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Abstract

This paper uses social network analysis to examine the impacts on practice patterns of the introduction of CompuHx, an Interactive Health Appraisal System (IHAPS), used in the examining room at Kaiser Permanente's San Diego Department of Preventive Medicine. The system is used to record patient information, assist in diagnosis, and provide a summary of findings. Twenty-two physician assistants and nurse practitioners responded to detailed surveys after the system was implemented. Findings indicate practitioners who used the computer system interacted more frequently with the other physician assistants and nurse practitioners, with physicians, and with individuals in other departments. Overall, the study points to the value of using network analysis to investigate the impact of computer technology on individuals' attitudes and behaviors.

INTRODUCTION

Changes in formal and informal interaction patterns among practitioners induced by the introduction of interactive computer systems have rarely been investigated even though research has uncovered important relationships between social interaction patterns and technological changes. For example, Barley (1986, 1990) investigated how the introduction of CT scanners had an immediate impact on the work roles of radiologists and radiological technicians. These changes influenced patterns of interactions and ultimately the organizational structure of two hospital radiology departments. A second investigation by Burkhardt, (1994) studied the effects of the introduction of a local area network into a federal agency. This transition to a new organizational technology changed the work processes. As a result, employees' attitudes and behaviors were influenced by the co-workers with whom they directly interacted in performing their jobs. Individuals who were apept at using the computer system formed an informal group that helped their co-workers. Computer-users became the informal leaders of those employees who had difficulty using the new technology.

A series of studies by Anderson and others (1987, 1994) indicated that physicians' location and role in the consultation network was an important determinant of adaptation, diffusion, and use of information system. Also, a study by Aydin (1989) of the effects of a pharmacy information system on occupational

communities in a hospital found increased interdependence and improved communication and cooperation between the nursing and pharmacy departments. A second study by Aydin and Rice (1992) found that new informal communication patterns developed among employees at all levels of the organization to support the use of a new information system.

The paper reports the results of a social network analysis of the introduction of an Interactive Health Appraisal System, CompuHx, into the consulting rooms of a health maintenance organization. The objective of the study was to examine the effects of the use of CompuHx on the communication patterns of the health care providers.

STUDY METHODOLOGY

Research Setting

Data are analyzed from a study conducted at the Kaiser-Permanente Medical Care Program in San Diego, California. The program provides a complete bio-psychosocial medical evaluation to about 50,000 members per year in the San Diego Department of Preventive Medicine. Patients' examinations are performed by 22 nurse practitioners or physician assistants with physicians always immediately available for consultation. CompuHx is designed to utilize data base management and computer graphics to create a fully detailed, legible medical record. All the providers completed a questionnaire after CompuHx was implemented.

Data Collection

A comprehensive survey was used to collect data on basic demographic information; examiners opinions concerning accuracy, format, and ease of use of the system; and the impact of CompuHx on individual job performance and the performance of the department as a whole. Respondents also were provided with a list of all nurse practitioners and physician assistants, doctors, and others (i.e., data processing clerks, chart room clerks, health assistants, radiology department, laboratory, the software development staff and people working in other departments). They were asked to indicate the frequency with which they communicated with each person or occupational group as part of their jobs. Frequency was coded: 0=never have a contact; 1=once a month; 2=several times a month; 3=once a week; 4=several times a week; 5=once a day; 6=several times a day.

Social Network Analysis

Social network analysis was used to study the pattern of relations among individuals and departments. The following indices were created for each CompuHx user:

(1) The average frequency of communication initiated by nurse practitioners (NPs) and physician assistants (PAs) who use and who don't use CompuHx.

(2) The average frequency of communication by CompuHx users and non-users with each physician on the service.

(3) The average frequency of communication by users and nonusers of CompuHx with other departments.

RESULTS
mographic Data

The 22 examiners include 7 nurse practitioners (NPs), 14 physician assistants (PAs) and one who was both a NP and a PA. They had an average of 8.7 years health care experience and had worked in the department for over 4 years on the average. Of the five CompuHx users, three had previous computer experience compared to six of the 17 non-users. Four examiners are classified as users of CompuHx in this analysis since one took maternity leave.

Practice Patterns

Table 1 shows the average frequency of communications for users and non-users of CompuHx with NPs, PAs, and physicians in the department. System users communicate several times a week with one another; while they communicate with NPs and PAs who don't use the system only once or twice a month on average. In comparison, NPs and PAs who don't use the system with patients communicate with users and non-users of the system with about the same frequency, several times a month.

Differences between users and non-users in the frequency with which they communicate with physicians in the department can also be seen from Table 1. NPs and PAs who use the system communicate with the medical director almost on a daily basis. Non-users communicate with him only about once a week. Differences in the frequency of communication with other physicians in the department are much smaller, although system users again communicate with physicians more frequently than non-users.

Table 2 shows the frequency of communication with staff of other departments. NPs and PAs who use CompuHx communicate with staff in the Data Processing Department several times a week on average. Non-users rarely communicate with this department. There are relatively small differences between users and non-users with most other departments with one exception. NPs and PAs who use the system communicate with staff of Fuzzy Logic, Inc. (designers of the system) while non-users do not communicate with them at all.

Figure 1 also indicates that there are major differences in the practice patterns of users and non-users of the CompuHx system. Densities of communication within and between subgroups are shown. NPs and PAs who use the system in examining patients have much higher densities of communication with one another, as well as with NPs and PAs who don't use the system, the medical director, other physicians and staff within and outside the department.

Table 1

Average Frequency of Communication for Users and Non-Users of CompuHx with NPs, PAs and Physicians

Communication with:	Users	Non-Users
CompuHx-Users	4.15	1.52***
Non-CompuHx-User	2.10	1.61
Medical Director	4.50	3.00**
Other Clinical Physicians	2.60	1.99

*P<.05, **P<.01, ***P<.001

Table 2

Average Frequency of Communication for Users and Non-Users of CompuHx with Other Department Staff

Communication with:	Users	Non-Users
Data Processing	4.00	0.22**
Receptionists	3.25	3.33
Chart Room	3.00	2.83
Radiology	0.50	0.72
Laboratory	0.50	0.61
SW Developer	0.50	0***
Others	2.02	1.00

*P<.05, **P<.01, ***P<.001
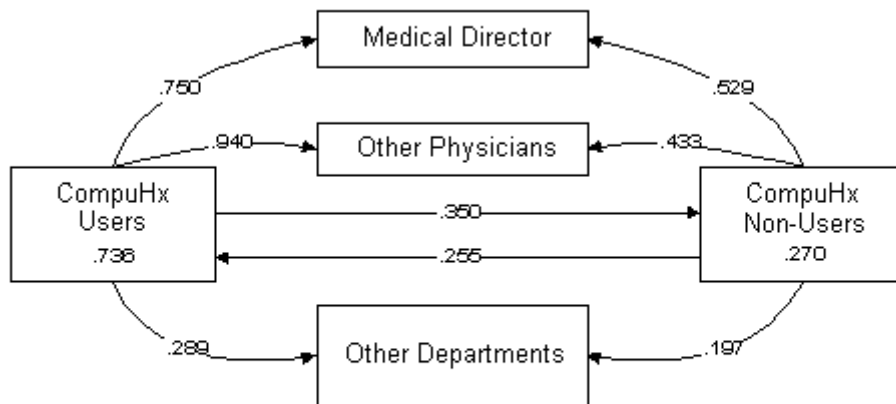
Figure 1 Network Density of CompuHx-Users and Non-Users

DISCUSSION

As hypothesized, the introduction of an Interactive Health Appraisal System, CompuHx, into the examining rooms of a health maintenance organization was accompanied by change in the practice patterns of the health care providers. Nurse practitioners and physician assistants who used the system came to communicate more frequently with one another and with other staff who could assist them in performing their professional duties. Their interactions with the medical director of the department, who was a leader in the development of the system and acted as an important source of information and support for the user, also increased. In addition, NPs and PAs who used the system, more frequently communicated throughout Preventive Medicine in carrying out their work.

These increases in communication may have important implications for the longer term quality and productivity of the department. Other studies indicate that the more co-workers an individual communicates with about a new technology, the more productive he or she is likely to be using the system (Papa, 1990). Research in health care settings shows that communication and collaboration among health care providers are associated with behavior patient outcomes as well (Baggs, et al., 1992; Knaus, et al., 1996; Shortell, et al., 1994). The study also illustrates the ways in which social networks can support system use. When implementing new technology, such as an information system, managers can facilitate the formation of support groups composed of more experienced users to assist employees who experience difficulty in using the new technology.

Acknowledgments

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