Implementation of a Handheld Electronic Point-of-Care Billing System Improved Efficiency in the Critical Care Unit

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Coding and billing are time consuming and important considerations for critical care practitioners. A 1-year prospective, observational study incorporated the use of a personal digital assistant and MDeverywhere software (Hauppauge, New York) for patient coding and billing. Twelve months of data were examined before electronic implementation (pre-elec) and compared with a 12-month period after implementation (post-elec) by using an unpaired *t* test or *z* test with $P < .05$ considered significant. The total number of charges was 2479 pre-elec and 2243 post-elec. The days from date of service to billing for services significantly decreased from 37.8 pre-elec to 12.4 post-elec ($P < .001$); days in accounts receivable significantly decreased from 92.0 to 73.0 ($P < .001$). The net collection rate increased from 44.7% pre-elec to 49.3% post-elec ($P < .001$). Duplicate charges significantly decreased from 5.0% pre-elec to 1.4% post-elec ($P < .001$). The return on investment was 1.97-fold (197%). The initiation of personal digital assistant technology to facilitate billing and coding resulted in significant improvements.

Key words: *personal digital assistant; PDA; information technology; billing and coding; electronic; critical care*

Improvements in medical technology and information management promise better communication between members of the health care team. Electronic medical record systems can facilitate workflow and improve quality of patient care and patient safety [1]. Electronic records can also provide a positive financial return on investment [2].

Personal digital assistants (PDAs) are being used increasingly in medicine for a variety of reasons. In a recent survey of physicians, 57% reported using some type of handheld computer device such as a PDA or pocket personal computer, with the most common use of these devices being tracking of contacts and appointments. Only 5% to 7% used the devices for medication orders, to obtain laboratory results, or for patient record access [3]. A recent survey of pediatricians found only 4% used PDAs for billing [4].

Personal digital assistants can be used to access medical references as well as clinical data such as laboratory and radiology results [5]. Many regulatory agencies require documentation of procedural experience for licensing or hospital privileges, which can also be facilitated with the use of PDAs [6]. With this in mind, a handheld billing system was introduced with the hope of improving business efficiency by decreasing the length of time to generate a bill for services rendered, decreasing duplication of bills, and increasing collection rates.

Methods

Setting

Three critical care physicians at the University of Kentucky were trained to use the MDeverywhere (MDe) software (MDeverywhere, Inc, Hauppauge, New York) on a PDA. None of these physicians had prior experience with handheld electronic billing and only 1 regularly used a PDA, primarily for calendar functions. They were trained for approximately 1 week before data collection began. The physicians carried the PDAs while they worked in

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the intensive care unit (ICU). The ICU patient population for both time periods was composed of multitrauma and neurosurgical patients from the surgical services, including general surgery, vascular surgery, and other surgical subspecialty patients. The payer mix and acuity within the ICU did not change between the 2 time periods.

The billing data from the PDA was synchronized at the end of each day. This synchronization of all data between the PDA and desktop computer was accomplished with a 1-button method with password protection. This enabled point-of-care billing immediately after each procedure was completed and allowed for point-of-care dictation. A staff member reviewed the billing data to enter any information that was required by edits (eg, missing diagnoses codes) and to ensure all required physician documentation for billing was present. The billing information was then uploaded to Signature (Siemens Corporation, Boca Raton, Florida) to generate the final bill.

The billing system before handheld implementation was physician-generated, with billing hand-recorded on preprinted billing cards that contained the most common diagnoses and billing codes. A staff member entered the physician-generated billing data into VitalWorks (VitalWorks Inc, Minneapolis, Minnesota). This required a staff member to use a computer keyboard to enter all billing information, including case identification number, service date, patient location, provider number, referring physician, diagnostic codes, and critical care service billings, including modifiers and procedures. Manual entry of demographic data in VitalWorks requires a minimum of 8 to 10 key fields, such as date of birth. Once all the data were entered and all required physician documentation for billing was present, the billing data were uploaded to Signature, which generated the final bill. The predata and postdata were collected from the same 3 physicians.

Hardware and Software

The physicians used the Palm Tungsten T3 (Palm Inc. Sunnyvale, California) and software from MDe. The Palm T3 has an OMAP1510 (ARM925 core + DSP) processor with 16 megabytes of random access memory and Palm OS 5.0 (Palm Inc). It has handwriting recognition, voice dictation, and also permits data input using a virtual keyboard. It can interface using a universal serial bus (USB) cable, infrared, or Bluetooth technology (Bluetooth Special Interest Group, Bellevue, Washington). The Palm Tungsten T3 was chosen because of MDeverywhere software compatibility, its dictation module, easy to read screen, compact size, battery life, and integrated keyboard function. The Palm PDA connected by a serial cable to designated computer terminals, including a personal computer, in each physician's office as well as several central locations within the hospital that allowed file synchronization with the 1-button method described previously.

A program from MDeverywhere was used to collect the data. The process involved synchronization of the desktop computer and the PDA. This obtained the entire hospital inpatient census in an encrypted text file from the IDX system (Siemens). The providers then used the hospital census to create a rounding list of their patients, which allowed billing on the PDA. In addition to providing billing data, the hospital census provided unique patient identifiers and updated locations. The hospital census was updated every 3 hours beginning at 6 AM, with the last daily update at midnight. Synchronization of the PDAs was required to update the PDA census. Before the PDA technology was implemented, the hospital system had generated the census data with updates as detailed above and used IDX for billing demographics. A simple interface program was written by University of Kentucky information technologists that permitted downloading of the census and billing demographic data to the PDA.

The minimum hardware and software requirements to allow storage of data and synchronization interchange between the desktop computer and PDA were a 500-MHz Windows 2000 Operating System, Internet Explorer 6.0 SP1 (Microsoft Corp, Redmond, Washington), Adobe Acrobat Reader (Adobe, San Jose, California), 128 MHz of memory, and a graphics adapter to support a screen area of 800 × 600 pixels. Because charge data were Internet-based, a basic personal computer with a high-speed Internet connection and Internet Explorer 6.0 SP1 or higher was required. This allowed optional entry of additional charges or editing of entered charges and generation of reports. No onsite server or network was required for implementation, and MDe provided storage for all practice data. This storage system was compliant with the Health Insurance Portability and Accountability Act (HIPAA). The PDAs could be secured by a PDA lock-down system to comply with HIPAA-mandated privacy and security regulations.

Charge data captured by the physician on the PDA included visit type or procedure-only visit, billable diagnosis, absence/presence of resident involvement, and place of service. The billing module would show required edits if any of the aforementioned data was omitted. The billing software would alert

the physician if a modifier were required. For example, if 99291 (30-74 minutes) of critical care time were billed concomitant with a procedure such as a central venous catheter (36556), the program would ask "Is the E/M service you are billing significant and separately identifiable from the procedures?" If answered yes, the computer software would automatically add modifier 25 to the bill.

The rules engine of the PDA used local medical review policy guidelines to prompt for missing or invalid information, including diagnoses, compatibility of the diagnosis with the procedure code, and referring physicians, if required. The billing software provides updates to the rules engines; the billing providers and billing organization can also both request updates. One bill per patient was generated daily, which included visit(s) and procedure(s).

Each PDA had a secure digital card that saved the handheld dictations. After each patient's dictation, a symbol appeared to the left of the patient name on the rounding list. Each physician could easily view completed and still-required dictations. After all dictations were completed, this secure digital card was placed in a card reader (Lexar Media, Inc, Fremont, California) and a WAV file (Windows audio format file extension) of the voice recording was sent to the transcription company (MedQuist Inc, Mount Laurel, New Jersey). The number of WAV files was confirmed at the time of transfer. The transcription was returned by Soft Med (SoftMed Systems Inc, Silver Spring, Maryland) and uploaded into the electronic medical record.

At the end of the day, each physician downloaded the billing data using communication software from the Internet to an offsite MDeverywhere central database for the University Hospital where it could be viewed and edited by designated business office staff before release. The bill was released if no further edits were required and appropriate documentation had been signed; no paper bill was generated in the time after this PDA billing system was implemented (post-elec phase). The PDA-generated bill was then uploaded in to the Signature billing software, which was the same final billing system that was used during the time before the PDA system was implemented (pre-elec period).

Data Collection

Twelve months of data were examined before the implementation of this PDA billing software system (pre-elec) and compared with the 12-month period after its implementation (post-elec). The following points were analyzed: number of days from date of service to date of billing, actual number of days in accounts receivable, and number of duplicate charges. In addition, the snapshot financial data included the net days in accounts receivable. This was calculated by the gross revenue, regardless of service date, for 12 months from all critical care payments divided by the number of dollars per day in accounts receivable. The collection rate was calculated by cash revenues received during the 12-month period divided by fees.

An unpaired t test was used to analyze data before and after the implementation of handheld electronic billing and dictation. In addition, time periods to post a bill as well as total number of duplicate charges were calculated as a percentage of total bills and analyzed with a z test. A value of $P < .05$ was considered significant.

Denial codes were also examined before and after the implementation of handheld electronic billing and dictation. Entry time for a typical physician PDA-generated bill was compared with billing data entry into VitalWorks by the staff specialist.

Results

There were a total of 2479 charges for the 12-month period pre-elec and 2243 charges for a 12-month period post-elec. The number of days from date of service to date of billing for the provided services was 37.8 days pre-elec and 12.4 post-elec ($P < .001$). Table 1 represents the monthly data. Table 2 represents the timeline of charges, with the handheld electronic implementation having a significant effect of increasing the percentage of charges submitted within 30 days of service and decreasing the number of all charges submitted after 30 days. The actual number of days in accounts receivable significantly decreased from 91.9 pre-elec to 73.0 post-elec ($P < .001$). There were 124 duplicate charges pre-elec (5.0%) and 32 duplicate charges post-elec (1.4%), which was significant ($P < .001$). Net days in accounts receivable decreased from 90.6 pre-elec to 67.7 post-elec ($P < .001$). The collection rate significantly increased from 44.7% pre-elec to 49.3% post-elec ($P < .001$).

If all billing demographic data were available for a patient, the average time for a typical bill, with 4 diagnoses and a 99291 charge to be entered manually into the pre-elec system electronically, was 65 seconds by a trained data entry specialist; the physician time to enter the same PDA bill in the post-elec system was 9 seconds. If billing information was not readily available and necessitated a search by the data

Table 1. Yearly Billing Data from Before and After Implementation of a Handheld Electronic Point-of-Care Billing System

Time Period	No. of Charges	No. of Days From Service to Billing	Charges, $	Payments, $	Days in Accounts Receivable
Pre-elec					
2003					
January	111	33.4	35 455	15 161	82.2
February	203	23.0	48 045	22 295	155.6
March	128	27.4	38 588	18 617	118.7
April	199	27.3	45 221	25 096	130.6
May	218	53.5	58 595	24 111	80.8
June	279	43.8	82 359	37 835	86.4
July	228	35.6	64 533	29 015	83.1
August	296	36.1	74 674	37 668	97.1
September	263	25.8	77 761	34 148	65.5
October	213	47.5	59 331	21 764	70.9
November	186	52.1	54 169	21 906	45.3
December	155	48.2	46 497	18 764	86.6
Totals	2479	453.7	685 228	306 380	1102.8
Average		37.8			91.9
Post-elec					
2004					
July	239	15.2	73 554	32 491	68.4
August	183	10.2	47 262	20 104	88.8
September	164	22.2	52 347	21 876	82.5
October	156	15.3	40 418	18 242	64.0
November	242	9.5	73 997	37 171	69.4
December	227	17.3	69 408	36 592	72.8
2005					
January	124	11.0	34 853	24 276	68.7
February	190	8.8	57 624	30 087	88.8
March	200	10.5	65 553	32 402	60.8
April	198	16.5	60 031	29 096	66.6
May	152	4.9	49 994	26 138	71.0
June	168	7.2	54 417	26 596	73.7
Totals	2243	148.6	679 458	335 071	875.5
Average		12.4			73.0

Abbreviations: Pre-elec, the period before the handheld device was used; Post-elec, the period after the handheld device was introduced.

Table 2. Days to Post Bill

Time Period	<30 d	31-59 d	60-89 d	>90 d	Total Charges
Pre-elec					
1/1/03-6/30/03	639	335	109	55	1138
7/1/03-12/31/03	729	469	74	69	1341
Total	1368	804	183	124	2479
% of all charges	55.2	32.4	7.4	5.0	
Post-elec					
7/1/04-12/31/04	1102	97	4	8	1211
1/1/05-6/30/05	1010	18	0	4	1032
Total	2112	115	4	12	2243
% of all charges	94.2	5.1	0.2	0.5	

Abbreviations: Pre-elec, the period before the handheld device was used; Post-elec, the period after the handheld device was introduced.
Note: Days to post bill expressed as percentage of total time period. All differences in percentages by z test were significant at each time period ($P < .001$).

entry specialist in the pre-elec system, this lengthened the required time because it required accessing other databases to search for required data. All billing data in the post-elec period, including updates, were available on the PDA, obviating the need for additional information updates or to search other databases.

Denial data were examined, and 62 charges were identified as data entry errors or lack of billing information entry in the pre-elec period, but no denials were found in this category during the post-elec period. This represented 2.5% of the total charges for the pre-elec period.

Discussion

The objective of this study was to determine whether point-of-care billing increases business efficiency for the division of critical care. Variables examined included length of time to generate a bill for services rendered, duplication of bills, and collection rates. Although many of the indicators affected were controlled by the final billing company, which remained Signature during both time periods, the replacement of the VitalWorks data entry by the electronic PDA billing data collection may have positively affected several variables. Although it is hard to isolate all of the variables, we believe there were some potential factors.

One factor was that the PDA linked the patient registration information and billing data with the medical record number when the patient's data were downloaded from the hospital census to the PDA; whereas in the previous system, this needed to be entered separately by a data entry specialist. Allowing the PDA system to download required billing data from the central hospital billing database (IDX system) might have resulted in fewer data entry errors because the PDA eliminated the step of reentering the data into VitalWorks. Fewer denials in the post-elec period produced by data entry errors or incomplete billing information are supportive evidence. When these denials occurred in the pre-elec period, additional research was required to identify the error, obtain the required information, and then resubmit the bill for services.

The PDA system also had significantly fewer duplicate bills for the same service and prompted physicians to ensure modifiers were attached, which resulted in fewer initial claim denials for this inaccuracy. Potentially a positive effect on days in accounts receivable could have been realized because more accurate bills were being submitted with earlier payments as a result.

The faster billing may have had additional benefits as well. Certain special funds (eg, Motor Vehicle Fund) have a cap on payment per occurrence, with bills typically paid in the order received; thus, earlier submission potentially resulted in a higher collection rate. These bills may be referred to collection if not initially paid, thus increasing the days in accounts receivable. Potential explanations for the increase in net collection rate could include such factors as the Motor Vehicle Fund. The overall average percentage of Motor Vehicle Fund billings is approximately 5%. Earlier submission of those bills could have increased net collection rate.

To examine if part of the increase in net collection rate could have been due to an increase in revenue, the top percentage of payers was examined during each time period. On average, the most frequently billed carrier was Medicare, followed by Medicaid; the most frequent charge was 99291. No change occurred in the net collection rate for Medicaid because the amount billed and collected remained identical for the initial critical care minutes with 99291 and subsequent critical care minutes with 99292 codes during both time periods. For Medicare, the amount billed and the amount paid for both critical care codes did increase during the pre-elec and post-elec periods; however, even using the highest percentage of increase, it only accounts for 0.8% to a maximum of 1.4% increase in accounts receivable; thus, not accounting for the total 4.6% increase in net collections in the post-elec period. Another possibility includes faster billing resulting in fewer bills needing to be sent to a different address secondary to the patient's change in demographic data during the time required for billing.

Although many of the variables affected were controlled by the last step of the billing company, which was not changed, we believe some variables were positively affected because the PDA shortened the time to submission of the charge information and potentially may have provided more accurate charge information. Further investigation needs to be done to confirm the impact of these and other variables.

Handheld computers have a great potential to improve health care. Although the technology is impressive, the handheld computer is not a tool used by mainstream caregivers. The lack of universal acceptance may be due to a number of factors. The most important is inadequate training and lack of familiarity with the technology [7, 8]. Three components need to be in place for successful implementation of this technology [9]: the technology, the software, and the users all have to be optimized at the introduction of this technology or it will not

Table 3. Return on Investment Calculation

Investment and Return	Amount, $
Total investment	
Handheld devices with cradle	1110.00
Card readers for secure digital cards	95.00
Secure digital cards	423.00
Physician licenses	3000.00
Extra cradles for synchronization	127.00
Transcription costs	10 301.00
Total investment	15 056.00
Total return	
Staff saving	29 397.00
Extra interest	264.00
Total return on investment	29 661.00

be used. If all 3 components are in place and there are clear benefits, including financial, the technology can be introduced successfully.

The number of days from service to date of billing was reduced from 37.1 to 12.4, almost a 3-fold decrease. Of note in Table 2 is the continued improvement between the first 6 months of electronic implementation compared with next 6 months, in which the number of bills submitted after 30 days was further reduced. Days in accounts receivable also decreased significantly, and the collection rate increased by almost 5%. The return on investment to the department was 197%, which included purchase of all PDA handheld devices and transcription costs (Table 3). The enterprise had already purchased the software billing licenses for physician providers; the cost was $1000 per physician license. This return on investment was largely due to elimination of a staff position and benefits due to the more cost-efficient transcription and higher collection rate with institution of point-of-care billing. The efficiency of this system was enhanced by having the patient demographic and billing data able to be used when a patient was entered from the census into the PDA.

The PDA data can be protected with a 4-digit personal identification number, password protection including strong alphanumeric password, and fingerprint technologies to provide heightened security. File-level encryption protects PDA data and dictation.

Handheld dictation at point of care allowed bedside dictation, allowing the clinician to perform physical examination components as well as review current hemodynamic data during dictation. Although telephone dictation could have been used, the software dictation system allowed continuous and quick access to dictated daily notes for updates. Thus, if scans were viewed in radiology, those results could be added to the dictation at that time and location. The PDA system allowed each patient note to be truncated or redictated if circumstances required. Other potential advantages of this system were noted by the users, including continuous calendar access regardless of time or location and the capability of generating meeting reminders. This system also tracks resident- and attending-performed procedures.

Several other advantages were noted by the physicians and used with variability, depending on the provider. At the start of the day, the updated census provided patient location and informed the provider if the patient changed locations. These updated locations increased physician efficiency because critical care units in this configuration are geographically separated. Patients identified as discharged from critical care areas no longer required critical care services and could be removed from the physician's rounding list. The PDA symbols confirming dictation on a given patient provided a system to confirm which patients' information had been dictated.

Conclusion

Compared with the prior billing system, the implementation of a point-of-care electronic billing and transcription system using PDAs had a positive effect on the bill collection rate and significantly decreased the number of days to post charges and the number of days in accounts receivable. The number of duplicate bills dropped dramatically. The new system provided a positive return on investment and the potential for better patient care through information access and rapid access to important clinical information.

As newer technologies become available, the ability for secure, wireless transfer of information from the hospital database to the handheld device—and transmission of billing data from the handheld device to the secure Internet location—has now become a reality.

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References

1. Shea S, DuMouchel W, Bahamonde L. A meta-analysis of 16 randomized controlled trials to evaluate computer-based clinical reminder systems for preventative care in the ambulatory setting. *J Am Med Inform Assoc*. 1996;3:399-409.
2. Wang SJ, Middleton B, Prosser LA, et al. A cost-benefit analysis of electronic medical records in primary care. *Am J Med*. 2003;114:397-403.
3. Baker ML. Doctors using handhelds, but not for medicine. Available online at: http://www.coinsight.com/article2/0,1397,1779861,00.asp. Accessed December 31, 2006.
4. Carroll AE, Christakis DA. Pediatricians' use of and attitudes about personal digital assistants. *Pediatrics*. 2004:113;238-242.
5. Lapinsky SE, Weshler J, Mehta S, Varkul M, Hallett D, Stewart TE. Handheld computers in critical care. *Crit Care*. 2001;5:227-231.
6. Martinez-Motta JC, Walker R, Stewart TE, Granton J, Abrahamson S, Lapinsky SE. Critical care procedure logging using handheld computers. *Crit Care*. 2004;8:R336-R342.
7. McAlearney AS, Schweikhart SB, Medow MA. Doctors' experience with handheld computers in clinical practice: qualitative study. *BJM*. 2004;328:1162.
8. Lapinsky SE, Wax R, Showalter R, et al. Prospective evaluation of an internet-linked handheld computer critical care knowledge access system. *Crit Care*. 2004;8:R414-R421.
9. Fischer S, Stewart TE, Mehta S, Wax R, Lapinsky SE. Handheld computing in medicine. *J Am Med Inform Assoc*. 2003:10;139-149.