

Use of Electronic Mail in a Teaching Hospital

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Electronic mail has been in use for almost 20 years at Boston's Beth Israel Hospital and is an integral part of the clinical information system. Through a study of usage patterns during a one-week period, we found that 1247 persons sent 7482 messages to 1302 different recipients. Each category of user (attending physician, house officer, nurse, etc.) sent the most e-mail to others of the same user category. Through an electronically administered questionnaire, we found that self-reported usage patterns had a high correlation ($r=0.6$) with measured use. Sixty-six percent of respondents used e-mail daily or weekly, and 58% used it for issues of patient care; nearly all users found this useful for communicating about patient care issues. Ninety percent of respondents felt e-mail made their lives easier and 61% felt it had a humanizing influence on their lives. We conclude that the e-mail system is well-utilized by clinical personnel and felt to be useful in both patient care and non-patient care situations.

Communication in organizations may take many forms, including personal contacts, telephone calls, electronic paging devices, overhead pages, and written notes. For almost two decades the Center for Clinical Computing (CCC) system at Boston's Beth Israel Hospital has offered electronic mail (e-mail) capabilities; it was the first health care institution to do so at a time when very few organizations of any kind had this means of communication available.

Prior work has focused on e-mail's sociologic impact[1-4], its use in universities and other organizations[3,5-7], and, with the CCC system in Beth Israel and Brigham and Women's hospitals, the total number of e-mail messages sent[8-9], but to our knowledge no detailed assessment of e-mail use in health care institutions has been published. This is surprising in view of the frequent need for rapid communication in hospital care.

Boston's Beth Israel Hospital is a 502-bed major teaching hospital of Harvard Medical School. It has had an integrated hospital information system—the CCC system—since 1976[8-9]. The system provides users with access to patient information, including

demographic, financial, scheduling, admissions, medications, and laboratory data, as well as an outpatient medical record, clinical decision support, bibliographic searching, and electronic mail. Approximately 5100 persons use the computing system through about 1500 terminals and personal computers located throughout the clinical and administrative areas of the hospital. As a general measure of the system's heavy use, authorized users look up patient information more than 50,000 times per week.

When users log on to the computing system, the e-mail system alerts them to the presence of messages, and asks if the user wishes to read them (the default answer being "yes"). In addition, the user may check for new messages at any time. Messages that are sent may be received instantaneously, owing to the integrated nature of the system.

The functions of the e-mail system include sending options and disposition options. Sending options include writing a message, which may be given a title and addressed to one or more individual users, a system-wide or personal list of users, or, for supervisors, an entire system of users. Any combination of these addressing schemes may be used. Users can also send quick messages that do not have titles and are sent to one other user. If one attempts to send a message to a user who has not read his or her e-mail in more than seven days, the sender is alerted to that fact and the number of days since messages were last read. All messages are composed using a full-screen editor. An unusual feature of this e-mail system is the ability to "unsend" or retract a message that has been sent but not yet read. Other options allow the user to inquire whether and when a message has been read by the recipient, to retrieve past messages for review or editing, and to send self-reminders.

Disposition options allow the user to read new messages, to read old messages from a particular user or from a particular day, to save a message to be delivered at a future time, to save a message in a file for future reference, to print a message, to reply to a

message, to forward a message to one or more individuals with optional editing of the message, and to indicate to other recipients that the message has been taken care of. Miscellaneous options allow maintenance of mailing lists and review and deletion of messages that have been saved.

The e-mail system is also used to generate automatic messages that tell clinicians when their patients have been seen in the emergency room or have been admitted or transferred within the hospital. The system also informs users that their password has expired and activates a program that assigns new passwords.

To our knowledge, no detailed studies of e-mail use in health care institutions have been published, but in a hospital like Beth Israel, where computer terminals are ubiquitous and e-mail is used routinely, we believe that non-emergency messages involving patient care can be most efficiently conveyed through e-mail rather than through electronic paging or telephone calls.

We studied the flow of e-mail with the CCC system at Beth Israel Hospital, assessed users' attitudes towards e-mail, and studied the way in which users report that they use e-mail, especially in patient care situations. Our hypotheses were that e-mail was widely used and well-liked, especially among those involved with patient care, and that in non-emergency patient care situations, e-mail would be used more frequently than electronic paging or telephone calls.

DESIGN AND METHODS

Of the approximately 5100 authorized users of our hospital information system, 3700 are authorized to retrieve clinical information. After excluding programmers and investigators, this leaves 3660 persons, who made up our study group.

The study had two parts. The first was an observational study of all e-mail usage during a one-week period: February 23 through February 29, 1992. This was made possible by the extensive auditing capabilities of Beth Israel's information system, and was performed retrospectively to avoid a Hawthorne effect[10]. The data were tabulated both in aggregate and at the level of the individual user, although the investigators were blinded to the users' identities.

The second part of the study consisted of a questionnaire that was developed and tested on a small group of users, who evaluated it for face

validity and clarity. The focus of the 24-item questionnaire was self-reported usage patterns, specific use in patient care situations, perceived utility of e-mail in various situations, and attitudes towards e-mail. It was written in Converse (a program for use in computer-based interviews)[11] and administered to all subjects through the e-mail system. At the time the user chose to read e-mail, the questionnaire was "delivered" and the user asked whether he or she was willing to complete the questionnaire right away, preferred to complete it later, or was not willing to participate. If the user wished to take the questionnaire later, it was redelivered on the following calendar day. If the user postponed taking it three times, this was construed as a refusal. If the user refused, the program asked again in two calendar days. If the user refused a second time, the program did not ask again. Once started, the user could escape from the interview at any time. All answers were entered through the keyboard. Most questions were answered using a 5-point Likert scale; others called for numeric or free-text responses.

The initial questionnaires were sent on June 15, 1992, and data collection ceased at the end of September 22, 1992 (after 15 weeks). A number of the users received the questionnaire more than once, owing to aborted interviews. Each user's partially completed questionnaires were assembled to create as complete a set of responses as possible for that user.

To assist in the analysis of the data, user information was obtained directly from our online database of users. The data included demographics, category of user (e.g., attending physician, nurse, house officer, etc.), time since the first issuance of an access key to the information system (as a proxy for the length of time the user had worked at Beth Israel), and number of times users looked at patient information per week in the 26 weeks from September 29, 1991, through March 26, 1992. The major stratification in all analyses was the category of user.

Statistical Analysis

Descriptive statistics were obtained using means or proportions as appropriate. Univariate relationships were sought using t-tests for continuous variables and χ^2 tests as appropriate. Multivariable modeling was performed using stepwise logistic regression, with an inclusion criteria set at $p=0.05$. Correlation coefficients were computed using the method of Spearman. All statistical analyses were performed using SAS[20].

RESULTS

Use Patterns

During the one-week study period, 1247 persons sent 7482 messages to 1302 different recipients. Each message was addressed to an average of 1.12 persons. Clinicians sent a mean of 7.3 messages each (range, 1-128, SD=11.2). One hundred fifty-three attending physicians sent 16% of the e-mail, 373 nurses 17%, and 208 house officers another 17%; together, they accounted for about half the e-mail sent that week. In addition, 1820 automatically generated notices of activity on patients were sent to providers. Eight automatically generated administrative notices were sent, and there were 19 broadcasts to entire systems of people, 5 of which were sent to users authorized to view clinical information; most of these were initiated by nurses, who sent them to all other nurses.

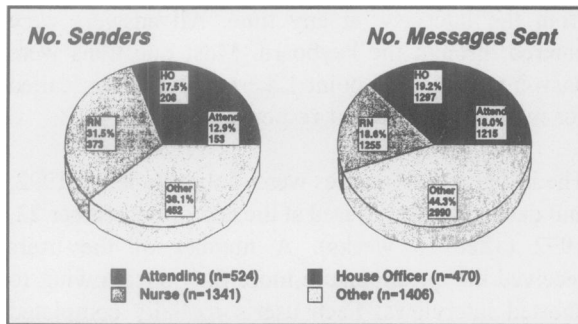


Figure 1 Senders of e-mail

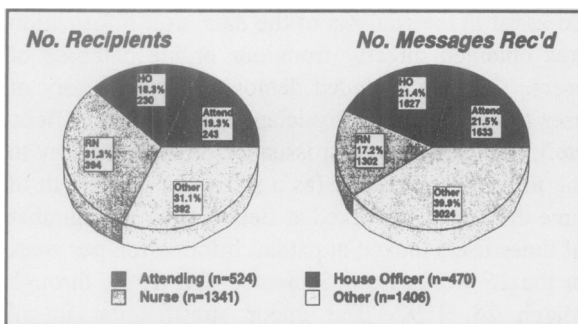


Figure 2 Recipients of e-mail

The number of messages sent and received by users appears in Figures 1 and 2. The proportion of users in each user category who used e-mail during the week studied appears in Figure 3 and the average number of messages sent or received per person (the intensity of e-mail use) is shown in Figure 4.

Questionnaire

The response rate to the questionnaire was 50% and the median response time was two days.

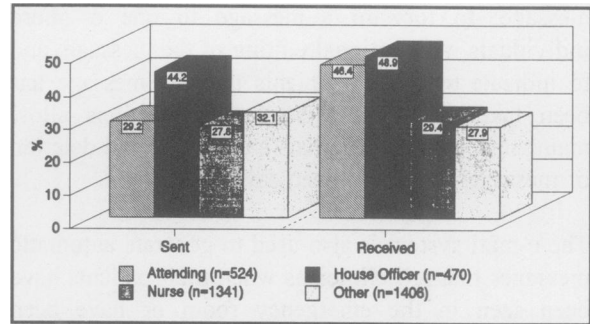


Figure 3 The proportion of users who used e-mail during the study week

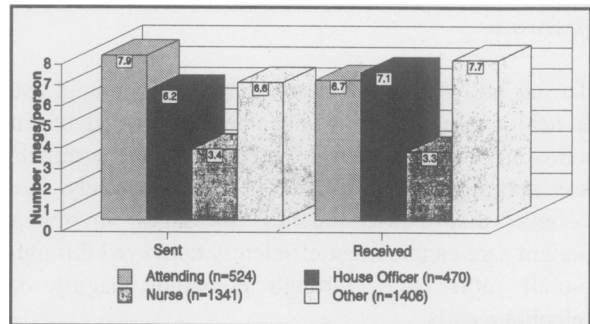


Figure 4 Intensity of e-mail use during the study week

Characteristics of respondents and non-respondents are listed in Table I. The respondent group was notable for being older and having a longer tenure at our institution, and having fewer males and house officers, more nurses and attending physicians, and more frequent measured use of e-mail during the study week. Number of years at Beth Israel, being a nurse or attending physician, not being a house officer or male, and having sent or received more e-mail during the study week were confirmed as independent predictors of response to the questionnaire.

Sixty-six percent of respondents said that they used e-mail daily or weekly. A composite weekly measure of self-reported e-mail use was derived from two of the questionnaire responses: the average self-reported use, 10.6 times per week, correlated well with measured use in February 1992 ($r=0.6$, $p=0.0001$ for messages sent; $r=0.6$ for messages received, $p=0.0001$).

Fifty-eight percent of the respondents said they sent e-mail regarding patient care and 94% said that this was useful. Predictors of sending e-mail for patient care were longevity at Beth Israel, frequent receipt of

Characteristic	Respondents N=1816	Non-respondents N=1843	p value
Mean age (yrs)	34.7	32.9	< 0.0005
Years authorized on system (mean)*	4.6	3.0	0.0001
Percent male	26.2	36.7	< 0.0005
Percent attending MD*	15.7	10.9	< 0.0005
Percent house officer*	9.0	13.7	< 0.0005
Percent nurse*	43.5	27.8	< 0.0005
No. of messages sent 2/23-2/29/92*	3.1	0.9	0.0001
No. of messages rec'd 2/23-2/29/92*	10.6	5.0	0.0001

Table I - Composition of respondent and non-respondent groups. T-test used for comparisons of means and χ^2 test used for comparisons of proportions. An asterisk indicates significant independent predictors.

e-mail, large numbers of clinical information queries, perceived utility of this medium, being a physician, and not being a nurse. Sixty-eight percent of the respondents reported frequent receipt of e-mail regarding patient care and 93% said this was useful. Ninety-five percent felt that sending e-mail was useful for administrative functions. Ninety percent said that e-mail made their lives easier and 61% said that e-mail had a humanizing influence on their communications. With regard to patient care situations, 97% of the respondents would contact another clinician in person or by page or telephone in an emergency; if there was no emergency, 63% would still make personal contact and 30% would use e-mail. In a logistic regression, independent predictors of using e-mail rather than the page system or the telephone in these situations were heavy use of e-mail, extensive use of the information system to look-up clinical information, perceived utility of this medium, and not being a nurse.

Comments

User comments were highly favorable. Most referred to how much they enjoyed using e-mail for work and for keeping in touch with people. Many cited the advantages of using e-mail to avoid "telephone tag" when trying to contact another person. Some requested features, such as Internet access, that are currently unavailable, while others requested features that were already part of our system. Some explained

their infrequent use of Beth Israel's e-mail system by stating that they were only in the hospital part-time.

CONCLUSIONS

Our results show that e-mail is a frequently used and well-liked means of communication at our hospital. In fact, the frequency of e-mail use at Beth Israel Hospital is second only to that of patient information look-ups. The Brigham and Women's Hospital information system—which was designed and implemented by the Center for Clinical Computing during the 1980's—also has a large volume of e-mail use[9]. To our knowledge, information systems designed by the Center for Clinical Computing carry as much e-mail traffic as any other health care institution in the world.

Those most involved with patient care sent most of the messages during the study week. Attending physicians and house officers showed the greatest intensity of use. Those in the major user categories (attending physicians, house officers, and nurses) sent the greatest number of messages to others of the same category. The proportion of each user category that used e-mail appear low; however, clinicians often rotate through other hospitals during their training and therefore may not have been at Beth Israel during the week studied.

The questionnaire used in the study, sent out through the e-mail system, produced a rapid (median response two days) and good response rate (50%), which was high in comparison with the response to most social, organizational or health services research questionnaires[13,14], but not as good as an electronic survey conducted by the CCC in 1983[8].

The results of our survey indicate that e-mail is widely used in many types of situations. Frequent use of e-mail was an independent predictor of e-mail use for patient care, suggesting that people who already find e-mail useful are those most likely to use it in patient care. Being a physician also predicted e-mail use in patient care situations, perhaps because these users find that e-mail is readily available while they are performing other computer-based patient care activities.

Another finding of interest in the questionnaire was that 30% of unselected respondents wishing to contact another person regarding a patient if no emergency existed said they would use e-mail. The factors that predicted this behavior included indicators of heavy information system and e-mail use, which suggests that these users have recognized the utility of hospital information systems.

We are currently refining our e-mail system to provide the ability to flag a message with a specific patient identifier, selected from a list of patients. We call this "patient-centered communication" and feel that it is an important function of a hospital e-mail system. It would allow a recipient to identify a message as one pertaining to a particular patient, whose name and identification number could be used to identify the patient accurately. A physician could sort messages by patient name for easy reference. Patient care alerts and reminders are also a type of patient-centered communication; Rind et al. showed that reminders sent through the e-mail system at our institution improved physician response to rising creatinine levels[15].

We envision an electronic meeting, similar to a discussion group on an electronic bulletin board, in which numerous providers post patient-centered communications to discuss patient care and discharge planning. This would facilitate patient care and avoid the need for frequent in-person meetings and unnecessary pages.

E-mail is a useful and important part of our hospital information system, and we hope that physicians will

insist that their clinical information systems provide this capability.

References

- [1]. RE Rice, D Case. Electronic message systems in the university: a description of use and utility. *J Communication*, Winter 1983.
- [2]. RE Rice. Computer-mediated communication and organizational innovation. *J Communication*. 37(4), Autumn, 1987.
- [3]. MJ Schaefermeyer, EH Sewell. Communicating by electronic mail. *Amer Behavioral Scientist* 32(2):112-23, 1988.
- [4]. PA Golden, R Beauclair, L Sussman. Factors affecting electronic mail use. *Comp Human Behavior* 8, 297-311, 1992.
- [5]. FM Jablin, LL Putnam, KH Roberts, LW Porter (eds.). *Handbook of organizational communication: an interdisciplinary perspective*. Sage Publications, Beverly Hills, 1987.
- [6]. RC Huseman, EW Miles. Organizational communication in the information age: implications of computer-based systems. *J Management* 13(2):181-204, 1988.
- [7]. NB McCormick, JB McCormick. Computer friends and foes: content of undergraduates' electronic mail. *Computers Human Behavior*, 8, 379-405, 1992.
- [8]. HL Bleich, RF Beckley, GL Horowitz et al. Clinical computing in a teaching hospital. *NEJM* 312:756-764, 1985.
- [9]. C Safran, WV Slack, HL Bleich. Role of computing in patient care in two hospitals. *M.D. Computing* 6(3):141-8, 1989.
- [10]. FJ Roethlisberger, WJ Dickson, HA Wright. *Management and the Worker*. Cambridge, MA, 1946.
- [11]. SM Bloom, RJ White, RF Beckley, WV Slack. Converse: a means to write, edit, administer, and summarize computer-based dialogue. *Comput Biomed Res* 11:167-75, 1978.
- [12]. PC SAS version 6.04. SAS Institute Inc. Cary, NC.
- [13]. LE Sproull. Using electronic mail for data collection in organizational research. *Academy Management J* 29(1):159-69, 1986.
- [14]. TW Smith. The hidden 25 percent: an analysis of nonresponse on the 1980 General Social Survey. *Public Opinion Quart* 47(3), 1983.
- [15]. DM Rind, C Safran, RS Phillips et al. The effect of computer-based reminders on the management of hospitalized patients with worsening renal function. *Proc Annu Symp Comput Appl Med Care* 1991:28-32.