PERCEPTIONS OF THE IMPACT OF COMPUTERS ON MEDICAL PRACTICE AND PHYSICIAN USE OF A HOSPITAL INFORMATION SYSTEM


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ABSTRACT

This study formulates and tests a model of the factors that affect physician use of a hospital information system (HIS). It was hypothesized that consultations among physicians on hospital services and computing experience and attitudes toward medical computer applications. Physicians who are more knowledgeable about computers and convinced of their effectiveness are more likely to develop their own personal order-sets for use and to use the HIS in clinical practice. The model was empirically tested with data from 270 physicians on the medical staff of a large, private, teaching hospital. The results of the analysis suggest that the slow introduction of clinical computing systems is related in part to physicians' perceptions of the effects of these systems on their practice. These perceptions appear to be significantly influenced by the physicians' interaction with his/her colleagues on the hospital service.

INTRODUCTION

There are a growing number of computer applications in which physicians directly interact with the computer (1). These systems involve various patient care functions such as order entry, results reporting, decision support, surveillance, and reminders. Many of these are tested applications which can be implemented economically. Moreover, the falling cost of these computer-based systems suggests that they will be even more available to physicians in the future. Yet there is a serious gap in their utilization by physicians in clinical practice. Friedman and Gustafson (2) found that less than 20 percent of the 32 clinical computer applications they surveyed were in routine use in hospitals. Wardle and Wardle (3) found that despite the development of an enormous number of computer-based diagnostic systems, the dissemination of any single system is limited. Laska and Abbey (4) concluded their review of medical information systems with the statement "Automated clinical decision support .... has not met with wide, general acceptance."

General resistance to innovation can not explain the limited spread of clinical computing systems. New drugs and diagnostic procedures such as CAT scans are readily accepted by practicing physicians. Furthermore, attitude surveys of medical staff have shown an almost universal enthusiasm for the use of computer applications that assist physicians in managing patient care or provide useful clinical information at little personal cost to the doctor. At the same time, physicians tend to resist those applications that alter their normal practice patterns or threaten their professional role and status (5-10). Several authors have suggested that this mixed reaction must reflect the medical profession's valuations of these systems (6,11,12).

The purpose of this study is to examine the degree to which physicians' perceptions of the impact of computers on medical practice affects their use of a hospital information system (HIS). A model is presented and tested that views consultations as influencing their exposure to and attitudes toward potential computer applications. These factors in turn affect actual use of a HIS in clinical practice. This model is depicted in Figure 1.

METHODS

The Research Setting

This study was undertaken a a large, midwestern, private, teaching hospital. The hospital was one of the first to implement the Technicon Medical Information System (HIS) and now has seven years of experience with the system. The HIS consists of 200 VMTs and 128 printers and is operational on all hospital units. It facilitates physicians' order entry, access, and modify patient information at a terminal using either a keyboard or a light pen. Personal and departmental order sets can be developed to facilitate direct order entry by physicians.
for 370 of these physicians by abstracting six weeks of patient discharge data captured on HIS purge tapes: (1) number of patients discharged; (2) the types of medical orders entered into the HIS for these patients; (3) who entered medical orders for each physician; and (4) consulting physicians. This analysis is based on data from 270 of these physicians who had admitted or consulted on a patient at the hospital within the past two years.

Scales and Indices

Fourteen dummy variables were used to differentiate the 15 hospital services that were included in this study. Also, a dichotomous dummy variable was used to indicate which physicians had developed personal order sets for use on the HIS. Factor analyses were performed on each of the sets of items on the questionnaire (13).

Four factors reflect the physician's involvement in the following professional activities: Factor I - Leadership in county and state medical societies; Factor II - Participation in voluntary health associations; Factor III - Attendance at professional association meetings; Factor IV - Leadership in national medical associations. Two factors emerged from the items that indicate physicians' prior exposure to computers. One reflects computer education; the other use of the computer. Five factors appear to underlie the 28 statements that reflect physicians' perceptions of the impact of the computer on medical practice; whereas, three factors were extracted from the statements concerning the perceived desirability of 13 medical computer applications. Finally, the five items having to do with the physician's use of the HIS loaded on a single factor.

Consultation networks were constructed for each hospital service from discharge data. A measure of each physician's relative location in the network was computed (14). A summary of the scales and indices that were developed is presented in Anderson, Jay, and Schweer (5,6).

RESULTS

Table 1 contains an analysis of who entered the orders for physicians on each of the hospital services. Overall, physicians only enter about 3 percent of their own orders. However, there is a great deal of variation among hospital services. Cardiovascular surgeons and/or their physician assistants personally enter more orders per patient than physicians on any other service - about 13 percent of the orders entered. However, it is important to note that all five of these
physicians have one or more physician assistants authorized to enter orders using the physician’s code. About five percent of the orders on neurosciences and orthopaedic surgery were entered by the physician him/herself. In contrast, less than one percent of the orders on general surgery, family practice, neuroscience, medicine, and psychiatry were entered by physicians. The 22 urologists did not enter any of their own orders for patients.

At the same time, prior computing experience is highly correlated with physician attitudes toward the use of computers in medicine. Physicians who have been exposed to computers express a more favorable attitude toward their use in clinical medicine. These physicians also are not as concerned about the potential impact of computers on medical practice.

Physician attitudes are significantly related to their use of the HIS. Physicians who view the use of computers for patient care as desirable and as reducing the cost and improving the quality of medical care are more likely to have personal order sets and to use the HIS in their clinical practices. The same is true of physicians who do not perceive the computer as negatively affecting their autonomy and professional role (see Figure 3).

Table 1. Mean Number of Medical Orders per Patient Entered into the HIS by Who Entered the Order for a Six Week Period

<table>
<thead>
<tr>
<th>Hospital Service</th>
<th>No. of MDs</th>
<th>MD</th>
<th>US</th>
<th>RN</th>
<th>LP</th>
<th>Other</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiovascular</td>
<td>5</td>
<td>3.17</td>
<td>129.1</td>
<td>24.4</td>
<td>2.7</td>
<td>57.1</td>
<td>245.0</td>
</tr>
<tr>
<td>Surgery</td>
<td>10</td>
<td>5.6</td>
<td>18.1</td>
<td>4.8</td>
<td>3.0</td>
<td>15.7</td>
<td>107.4</td>
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<tr>
<td>Neurosciences</td>
<td>19</td>
<td>4.6</td>
<td>63.3</td>
<td>5.0</td>
<td>0.8</td>
<td>12.7</td>
<td>86.7</td>
</tr>
<tr>
<td>Internal Medicine</td>
<td>97</td>
<td>3.4</td>
<td>101.5</td>
<td>7.0</td>
<td>0.8</td>
<td>12.6</td>
<td>125.3</td>
</tr>
<tr>
<td>Cardiovascular Medicine</td>
<td>23</td>
<td>3.4</td>
<td>86.8</td>
<td>6.8</td>
<td>0.6</td>
<td>13.7</td>
<td>111.3</td>
</tr>
<tr>
<td>Ophthalmology</td>
<td>14</td>
<td>2.1</td>
<td>46.2</td>
<td>6.1</td>
<td>0.8</td>
<td>4.8</td>
<td>60.0</td>
</tr>
<tr>
<td>Pediatrics</td>
<td>46</td>
<td>1.7</td>
<td>44.7</td>
<td>5.0</td>
<td>0.6</td>
<td>20.1</td>
<td>72.1</td>
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<tr>
<td>Oral Surgery</td>
<td>9</td>
<td>1.6</td>
<td>51.0</td>
<td>4.2</td>
<td>0.5</td>
<td>16.9</td>
<td>74.2</td>
</tr>
<tr>
<td>OB-GYN</td>
<td>28</td>
<td>1.2</td>
<td>48.6</td>
<td>4.6</td>
<td>0.7</td>
<td>51.6</td>
<td>56.1</td>
</tr>
<tr>
<td>Otolaryngology</td>
<td>13</td>
<td>1.1</td>
<td>32.2</td>
<td>1.5</td>
<td>0.1</td>
<td>3.2</td>
<td>38.1</td>
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<tr>
<td>General Surgery</td>
<td>27</td>
<td>0.7</td>
<td>100.1</td>
<td>5.7</td>
<td>0.9</td>
<td>11.6</td>
<td>119.0</td>
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<tr>
<td>Family Practice</td>
<td>33</td>
<td>0.7</td>
<td>73.3</td>
<td>3.1</td>
<td>1.1</td>
<td>6.0</td>
<td>84.2</td>
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<tr>
<td>Neurosciences</td>
<td>7</td>
<td>0.4</td>
<td>53.4</td>
<td>2.5</td>
<td>1.6</td>
<td>3.6</td>
<td>61.7</td>
</tr>
<tr>
<td>Psychiatry</td>
<td>17</td>
<td>0.1</td>
<td>72.8</td>
<td>3.9</td>
<td>1.4</td>
<td>2.4</td>
<td>80.6</td>
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<tr>
<td>Urology</td>
<td>22</td>
<td>0.0</td>
<td>59.7</td>
<td>3.0</td>
<td>1.1</td>
<td>3.2</td>
<td>67.0</td>
</tr>
</tbody>
</table>

Total: 370

Means: 2.5 73.7 5.4 0.9 11.6 94.1

Figure 2 examines the relationship between HIS use, professional activities, and prior computing experience. Involvement in professional activities appears to have little direct effect on the physician’s use of the HIS. However, all four factors are significantly correlated with computing experience. Physicians who participate in local, state, and national medical associations are more likely to have been exposed to various medically related computer applications and to have prior experience in using computers. Computing experience, in turn, has a small but significant correlation with physician use of the hospital information system.
who do not have POS for all categories except to obtain CME information. Almost 60 percent of the physicians with personal order sets use the HIS daily to retrieve patient lists and check lab results compared to only 30 percent of the physicians without order sets. One out of four of the former group of physicians use the HIS daily to enter and to check medical orders. Less than ten percent of the physicians without order sets use the system to check orders daily and only one out of 20 enter orders into the HIS daily.

Finally, the model was tested by incrementally partitioning the variance in physician use of the HIS accounted for by all of the factors (15). Sets of variables were sequentially entered into the regression equation and the increment in the proportion of variance accounted for by each set was tested for significance. The order of entry was determined by the model shown in Figure 1. A major purpose for the incremental partitioning of variance is to study the effect of a set of variables on HIS use after having controlled for the other variables that precede it in the model. Results are presented in Figure 5.

The variables together account for 49 percent of the variance in physician use of the HIS. Differences among the 15 hospital services account for 15 percent of the variance in HIS use by physicians. As predicted, the physician's location in his peer communication network is also a significant predictor of HIS use, accounting for an additional nine percent of the variance.
Physicians' attitudes toward medical computer applications account for a significant portion of the variance in HIS use even when the other variables are controlled, a total of nine percent. Moreover, attitudes toward computers appear to intervene between network location and the development of personal order sets which can be used to tailor HIS use to the physician's individual practice. Once the physician develops personal order sets, he significantly increases the frequency of HIS use in caring for patients. Personal order sets account for an additional 12 percent of the variance in HIS use.

**DISCUSSION**

Clear reasons for the slow introduction of clinical computing systems relate to physicians' perceptions of the effects of these systems on their practice. This paper presents and tests a model that views physician perceptions of medical computer applications and their exposure to computers in general as being significantly influenced by consultations with other physicians on the hospital service. Attitudes, in turn, appear to significantly affect the physician's decision to develop personal order sets designed to tailor HIS use to individual practice. The development of personal order sets results in a significant increase in HIS use.

**REFERENCES**


**ACKNOWLEDGEMENTS**

This project was supported by Grant No. HS 04774, National Center for Health Services Research.