites that are not qualified to provide health information [2]. Practitioners and academics argue that source credibility lies at the heart of patient decision making in a medical context [1,2]. Trustworthiness and expertise of the source are the 2 critical criteria underlying source credibility judgments [3]. A source that is not trustworthy and does not have the expertise is more likely to mislead the patient, leading to misdiagnosis and mistreatment [2,3,4]. Whereas organizations such as the Centers for Disease Control and Prevention, National Institute of Health, nationally-recognized universities, and one's local doctor might qualify as trustworthy sources of health information, the exponentially-growing access to posting information on the World Wide Web also makes it possible for information to be posted by unqualified individuals and companies trying to sell their products to the public [5,6,7]. The important questions then are: How do patients make judgments about the credibility of Web sites? What sources do they consider to be most trustworthy?

These questions, although historically raised in speculative and prescriptive articles about the effects of the Internet on patients, have recently started receiving systematic empirical attention [2, 8-12]. Although the study of experts' perceptions of patient use of medical information on the Internet [13] is a worthwhile endeavor, it does not tap into the experiences of the patient. As a consequence, the discourse about consumer health-information searches on the Internet remains limited to the realm of the medical professional, reflecting the paternalistic sentiment of modern medical practice [14,15]. Based on the articulation that studying the health care consumer is central to the scholarship of Internet health information, this paper applies a consumer-based perspective to investigate the evaluation of credibility of health information on the Internet. It uses the HealthStyles data [16] to examine the differences in demographic, attitudinal, and cognitive variables between individuals on the basis of the different Internet sources of health information that they consider to be most credible.

Methods

The Porter Novelli HealthStyles database, collected annually since 1995, is based on the results of 3 postal mail surveys. The initial survey, the DDB Needham Lifestyles survey (commissioned by DDB Needham Worldwide), is sent to a stratified random sample of approximately 5000 US adults in April of each year. The sample is generated from a panel of 500000 cooperating households that represent a range of sociodemographic characteristics. The second survey is a supplemental mailing of the Lifestyles survey to adjust the representation of particular households in the database. In 1999, the supplemental mailing was sent to 210 low-income households and 210 minority households to compensate for their lower return rates.

The third survey, HealthStyles, is sent to respondents who complete either the initial or supplemental Lifestyles survey. Respondents to each of the surveys are sent small gifts for their participation (such as a 20-minute calling card) and are entered into a cash prize drawing. In 1999, the response rate for Lifestyles survey was 68%. Of the Lifestyles respondents, 74% completed the HealthStyles questionnaire. The entire sample is weighted on age, sex, race/ethnicity, income, and household size to reflect the US Census population.

Usable data was provided by 2636 respondents. The sample was comprised of 48% men and 52% women. The mean age of the sample was 44.87 (SD = 16.71). The mean education level of the sample was 4.97 (SD = 1.29), and the mean household income of the sample was 12.59 (SD = 5.95).

Measures

Credibility of Online Health Information

To measure the credibility of the different sources of health information, the following guideline was provided: "If you had to choose only three sources of health information on the Web, which three sources would you trust the most? ("X" only three)." Categories included "personal doctor," "local hospitals," "medical universities," "insurance companies," "community health organizations," and "federal government." Responses were measured in a dichotomous "Yes/No" format.

Demographics

Age was measured by a single item that simply asked the respondent to report his/her exact age in number of years. Education was measured by a single item, "education level of respondent." The scale ranged from 1 to 7, with 1 representing "attended elementary," 2 representing "graduated from elementary," 3 representing "attended high school," 4 representing "graduated high/trade school," 5 representing "attended college," 6 representing "graduated college," and 7 representing "post-graduate school." Income was measured by a single item "household income of respondent." The responses were measured on a 1 to 21 scale.

Health Consciousness

Health consciousness was measured by 5 items: "living life in best possible health is very important to me," "eating right, exercising, and taking preventive measures will keep me healthy for life," "my health depends on how well I take care of myself," "I actively try to prevent disease and illness," and "I do everything I can to stay healthy." Responses were measured on a 1 to 5 scale with 1 representing "strongly disagree," and 5 representing "strongly agree." When subjected to a principal component analysis with Varimax rotation, a single factor was produced with an eigenvalue of 2.36 and explaining 47.24% of the variance. The Cronbach's alpha for the scale was 0.72.

Health Information Orientation

Eight items were used to measure health information orientation. The items were: "I make a point to read and watch stories about health," "I really enjoy learning about health issues," "to be and stay healthy it's critical to be informed about health issues," "the amount of health information available today makes it easier for me to take care of my health," "when I take medicine, I try

to get as much information as possible about its benefits and side effects," "I need to know about health issues so I can keep myself and my family healthy," "before making a decision about my health, I find out everything I can about this issue," and "it's important to me to be informed about health issues." Responses were measured on a 1 to 5 scale with 1 representing "strongly disagree" and 5 representing "strongly agree." A principal components factor analysis with Varimax rotation produced a single factor with an eigenvalue of 4.18. Factor loadings ranged from 0.62 to 0.82 and the factor explained 52.24% of the variance. Cronbach's alpha for the aggregated scale was 0.87.

Health-Oriented Beliefs

Health oriented beliefs were measured by 8 items. The respondents were provided the following instruction: "please rate each of the following health behaviors on a scale of 1 through 5 depending on how important you think that behavior is for your overall health." Items included "eating a diet that is low in fat," "eating lots of fruits, vegetables and grains," drinking plenty of water every day," "taking vitamins and mineral supplements regularly," "exercising regularly," "not smoking cigarettes," "not drinking alcohol or drinking in moderation," and "maintaining a healthy body weight." A principal components analysis with Varimax rotation yielded a single factor with factor loadings ranging from 0.52 to 0.77. Eigenvalue of the factor was 3.71 and it explained 46.31% of the variance. Cronbach's alpha for the aggregated scale was 0.82.

Analysis Plan

Data were analyzed in SPSS 10.00 for Windows (SPSS Inc). For the demographic comparisons of the individuals that trusted a particular source type with individuals that did not trust the source type, independent samples t tests were conducted. The reported t values for the demographic comparisons are 2-tailed. Since the health-oriented variables (health consciousness, health information orientation, and health-oriented beliefs) were correlated (Pearson's r ranging from 0.46 to 0.62), multivariate analyses of variance (MANOVA) were conducted for each source type.

Results

The personal doctor emerged to be the most trusted source of online health information, followed by the medical university

and the federal government. Of the respondents, 1548 (58.7%) reported trusting the personal doctor compared to 1088 (41.3%) respondents that did not list the primary doctor as one of the most trusted sources of health information on the Web. While 840 (31.9%) respondents documented their trust in the local hospital, 1796 (68.1%) respondents did not consider the local hospital as one of the most trusted sources of online health information. According to 1280 (48.5%) respondents, the medical university is one of the most trustworthy sources of health information on the Web compared to 1357 (51.5%) respondents who did not rate medical universities as one of the most trustworthy sources of online health information. Only 221 (8.4%) of the respondents reported considering the insurance company as one of the three most trustworthy sources of health information on the Web compared to 2415 (91.6%) respondents that did not consider the insurance company to be one of the most trustworthy sources. According to 979 (37.1%) respondents, community health organizations such as the American Cancer Society and March of Dimes were most trustworthy whereas 1657 (62.9%) respondents did not consider these sources to be among the most trustworthy. 1121 (42.5%) participants reported that they considered federal government resources such as the FDA, CDC, or NIH among the most trustworthy sources in contrast to 1516 (57.5%) individuals that did not consider the federal agencies to be trustworthy.

Participants who considered information provided by a personal doctor on the Web to be most trustworthy (mean = 43.77; SD = 16.44) were younger (t_{2634}= 4.02, P< .001) than participants who did not consider the online information provided by a personal doctor to be most trustworthy (mean = 46.42; SD = 16.97). No significant differences were observed in education and income. Furthermore, the results of the MANOVA (see Table 1) showed no significant effect of the trustworthiness of the personal doctor on health-oriented beliefs and attitudes (Wilk's = 1.00, F = 1.92, P= .12). Individuals who trusted online information provided by their local doctor (mean = 4.16; SD = 0.69) were more likely to hold stronger health beliefs as compared to those individuals that did not trust the online information provided by their personal doctor (mean = 4.09; SD = 0.68).

Table 1. Relationship between health-oriented variables and personal doctor as a trustworthy source

Variable	F	df	P	2
Health attitude	1.38	1	.241	0.001
Health belief	5.65	1	.018	0.002
Health information orientation	1.87	1	.171	0.001

Local hospitals often provide their information through Web sites. To what extent does local hospital trust as an online information resource vary with sociodemographics? Participants that trusted the local hospital as a Web resource were typically less educated (t_{2634}=3.83, P< .001) than their counterparts. They were also younger (t_{2634}=1.76, P= .08) than the respondents that did not trust the online information provided

by the local hospital. The MANOVA (see Table 2) with the health-oriented dependent variables showed a significant main effect of local hospital trustworthiness on health-orientation (Wilk's = 1.00, F = 3.24, P= .02). Individuals who trusted online information provided by their local hospital (mean = 4.12; SD = 0.72 were less likely to hold stronger health beliefs as compared to those individuals that did not trust the online

information provided by their personal doctor (mean = 4.18; SD = 0.64). They (mean = 3.66; SD = 0.76) also were less health

information oriented than their counterparts (mean = 3.74; SD = 0.71).

Table 2. Relationship between health-oriented variables and local hospital as a credible source

Variable	F	df	P	2
Health attitude	0.86	1	.35	0.001
Health belief	5.56	1	.018	0.002
Health information orientation	6.41	1	.011	0.002

Comparisons of respondents in the context of their trust in medical universities point out that those individuals who trust medical universities as credible sources of online health information are younger (t_{2634}= 4.70, P< .001), more educated (t_{2634}= 11.83, P< .001), and have higher income (t_{2634}= 10.19, P< .001) than individuals that do not consider online information from medical universities to be credible. Results of the MANOVA (see Table 3) pointed out that the trustworthiness

evaluation of the medical university had a significant main effect on health-oriented outcomes (Wilk's = 0.98, F = 14.52, P< .001). Participants with a greater degree of trust in the information provided by the medical university (mean = 4.21; SD = 0.32) held stronger health beliefs than their counterparts (mean = 4.07; SD = 0.72). Those who trusted online health information from medical universities (mean = 3.71; SD = 0.72) were also more health information orientated than their counterparts (mean = 3.65; SD = 0.73).

Table 3. Relationship between health-oriented variables and medical university as trustworthy source

Variable	F	df	P	2
Health attitude	0.06	1	.81	0.000
Health belief	25.81	1	.001< .001	0.010
Health information orientation	10.32	1	.001< .001	0.004

Insurance companies have recently ventured into the domain of providing online health information through their Web sites. Those individuals that considered insurance companies (mean = 4.81; SD = 1.18) to be most trusted sources of health information on the World Wide Web were less educated (t_{2634}= 1.90, P= .05) than the individuals that did not consider insurance

companies to be most trusted sources of health information on the World Wide Web (mean = 4.97; SD = 1.30). Results of the MANOVA) did not demonstrate a significant main effect of health-oriented variables. However, respondents who trusted health insurance companies (mean = 3.56; SD = 0.75) were less health information oriented than the respondents that did not trust the health insurance companies (mean = 3.70; SD = 0.73).

Table 4. Relationship between health-oriented variables and insurance company as a trustworthy source

Variable	F	df	P	2
Health attitude	0.11	1	.75	0.000
Health belief	0.00	1	.96	0.000
Health information orientation	4.30	1	.04	0.002

Participants reporting community health Web sites as most trusted resources were younger (t_{2634}= 8.93, P< .001), more educated (t_{2634}= 6.32, P< .001), and earned more (t_{2634}= 3.21, P< .001) than participants who did not trust community health organizations as most credible health resources. A significant main effect (Wilk's = 0.99, F = 10.36, P< .001) of community health organization trustworthiness was observed in the

MANOVA (see Table 5). Respondents who considered community health Web sites as most trusted sources (mean = 4.21; SD = 0.60) held stronger health beliefs than their counterparts (mean = 4.09; SD = 0.73). They (mean = 3.76; SD = 0.68) were also more health information oriented than respondents who did not consider community health Web sites as credible (mean = 3.64; SD = 0.75).

Table 5. Relationship between health-oriented variables and community organization as a trustworthy source

Variable	F	df	P	2
Health attitude	0.28	1	.69	0.000
Health belief	10.02	1	002	0.004
Health information orientation	18.80	1	.001< .001	0.007

Federal agencies such as the National Institute of Health, National Cancer Institute and Center for Disease Control provide a great deal of health information to the public through their Web sites. In the next section, comparisons are drawn between individuals that consider federal Web sites to be most trusted sources of health information with individuals without a great deal of trust in health information provided by federal Web sites. Respondents considering federal Web sites to be most trusted sources of online health information were younger (t_{2634} = 9.84, P< .001) and more educated (t_{2634} = 7.45, P< .001)

than respondents that did not consider federal Web sites as most trusted sources of online health information. However, no significant differences in income were observed. The MANOVA showed that the trustworthiness evaluation of a federal Web site had a significant effect on the health-oriented variables (Wilk's = 0.99, F = 6.50, P< .001). Individuals that trusted federal Web sites (mean = 3.72; SD = 0.73) were more health information oriented than individuals that did not trust federal Web sites (mean = 3.65; SD = 0.73).

Table 6. Relationship between health-oriented variables and federal government as a trustworthy source

Variable	F	df	P	2
Health attitude	2.92	1	.09	0.001
Health belief	0.10	1	.75	0.001
Health information orientation	4.45	1	.04	0.002

Discussion

A recent guest editorial in the Journal of Medical Internet Research articulated the growing need for developing an adequate understanding of the information-use strategies of the online health consumer [17]. The article suggested that current debates over the issues of online health information quality within the expert domains [18] could only be resolved by opening up the discursive space to consumer-based approaches [16,17,19]. This study applied the consumer-based approach to study the trustworthiness of different sources of online health information. The central question answered in the current paper involved differences in demographics, attitudes, cognitions, and behaviors between individuals based on their trust in different sources of health information on the Web. The results demonstrated systematic differences among the different groups of individuals that trust different sources of online health information, voicing the need for a segmentation-based perspective in the realm of application and scholarship of online health information. Online health consumers are not a homogeneous entity and should not be treated as such in studies of source credibility [20]. Instead, they should be clustered into groups, and future scholarship on source credibility should be driven by this fundamental cognizance of individual-level differences in online health information behavior.

The results suggest that the personal doctor, medical university, and federal government Web site are the 3 most trusted sources of health information on the World Wide Web. These findings provide reason to be optimistic because the trustworthiness evaluations of patients do indeed mirror the trustworthiness suggestions and prescriptions of the medical profession [2]. In spite of the increasing consumer autonomy with the advent of the Internet, the personal doctor remains one of the most trusted sources of health information in the new-media environment, suggesting that more and more doctors need to explore the Internet as a viable medium for communicating with their patients.

The systematic differences between the different groups that trust different online health information sources have far-reaching implications for consumer-targeted health information delivery. For example, the findings that the online health information provided by local hospitals and insurance companies is more likely to be trusted by the unhealthy consumer segment suggest that these sources can be used as sites for Internet-based prevention campaigns targeting to change unhealthy behaviors. Local hospitals and insurance companies might be at an advantageous position for reaching this at-risk group with information on medical treatments. Health-oriented individuals who hold strong health oriented attitudes and health beliefs and are health information oriented, on the other hand, are more likely to trust information provided by medical universities, federal agencies, and community organizations (such as the American Cancer Society), suggesting that the trustworthiness judgments of higher socioeconomic groups are more closely aligned with the assessments of trustworthiness recommended by the existing expert-based literature on credible sources of health information. This match between expert opinions and higher socioeconomic groups perhaps articulates information gaps in society such that the higher socioeconomic groups have greater access to expert opinions than their lower socioeconomic counterparts.

The study has two important limitations. First, it uses secondary data, limiting further exploration of theoretically driven questions. Second, although the sources of health information surveyed in this study constitute a large portion of the available sources of health information on the Web, the study does not tap into all the different health information sources on the World Wide Web. Especially important to study are those online information providers that are driven by profit motives and pose potential threats to patient health. Future research needs to expand the findings of this study to other domains of health information sources such as pharmaceutical companies, individuals, and private organizations such as drkoop.com.

Acknowledgments

Conflicts of Interest

None declared.

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