INNOVATIONS IN EDUCATION AND CLINICAL PRACTICE

Developing an Internet-based Communication System for Residency Training Programs

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Administrative communication is increasingly challenging for residency programs as the number of training sites expands. The Internet provides a cost-effective opportunity to address these needs. Using the World Wide Web, we developed a single, reliable, accurate, and accessible source of administrative information for residents, faculty, and staff in a multisite internal medicine residency at reduced costs. Evaluation of the effectiveness of the website was determined by tracking website use, materials and personnel costs, and resident, staff, and faculty satisfaction. Office supply and personnel costs were reduced by 89% and personnel effort by 85%. All users were highly satisfied with the web communication tool and all reported increased knowledge of program information and a greater sense of "connectedness." We conclude that an internet-based communication system that provides a single, reliable, accurate, and accessible source of information for residents, faculty, and staff can be developed with minimum resources and reduced costs.

KEY WORDS: internship and residency; graduate medical education; web-based communication; computer communication networks; Internet.

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Successful administration of residency programs requires timely, efficient, and accurate communication of information among program directors, faculty, residents, and office staff. Changes in work hours and curricula have resulted in increased complexity and size of many residency programs. Changes in affiliations between institutions and training programs have increased the number of training sites. Communicating the resulting complex schedules, program announcements, and administrative directives while maintaining cohesiveness and identity

among trainees is difficult. Training programs devote significant material, personnel, and financial resources to meeting this challenge.

Evolving computer technology makes the Internet an appealing tool for meeting administrative communication needs. Medical students, residents, faculty, and program administrators are increasingly computer literate.^{1,2} Applying to medical school and residency training programs in many specialties is now web-based and paperless.³⁻⁵ Many residency programs enhance the accessibility of their program brochure by placing it on the web, at much less cost than printed brochures.^{6,7} A survey of internal medicine residency program directors and administrators attending a workshop on web-based communication in April, 2000 at the Association of Program Directors of Internal Medicine annual meeting revealed that 99% of programs in attendance had their brochure on the web, 33% used the web to communicate with residents and faculty, and all wanted to develop or expand web-based communication resources.⁸

We developed an Internet-based residency program website that functions as a single, reliable, accurate source of information. This report describes the process used to develop our website and provides an evaluation of costs and utility.

METHODS

Setting

The Yale Primary Care Internal Medicine Residency Program is a large multicenter residency with 74 residents who rotate through 2 community hospitals in Waterbury, Connecticut (St. Mary's Hospital and Waterbury Hospital) for their general medicine ward experience and through a tertiary care referral hospital, Yale-New Haven Hospital, in New Haven, Connecticut for subspecialty training. Ambulatory medicine experiences occur in 26 different practice sites, 2 community health centers, and 2 hospital-based clinics. Elective rotations take place in any of these sites, at the West Haven Veterans Administration hospital, and/or through an International Medicine program. There are full-time faculty and a program administrative office with support staff, a program coordinator, and an associate

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program director at each hospital training site and a similarly structured administrative office for ambulatory education.

Assessment of Information Needs

We identified information needs of stakeholders (residents, faculty, and office staff) through focus groups, review of information posted on bulletin boards, and tracking of telephone calls into the program office.

One or more of the authors met separately with groups of chief residents, house staff, office staff, and faculty in focus groups. Open-ended questions were used to elicit information needs. Identified needs were compared among the focus groups and an "information goal" list generated. An administrative group consisting of the program director, associate directors, and chief residents reviewed the list and the frequency of occurrence of specific items, and made qualitative judgments about information to propose for inclusion on the website. Stakeholders reviewed a copy of the proposed list and the administrative group considered suggested revisions.

Program-specific information that was posted on bulletin boards at each training site was also reviewed. Items deemed important and not already included on the information goal list were added.

Office staff maintained telephone logs of incoming calls requesting program information for a 3-week period in May 1999. Staff recorded the category of information (e.g., schedule assignment, meeting registration, licensing exam registration information, etc.), the time required to find the information, and the method used to transmit the information to the caller (e.g., written note, page, fax, voice mail, e-mail, etc.). Information needs that had not been previously identified were added to the information goal list.

Assessment of Computer Accessibility and e-mail Use Status

Computer hardware, software, and Internet connectivity was recorded for each training site. Stakeholders were asked about computer access and use, including Internet connections and e-mail accounts. Residents without e-mail accounts were given information about how to sign up for a free commercial e-mail account (e.g., Hotmail: <http://www.hotmail.com>, Yahoo: <http://yahoo.com>) or how to purchase a university account and received 3 weekly reminders to obtain one. Thereafter, a free commercial account was assigned to those residents who had not created an account. To facilitate access to the website, we book marked the web page on computers the residents frequently used.

Website Development

Microsoft FrontPage 98 (Microsoft Corporation, Redmond, Wash) was used to develop the website. Specific training in web design or hypertext markup language (HTML) is not needed to use this or similar software

programs. The university information services (IS) department designed a blank web page using the university design standard (colors, format, university, and medical school links) to use as a template.

The university was our Internet service provider (ISP), providing space on a server (essentially a large hard drive accessible via the World Wide Web [WWW]) for the website to reside. One of the authors (KL) was designated Webmaster and given a password by the ISP to post changes to the website. Information from the 3 training sites was e-mailed to the Webmaster. Completed web pages were transferred from our office computer to the ISP's server using a shareware program entitled CuteFTP (Global-SCAPE, Inc., <http://www.cuteftp.com>), which was downloaded from the Internet. CuteFTP is a file transfer protocol (FTP) program that allows files to be uploaded and downloaded directly to a server. Microsoft FrontPage also has FTP capability, as do other website programs such as Netscape Composer (Netscape Communications Corporation, Mountain View, Calif). Information to be posted on the website was either imported into Microsoft FrontPage or saved in HTML text and posted to the website.

The university IS department created password protection to limit access to certain information posted on the website (see Table 2). For convenience, a single password was used for all authorized users.

Implementation

To ensure that all stakeholders knew how to use this new website, "rollout" sessions with mandatory attendance were held. In addition to a live demonstration of the website, stakeholders were asked to log on and explore the site, and received a reference handout. The website went "live" 1 week after the rollout sessions. Any subsequent requests for information that was electronically posted were referred to the website for answers. "Hit counters," downloaded from the WWW (e.g., <http://bravenet.com>), were used to assess website use, including which aspects of the site were accessed most frequently and when they were accessed.

Cost Analysis

Administrative communication costs without the website were compiled by reviewing costs for the preceding academic year (July 1998–June 1999). Personnel time for obtaining and responding to information requests was estimated from telephone logs, and materials costs for communication tasks (paper/copying/envelope stuffing/postage, etc.) were calculated. Administrative communication costs associated with the website were calculated for both initial website development and ongoing website maintenance. The total website development cost was calculated by estimating the costs of faculty time, staff time, software costs, and hardware costs associated with establishing the website. Ongoing maintenance costs were

calculated by estimating the costs associated with posting information concerning core program activities (e.g., schedules, policies, program curriculum), personnel costs, and software costs. Annual maintenance costs for the website were extrapolated based on data collected over the first 3 months of use. Total costs before and with the website were then compared on an annual basis.

Utility Analysis

One month after completion of the rollout sessions, we surveyed stakeholders by e-mail regarding frequency of use, satisfaction, and perceived benefits/problems with the website. Verbal feedback was also solicited at each hospital. Once again, office staff maintained logs of telephone calls requesting program information, and noted whether or not it was available on the website and the method used to transmit the information to the caller (e.g., referral to the website, written note, page, fax, voice mail, e-mail, etc.). They also recorded the time required to find information not posted on the website.

RESULTS

Information Needs

During focus group discussions, all residents identified access to their personal schedules (block, call, clinic, etc.) and program event information as their greatest information needs (Table 1). Information that was identified as a priority need by more than half of residents included: program policies, United States Medical Licensing Exam (USMLE) and American Board of Internal Medicine (ABIM) exam registration information, links to academic websites (journals, professional societies), and resident and faculty e-mail addresses.

Faculty identified similar information. Clinic directors were most interested in access to the clinic schedules. The Program Director and Associate Directors most needed access to accurate block and call schedules. Core faculty

were most interested in access to program policies, event information, and faculty and resident e-mail addresses.

Office staff identified resident schedules, program policies and events, and house staff addresses and telephone numbers as the priority information needs. Analysis of telephone-tracking logs revealed that the most frequent incoming information-related calls were from residents with questions about their schedules, upcoming events, and travel directions to new rotations and events. Outgoing calls were most often made to remind residents and faculty of upcoming events, to notify residents of schedule changes, and to schedule meetings for faculty and residents.

The most time-consuming information retrieval and notification task for office staff was communicating schedule information. This often involved contacting a chief resident or the program director to obtain an updated print copy and paging and verbally reporting the information to the resident, then sending a print copy by fax. This activity occurred on average 1 to 3 times daily, but more frequently, as often as 10 times daily, around the time of rotation switches when there had been schedule changes.

Computer Accessibility and e-mail Use Survey

One hundred percent of residents and faculty completed the computer access and use survey. Eighty-three percent of residents had a home computer, and 76% of those had Internet access at home. Fifteen percent of residents did not have an e-mail account. All residents felt they had access to computers with an Internet connection at the various training sites. All faculty had office computers with Internet access and e-mail accounts. Site visits confirmed that all training sites had adequate computer resources for residents, including Internet connectivity. There was at least 1 Internet-connected computer on each hospital ward, in the program office and resident lounge at each hospital, and in each hospital-based clinic and ambulatory practice site. All office staff had computers with Internet access and e-mail accounts.

Website Development and Implementation

Table 2 shows the information posted on our program website. The "Weekly Update" is also e-mailed to all stakeholders. There have been no difficulties accessing the website from any of the training sites, and the password protection mechanism has not posed a barrier to users. All stakeholders attended the rollout sessions, and all reported having successfully accessed the website during the first week after rollout. Hit counter data showed that residents' schedules were the most frequently visited site. The most active times were Mondays and Thursdays, each accounting for 20% of total use (schedule updates are posted on Thursdays and residents begin new rotations on Fridays).

Table 1. Residents' Priority Information Needs Identified in Focus Groups

Information Category	Percent Identifying as Important
Schedules (block, call, clinic, etc.)	100
Program event information	100
Faculty and resident e-mail addresses	90
USMLE and ABIM exam information	90
Links to journals, professional societies	80
Program policies	60
Site-specific parking information/directions	40
Links to community resources	10
Link to program brochure	10

USMLE, United States Medical Licensing Exam; ABIM, American Board of Internal Medicine.

Table 2. Information Posted on Website

Resident schedules (block, call, clinic, etc.)*
Program policies*
USMLE and ABIM exam information
Weekly Updates*
Program curriculum*
Physician licensing information
Lecture/conference schedule*
Links to community resources
Upcoming events*
Links to journals, professional societies
Faculty and resident e-mail addresses*
Link to program brochure
ACLS course information
DEA application information
Housing information*
Site-specific parking information

* Indicates password-protected information.

USMLE, United States Medical Licensing Exam; ABIM, American Board of Internal Medicine; ACLS, advanced cardiac life support; DEA, Drug Enforcement Agency.

Cost Analysis

Communication costs were calculated for both the time before the website and with the website for each of the individual communication expenses (including schedules, notifications, policies, curricula, personnel, and software), and a total annual cost was determined for each period. The total annual cost for communication before the website was \$26,400; the highest category was personnel costs at \$17,400 (Table 3). The up-front development costs for the website were estimated to be \$10,896. This included \$7,315 for 100 hours of cumulative faculty time (based on an hourly rate of \$55 per hour plus a fringe rate of 33%), \$3,341 for 200 hours of cumulative staff time (based on an hourly rate of \$13 per hour plus a fringe rate of 28.5%), \$90 for software purchases (Microsoft FrontPage, Cute FTP), and \$150 to upgrade the memory capacity of the main office computer. The ongoing annual cost of information communication was

estimated to be \$2,905 of which \$2,600 was associated with personnel costs (Table 3). Thus, a comparison of the estimated annual cost for information communication without the website was \$26,400, versus \$2,905 with the website, an 89% reduction in associated costs (total savings of \$23,495). Included in this calculation is a 17-hour per week (85%) reduction in office personnel time.

Utility Analysis

Eighty-nine percent of residents and 100% of the core faculty and office staff completed the 1-month follow-up survey. Results indicated that residents accessed the website at least once weekly, program staff accessed the website daily, and faculty accessed the site from 0 to 3 times weekly. All survey respondents reported a high degree of satisfaction with the website. One hundred percent of respondents reported no difficulty in accessing the website from work, and from home as well, for those with a home computer. Further, all respondents reported that the website met the primary objective of providing a single source of current, accurate, programmatic information. The Weekly Update was successfully e-mailed to 100% of stakeholders each week. Office staff referred residents to the website for information needs posted there. As a result, telephone logs documented that calls requesting this information fell to essentially zero over the course of the first month. In informal conversations, residents and faculty frequently noted feeling more "connected" to the residency program because of the website.

DISCUSSION

Residency training programs have taken advantage of the burgeoning Internet to meet a variety of programmatic needs including recruitment,^{6,7,9} education,¹⁰ and evaluation.¹¹

Our study demonstrates that the Internet is also an effective, cost-saving tool for developing a communication

Table 3. Communication Costs

Category	Costs Before Website, \$/y	Costs With Website, \$/y
Resident schedules*		
(block, call, clinic, ED, ambulatory, etc.; including updates)	3,000	50
Event notifications	500*	0
Program updates	500*	0
Lecture/conference schedules	1,000*	5
Program policy/handbook	2,000 (\$20/copy × 100) [†]	80 (\$20/copy × 4) [‡]
Program curriculum	2,000 (\$20/copy × 100) [†]	80 (\$20/copy × 4) [‡]
Personnel	17,400 (20 hr/week) [‡]	2,600 (3 hr/week) [‡]
Software (Microsoft FrontPage, CuteFTP)	N/A	90
Total annual cost	26,400	2,905

* Includes cost of paper, copying, envelope stuffing, and postage.

[†] Before the website, all residents, office staff, and core faculty received a printed copy. With the website, one printed copy is kept in each program office.

[‡] Assumes an hourly wage of \$13.00 and a fringe benefit rate of 28.5%.

N/A, not applicable.

and information resource for residency programs. Web page design was easy to learn and did not take significant staff time. Internet access and server space already existed and these costs were absorbed by the institutions. The savings accrued during the first year of operation (\$23,495) far exceeded the development costs of the website (\$10,896), suggesting that these costs are quickly recovered. Because ongoing costs for maintaining the website are minimal, there are significant long-term savings. In addition to financial cost savings, we have realized substantial personnel time savings, allowing us to address other program administrative duties more effectively. There also are significant unmeasured "cost savings" for all stakeholders who can now find answers to their information needs in less time and with less frustration.

We believe that the most important facets of our project were: the needs assessment, especially the focus groups; assigning e-mail accounts to residents who did not have one; the rollout sessions; referring faculty and residents with information inquiries to the website once it was developed; and the "Weekly Updates" that were e-mailed to all stakeholders and posted on the website.

The focus groups were essential to identifying information needs of the stakeholders and to achieving "buy-in" from them. They also provided a forum for discussing difficulties and frustrations with the current information exchange systems and for brainstorming how the new website could solve these problems.

Providing e-mail addresses and training sessions for residents not already using e-mail was viewed as very helpful and removed a potential barrier to using the website. This seemed particularly important for residents on very busy rotations such as the intensive care unit.

The mandatory rollout sessions assured that all users understood how to get full use out of the system and provided a forum to "celebrate" the launching of the website. The sessions generated enthusiasm and support for the initiative.

The programmatic decisions to refer stakeholders to the website for answers to information requests rather than providing the information verbally and to stop mailing web-posted information were also important. Schedules were no longer mailed or placed on bulletin boards around the program offices. This forced stakeholders to access the website for this information, thereby assuring that they always viewed current and accurate schedules. In addition, when they logged on to view the schedules, they would see important program communications that had been posted.

An unanticipated benefit of the web communication project has been an increased sense of "connectedness" among the residents and faculty. This is due to all stakeholders having ready access to important program information and announcements regardless of rotation

assignment, and also to the "Weekly Update," to which residents, faculty, and staff can contribute and which can be received by e-mail from the program office.

Future plans include adding interactive capability to the website, such as online structured forms (e.g., schedule requests) and an online evaluation system. Although adding such interactive features increases startup cost, the enhanced functionality increases long-term administrative savings and may be appealing. Residency programs without the internal expertise to add these components may be able to find affordable commercial resources.

In summary, our project demonstrates that in a large, multicenter residency program, stakeholders have frequent and recurring need for up-to-date program information, that this information is poorly disseminated by traditional means, that significant material and personnel costs are involved in assembling, updating, and distributing this information, and that a residency program website can be developed using local resources to meet program information needs at reduced overall costs and without requiring significant computer expertise. To our knowledge, no residency program has previously reported on using the Internet as a tool for virtually all administrative communication.

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