

# The Usefulness of Handheld Computers in a Surgical Group Practice

Jon Blackman, M.D.<sup>1</sup>, Paul Gorman, M.D.<sup>2</sup>, Richard Lohensohn, M.D.<sup>2</sup>,

Dale Kraemer, Ph.D.<sup>2</sup>, Scott Svingen, C.I.O.<sup>1</sup>

<sup>1</sup>HealthFirst Medical Group, Portland, Oregon

<sup>2</sup>Division of Medical Informatics and Outcomes Research  
Oregon Health Sciences University

*We designed a system using handheld computers allowing physicians in the hospital setting to access their surgical schedules, to track patients in multiple hospitals, and to quickly enter billing information. The physicians would then update their schedules and pass billing information electronically when they returned to the office. The system was successfully implemented, it was well accepted by clinicians and staff users, and it showed an increased capture of charges. Whether an economically important effect on the number of days to post hospital charges will be evident after follow-up data has been collected.*

## INTRODUCTION

As medical organizations become larger and more complex, there is a need for information management tools to improve communication among the members of the health care team. One tool attracting attention is the mobile, or handheld, computer. Despite technical advances showing great promise, the optimal role of this device is still uncertain.

One potential role of the handheld computer is in improving the quality of patient care. A mobile computer can be used to generate the clinical note at the point of service [1, 2], to store patient care guidelines [3], to facilitate communication through e-mail and voice messaging [4, 5], and to provide connectivity to the patient's longitudinal record [6].

Another potential role for the handheld computer is in improving business efficiency. This may be achieved by improving scheduling as well as improving the accuracy and speed of billing [7].

Patients [8, 9] and physicians [10, 11] seem to accept the use of mobile devices. It is possible that mobile computers will take some of the drudgery out of clinical recordkeeping, being simultaneously more efficient and gratifying to use.

## HealthFirst Medical Group

HealthFirst Medical Group (HFMG) is a multispecialty group in the Portland area with approximately 100 physicians. The surgery department identified the following problem areas:

- Standardizing and coordinating the schedules for the physicians when they performed surgery or provided consultations in the hospital.
- Concern that the capture of charges was not complete or efficient.
- Intradepartmental communication had become difficult. The department had rapidly grown to encompass 7 full-time surgeons, 7 medical assistants (MAs), and 2 billing office persons operating out of 4 offices and 5 hospitals. It was increasingly difficult for the providers and MAs to communicate regarding patient care, meeting times, and call schedules.

We were asked to assess the feasibility of using a handheld computer to help solve the problems identified. Our project was to design and implement a workable system and to evaluate our findings.

## METHODS

### Research Question and Goals of the Study

We defined our research question as "What is the usefulness of a handheld computer in a large multispecialty group practice when used by a group of general surgeons to coordinate their schedules and increase their efficiency?"

The goals of the study were as follows:

1. To test the following hypotheses:
  - Hypothesis 1: The use of handheld computers will make it easier to coordinate the schedules of physicians who perform multiple procedures/consultations in multiple locations.
  - Hypothesis 2: The use of handheld computers will allow transmission of billing data to the organization in a more timely and cost-effective fashion.

- Hypothesis 3: The use of handheld computers will improve physician communication.
2. To design and deploy an integrated system utilizing handheld computers in conjunction with a network-based groupware product.
  3. To design and implement a database program to store and display all patient procedures, consultations and associated procedure and billing codes.

### Study Design

The study subjects consist of 100% of the surgeons, surgical medical assistants, and surgical billing personnel at HealthFirst Medical Group. The project utilized a study design where stable pre-implementation data spanning 11 months was compared to post-implementation data collected over 3 months.

### Implementation

At HFMG, the clinic sites are connected to a central Unix server over T1 lines. We use Reynolds and Reynolds for our Practice Management System (PMS), Microsoft Office for office productivity, and Microsoft Exchange and Microsoft Outlook for e-mail and administrative scheduling.

We looked at handheld devices that could synchronize with Outlook. We chose the Hewlett Packard 620LX Handheld PC (H/PC) running Windows CE 2.1 because of its compact size, easy-to-read screen, integrated keyboard, ease of connectivity, software compatibility, and battery life. The unit connects over the network by ethernet or modem to a designated PC, or it can connect directly to the PC by a serial cable. Files are synchronized to reflect the most recent changes on either device. We created a shared database to store and display all patient procedures, consults and associated codes. The surgeon enters billing information while making rounds at the hospital, it is passed to a central database upon synchronization, and it is viewed by business office personnel, who verified the information and then re-keyed the data into our PMS.

We installed a PC with a network connection for each MA. A separate PC for the surgeon at the office was viewed as desirable, but not essential. The MA scheduled hospital procedures or consultations into Outlook on the PC, but the surgeon could also enter new patients on the H/PC.

### Days to Post

We measured the Days to Post charges (DTP), which is the length of time it takes from completing the

procedure or consult to the time it takes to post the charge in the billing system. We ran a query on our PMS to include all hospital charges for our surgeons. Specifically we looked at the physician identifier, the patient account number, the Date of Service (DOS), the date posted in the PMS, the DTP, and the CPT code. The data was imported into JMP for statistical analysis, testing for improved speed of billing.

Other variables include "Before" and "After" the intervention, the month of the study, DTP > 30 days, DTP > 45 days, and DTP > 60 days. We used the Chi Square Test to analyze grouped data.

### Hospital Charges

Although we looked at all hospital charges, we specifically measured the number of charges with CPT codes  $\geq 90000$ , which are charges for consultations and other cognitive services.

### Questionnaire

A questionnaire was developed to assess satisfaction with the current system. Questions were targeted to each group of users and the same questions were asked before and after the intervention. In our study, there were 16 questions. Of these, 15 were asked of the surgeons, 8 were asked of the MAs, and 6 were asked of the billing office personnel. The questions were rated on a seven point scale, with 1 being most positive and 7 being most negative. The validity of the questionnaire was not evaluated given the small available sample size.

We used the Wilcoxon Signed-Rank Test to test for median differences (before and after) equal to zero. We tested for statistical significance with a two-sided significance level of 5%. As this is primarily a descriptive study, we did not adjust for multiple tests.

## RESULTS

### Days to Post

The handheld computers were introduced on December 4, 1998. Between 1/1/98 and 2/3/99 there were 4880 entries, 3854 before and 1026 after the intervention. The report was run on 2/26/99, 23 days after the last Date of Service.

Looking at the distribution of values of the DTP, it was apparent that the curve was not normal, but positively skewed. When we looked at grouped data, we found that the Mean DTP before the intervention was 20.36 days, and after the intervention it was 19.36 days. Likewise, the Median DTP before the intervention was 16 days, and after the intervention it was 17 days.

We found that before the introduction of the H/PC, 486 of 3854 charges (13%) were posted > 30 days from the DOS. After the H/PC, the number was 105 of 1026 (10%). This was statistically significant, with a Chi Square Likelihood Ratio of 0.03. Values for DTP > 45 days and > 60 days are found in Table 1.

Measure	Before	After	p-value
> 30 days	486 (13%)	105 (10%)	0.03
> 45 days	218 (6%)	39 (4%)	0.01
> 60 days	123 (3%)	5 (<1%)	0.001

**Table 1**

### Hospital Charges

Before the introduction of the H/PC, there were 573 CPT codes  $\geq$  90000 (15% of the total or 52 per month). After the intervention, there were 268 (26% of the total or 134 per month). This relative increase was highly significant, with a p-value of <0.001.

The absolute increase in number of charges for consultative services, as noted above, went from 52 to 134 per month, an increase of 157%. Before the H/PC, the group billed \$9393 per month in consultative services. After the intervention, they billed \$19,867 per month for the same services, an increase of 111%.

Analyzing the hospital procedures (CPT < 90000), the surgeons performed 298 procedures per month before the H/PC and 379 after, an increase of 27%.

### Questionnaire

The questions were initially asked in November 1998, prior to the introduction of the handheld, but several months after the medical assistants received new computers with Microsoft Outlook installed. The questionnaire was re-administered in mid-February 1999, 2 ½ months after the introduction of the H/PC and one month after we felt that everyone was comfortably using the device on a daily basis.

We performed the Wilcoxon Signed-Rank test on each question for all team members and then looked at the average score for each group.

All 16 questions showed a trend toward improvement in the scores after the introduction of the H/PC. The following questions were shown to achieve statistical significance:

- Q2: Rate your system's ability to coordinate the schedules of more than one surgeon.
- Q3: Rate your system's ability to turn in billing in a timely and cost-effective fashion (i.e. no loss of revenue).

- Q4: Rate your system's ability to turn in billing in an accurate fashion (procedures and consults identified correctly).
- Q5: Rate your system's ability to document complexity of visit to support CPT coding.
- Q6: Rate your system's ability to access/list procedures and consultations previously performed.
- Q8: Rate your system's ability to perform outcome analysis.
- Q9: Rate your system's ability to communicate with other members of the surgical team.
- Q11: Rate your system's ability to view/access your own or your surgeon's schedule.
- Q12: Rate your system's ability to view/access other physician's schedules.
- Q16: Please rate your level of administrative satisfaction (the business of medicine).
- The grouped responses for all surgeons.
- The grouped responses for all MAs.

The following questions were not shown to achieve statistical significance:

- Q1: Rate your system's ability to schedule procedures efficiently.
- Q7: Rate your system's ability to track missing charges.
- Q10: Rate your system's ability to communicate with other physicians.
- Q13: Rate your system's access to notes and reminders about patients seen in the hospital.
- Q14: Rate your system's ability to perform hospital rounds efficiently.
- Q15: Please rate your level of professional satisfaction (the art of medicine).
- The grouped responses for the business office.

Question	Before	After	p-value	N
Q1	2.57	2.00	0.197	14 /SM
Q2	<b>4.36</b>	<b>2.57</b>	<b>0.009</b>	<b>14 /SM</b>
Q3	<b>4.56</b>	<b>2.25</b>	<b>0.001</b>	<b>16/SM</b>
Q4	<b>4.44</b>	<b>2.19</b>	<b>0.002</b>	<b>16/SMB</b>
Q5	<b>3.87</b>	<b>2.87</b>	<b>0.016</b>	<b>16/SMB</b>
Q6	<b>4.56</b>	<b>2.33</b>	<b>0.031</b>	<b>9/SB</b>
Q7	6.00	2.50	0.500	2/B
Q8	<b>5.44</b>	<b>3.67</b>	<b>0.016</b>	<b>9/SB</b>
Q9	<b>4.50</b>	<b>3.00</b>	<b>0.006</b>	<b>14/SM</b>
Q10	4.49	3.29	0.063	7/S
Q11	<b>3.50</b>	<b>1.71</b>	<b>0.013</b>	<b>14/SM</b>
Q12	<b>5.07</b>	<b>2.57</b>	<b>0.005</b>	<b>14/SM</b>
Q13	5.00	2.29	0.063	7/S
Q14	4.00	2.00	0.141	7/S
Q15	2.29	1.86	0.375	7/S
Q16	<b>5.86</b>	<b>2.57</b>	<b>0.031</b>	<b>7/S</b>
AllSurg	<b>4.61</b>	<b>2.52</b>	<b>0.016</b>	<b>7/S</b>
AllMA	<b>3.66</b>	<b>2.50</b>	<b>0.047</b>	<b>7/S</b>
AllBus	3.66	2.50	0.500	2/B

**Table 2** S=Surgeons M=MA's B=Business Office

## DISCUSSION

### Setting Up the Network

The first part of the project involved setting up each MA with a PC linked to the clinic network. Within about a month, most MAs were comfortable with the e-mail and calendar functions in Microsoft Outlook and were able to view each surgeon's schedules. We then began entering all hospital procedures in the calendar, switching from a paper-based system.

During this time we gave the H/PCs to the physicians so they could familiarize themselves with the units and learn to synchronize them with the MA's PCs. Synchronization with Outlook has been flawless, with the exception of a software error that we receive on most units about once a month that temporarily prohibits the units from recognizing each other. This can be temporarily fixed by reinstalling Windows CE, but to date this remains an unsolved problem.

The patient billing database was built using Syware Visual CE on the H/PC and Microsoft Access on the PC. Although Visual CE is reasonably intuitive and powerful, a number of undocumented features and problems slowed the development. However, after several months of trial and error, we have a system that is working well.

We noted that we were making several interventions. We linked schedules over our network, distributed handheld computers to the physicians, and developed a database program, a novel application to support hospital visits and billing. Although we are focusing on the handheld computer, any one of these elements may be responsible for our findings.

The hardware has both positives and negatives. Our surgeons liked the bright screen and integrated keyboard of the HP 620 LX. However, the units were larger than they would have ideally liked. During the project, four out of nine units experienced failures. One unit failed when it got wet, one failed after it dropped onto carpet, and two failed for unknown reasons. Three were returned to the manufacturer and one was restarted by removing and then reinstalling the batteries. Because of hardware and software difficulties, the IT department has viewed this as a high maintenance project.

Our business office also experienced a number of difficulties. Two months into the project, our major billing problems are as follows:

- Incomplete capture of charges. So far, we have found 30 procedures (3%) that were not entered

directly into the H/PC. These were discovered by routine checking of our backup paper system.

- Inadequate patient identifiers entered by the surgeon to correctly identify the patient.
- Inadequate documentation of diagnosis and procedures.

Our feeling is that we are capturing more charges with the H/PC, but the staff still has to expend considerable effort to assure this. We believe that the solution to the problems may be in improved software design, and we have built a continuous feedback and modification loop into the project.

### Days to Post

There did not appear to be significant change in the Mean or Median DTP after the H/PC was introduced. With regard to charges that are posted >30 days, >45 days, and >60 days, it is too early to draw conclusions about whether there is an economically important difference between the groups.

### Hospital Charges

We were able to show that the percentage of billing that reflects cognitive services increased significantly with the use of the H/PC. Part of this increase may be due to the growth of the surgical practice. However, the number of hospital procedures increased by only 27% per month after our intervention, whereas the number of consultative charges increased by 157% and the amount of these charges increased by 111%.

We believe that our physicians were forgetting to turn in their billings for their hospital consultations and that the ease of entering codes into the unit while they were making rounds in the hospital resulted in an increased capture of appropriate charges.

### Questionnaire

All questions showed a trend toward improvement, and the study had sufficient power to show statistical significance for 10 of the 16 questions. Furthermore, there are some interesting trends that can be noted from those that did achieve significance.

Questions 2, 11, and 12 showed that users were more able to view, access, and coordinate their own and other's schedules. This is not surprising, as they were moving from a system that was largely paper-based.

Question 9 also showed that users felt they were better able to communicate with members of the surgical team, which supports one of our key hypotheses. Question 10 also showed a positive trend when asked about the ability to communicate with other physicians, going from values of 4.49 to 3.29, but this did not achieve statistical significance.

Questions 3, 4, and 5 showed that users felt that the system allowed them to turn in billing that was more accurate, timely, and complete with regard to documenting the complexity of the visit. This is supported by the statistical analysis from the Days to Post, as noted previously.

Questions 6 and 8 showed that users felt that the system allowed them to access a list of procedures and consultations previously performed and to perform outcome analysis.

Question 16 is interesting, as it shows that physicians had an increased level of administrative satisfaction (the business of medicine) with use of the H/PC. This value went from 5.86 (quite dissatisfied) to 2.57 (somewhat satisfied). The level of professional satisfaction (the art of medicine) also went up from 2.29 to 1.86, but it was not statistically significant, partly as a result of a high level of professional satisfaction before the study was initiated.

Looking at grouped data, the average surgical response went from 4.61 to 2.52. ( $p = 0.016$ ), while the average MA response went from 3.66 to 2.50 ( $p = 0.047$ ). Whereas it is difficult to interpret grouped data, it seems reasonable to state that the responses went from dissatisfied to satisfied, with the surgeons perceiving a somewhat larger gain from use of the H/PC than the MAs.

#### A Work in Progress

The results presented in this paper are preliminary. We will continue to collect data for an additional four months, analyzing the Days to Post and Hospital Charges for one more month and then allowing three months to collect data after the cutoff date. We will present this information when it becomes available.

#### CONCLUSION

Handheld computers are extremely popular with the public and are making their way into medical applications. Our hypotheses were that handheld computers would make it easier to coordinate physician schedules, make billing more timely and cost-effective, and would improve physician communication. Our preliminary study supports these hypotheses and also indicates that the use of these devices enhances physician satisfaction. If further analysis confirms our findings, we expect that the use of handheld computers for physician billing and scheduling will become a common practice in the near future.

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