Respiratory Care Billing Using a Personal Digital Assistant

William R Howard MBA RRT

In 2003 I reported how my respiratory care department at Tufts-New England Medical Center developed an inexpensive, in-house, computerized clinical-information-management system, in which the respiratory therapists carry handheld computers during their rounds, entering clinical information into the handhelds as they work and later downloading that information to a database in a desktop computer. Now we have added a billing module to our customized software. This article describes the design, use, and attributes of this billing system, including improved charge-capture, which increased department revenue substantially. Our system has several other important advantages over traditional billing systems. *Key words: information management; data collection; medical records; hospital charges; fees, medical; computers, handheld; PDA; personal digital assistant; computers, palmtop; pocket PC.* [Respir Care 2004;49(11):1339–1348. © 2004 Daedalus Enterprises]

Introduction

The use of personal digital assistants (PDAs) in health care continues to evolve but appears limited to providing conveniences such as literature or drug referencing, critical care formula calculation, manual entry of patient data, and drug dosage aids.[1–9] The evolution of PDA software has brought to the market attractive packages for the physician and nursing professions (eg, ER Suite and Nurse's Toolbox [both made by Medical Wizards, Santa Rosa, California], and PatientKeeper [made by PatientKeeper, Brighton, Massachusetts]). Those packages are marketed specifically to those professions, and they allow caregivers to record basic patient information, admission diagnoses, patient histories, daily progress notes, and laboratory results, and to track medications. A common feature of all medical PDA software is that the manufacturer attempts to bring useful tools to the bedside, with the health care provider's convenience in mind.

A limiting factor, apparent with the majority of PDA software packages, is an interface with a desktop computer, which I find advantageous for the integration with database software. Having this integration, the end-user can query the data and generate customized reports. Considering the apparent success with non-respiratory-care medical software, though, this evolution may serve as a foundation for expansion into this profession.

See the Related Editorial on Page 1307

The use of PDAs in respiratory care was limited until recently, when the use of PDAs for this profession was reported.[10] There are no additional references of comparable projects noted in the literature. In the original project, PDAs were described as replacements for traditional paper flow-sheet forms for capturing and documenting comparable clinical information standard to our profession. These data include ventilator settings and measurements, inhaled medication treatment dosing, and patient assessment. At shift completion, the PDAs are synchronized with a Microsoft Access database (Microsoft, Redmond, Washington), which is then used to generate end-of-shift reports. These patient-specific reports are filed in the patients' medical records.

At my institution, complete transition occurred from paper-form documentation of respiratory care services in critical care. This has resulted in the capture and digital storage of approximately 160,000 ventilator checks annually, with the assistance of PDAs and desktop-computer database software. Accompanying these data are the documentation of inhaled medication treatments and SOAP

William R Howard MBA RRT is affiliated with the Department of Respiratory Care, Tufts-New England Medical Center, 750 Washington Street, Boston, Massachusetts.

Correspondence: William R Howard MBA RRT, Department of Respiratory Care, Tufts-New England Medical Center, 750 Washington Street, T-NEMC #785, Boston MA 02111. E-mail: whoward@tufts-nemc.org.

(subjective, objective, assessment, plan) chart notes (known as "problem-oriented documentation").

Flexibility of the system addressed various needs, which were customized reports, flow sheet charting, research, quality assurance, daily census, and the identification of patients considered ready to wean from mechanical ventilation. Considered a related element to this initial effort was a billing module found on the more expensive ($150,000-$250,000) commercial products such as Clinivision (Mallinckrodt, Carlsbad, California), Tenet (Tenet, Sandy, Utah), and MediServe (MediServe, Tempe, Arizona). The transition to PDA data capture has been positive, and digitizing the data allows the opportunity for numerous analytical possibilities. Currently, the database is queried for numerous quality-assurance reports, service utilization, and respiratory therapist (RT) practice. These are features that are easily and efficiently possible due to having the data digitized.

The recording of billable items typically occurs using paper charge forms located within the offices of our department. Logistically, this is far from the location of where respiratory care procedures occur. Attempting to remember all of the chargeable items for the shift, when the RT decides to enter patient charges, can result in billing errors. Ideally, each clinician should document point-of-care billing with a convenient-to-use recording device at the location of the service provided.[11,12]

Recording of billable procedures and products is not unique to our institution. Often, though, the staff has difficulty managing and making time available to record the services that they provided to the patients. Therefore, the goals of this project were to produce a more accurate patient bill, to lessen the clerical burden of billing on the RT, and to institute a more convenient method of capturing billable services. The following describes the latest module of our *electronic data-capture project* (EDCP).

Process

The process for this project begins with PDA data entry of routine ventilator checks,[10] identification of miscellaneous billable services, synchronization of those data to a database in a desktop computer, printing charge-entry reports, and clerical entry of the service codes (Figs. 1 and 2). From beginning to end of that process, there are automated and manual entry components that, combined, develop a report of all billable services for each patient.

Automated Component

The automated component identifies the primary respiratory care services provided to the patient (Table 1). This automated component of the billing system captures 95% of the gross patient service revenue for the department.

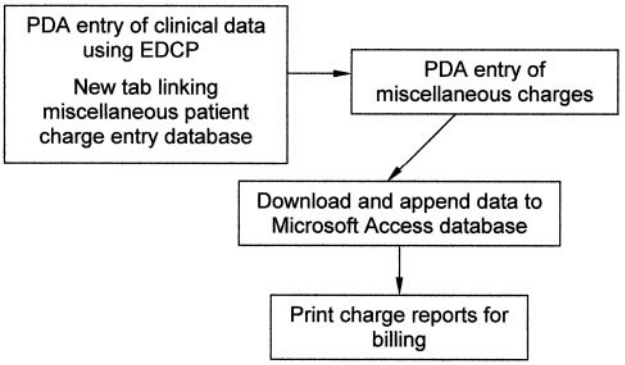

Fig. 1. The billing module flow process. PDA = personal digital assistant. EDCP = electronic data-capture project.[10]

The identity of the service results from a link to the data entered in the EDCP module. Specifically, the Mode field is used to identify the primary service group (see Table 1), the Medication Time fields identify the number of administered inhaled medications, and the number of records for each patient in a 24-hour period is totaled to identify the number of ventilator checks or RT visits for clinical assessment.

Manual Entry Component

Several chargeable items (Table 2), which represent 5% of the gross patient service revenue, are not captured with the automated billing component. The PDA is used to capture all nonautomated billable services and products provided by the RT.

PDA Database Design

There are 5 databases stored on the PDA for this project. Figure 2 shows an entity relationship diagram[13] that illustrates the structure of the PDA databases and their relationships to the database in the desktop computer. The description of the 2 primary PDA databases (used for recording adult, pediatric, and neonatal patient data) was discussed in the original article on the EDCP.[10] The 3 new databases code and store miscellaneous charges until a HotSync or download to the server database occurs.

Minor programming adjustments to the original EDCP SmartList To Go software (DataViz, Milford, Connecticut) were necessary to accommodate the manual-entry billing module.

Table 3 and Figures 3 and 4 show the fields of the new screens in the manual entry component of the billing module.

The manual-entry billing module includes 2 separate databases that link to the parent EDCP module in the PDA.

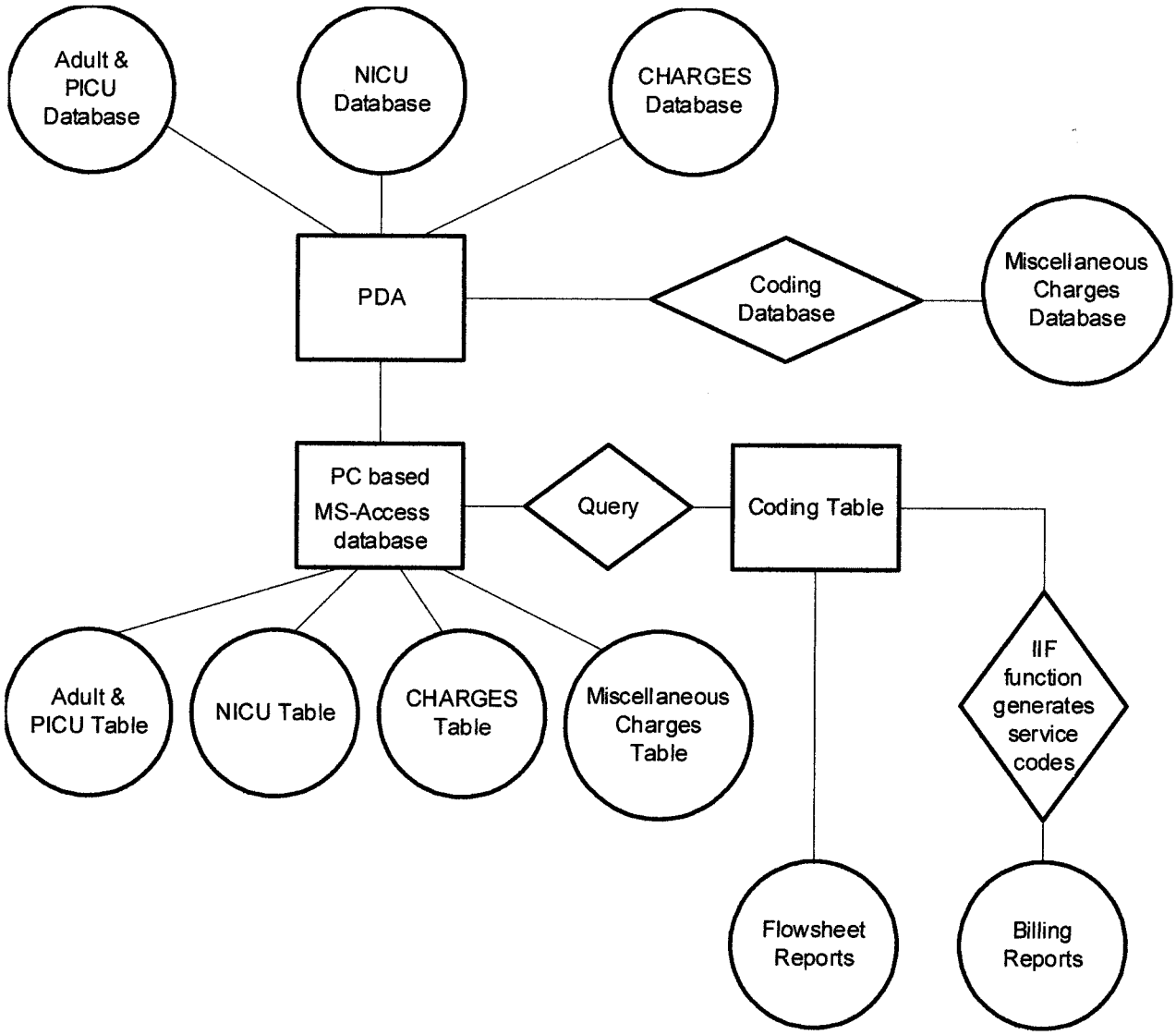

Fig. 2. This entity relationship diagram illustrates the structure of the personal digital assistant (PDA) database and its relationship to the desktop-computer (PC)-based database. PICU = pediatric intensive care unit. NICU = neonatal intensive care unit. MS = Microsoft.

Table 1. Primary Services

Aerosol therapy
BiPAP
CPAP
Heliox therapy
Inhaled medication therapies
Mechanical ventilation
Oxygen therapy
Ventilator and patient assessment checks

BiPAP = bilevel positive airway pressure
CPAP = continuous positive airway pressure

Selecting the CHARGES button (see Fig. 3) initiates a "one-to-many" relationship and links to a separate database that shows a screen that has 2 tabs: Major and Surfactant (see Fig. 4).

The fields Patient Name, Medical Record Number, Date, and Patient Room with number are linked to the parent EDCP database and are transferred to the patient record. From drop-down lists the clinician selects his or her shift and name. Auto-increment fields are used to indicate the number of ventilator or fraction of inspired oxygen (F_{IO_2}) adjustments and the number of airway suctionings during the shift. The Surfactant tab, which also uses the auto-increment feature, is used to input the number of surfactant treatments administered. The first tab also includes a "one-to-many" button that directs the clinician to the database used for billing of all miscellaneous services (see Table 2). The display for Miscellaneous Charges has a single screen

Table 2. Miscellaneous Services

Bedside PFT
Cardiopulmonary resuscitation
Chest physiotherapy
Disposable products
P_{ETCO_2}
Overnight oximetry
Pentamidine treatment
Sputum induction
Tracheostomy tube change
Transports (internal and external)
Ventilator and F_{IO_2} adjustments

PFT = pulmonary function testing
P_{ETCO_2} = end-tidal partial pressure of carbon dioxide
F_{IO_2} = fraction of inspired oxygen

(Fig. 5). Being linked to the parent EDCP database, the fields for patient name, medical record number, date, and intensive care unit (ICU) room number are automatically entered. Tapping the "database join" icon on the right side of the Description field, displays a list of miscellaneous billable services. Tapping on one of those services selects and enters the charge for that service in the appropriate Description field. The specific entries are merely stylus selections from pre-programmed lists of disposable products and procedures. There is no stylus writing or keyboard entry required. In the Quantity field, each tap of the stylus on the plus or minus indicator increases or decreases the value by one, to indicate the number of occurrences.

After entering all miscellaneous charges, selecting the back arrow button returns to the initial charge entry screen. From that screen, selecting OK for confirmation shows a list of charges for the selected patient. Selecting the back arrow button from that display returns to the original patient record of the parent EDCP database.

Downloading the Data

Placing the PDA into its cradle at the end of each shift (Fig. 6) and pushing the HotSync button begins the HotSync operation that downloads the data from the PDA to the hospital's network server, which contains a copy of the Microsoft Access database. The HotSync function appends PDA database data to the desktop-computer based Microsoft Access database table counterpart used in the original EDCP, including all clinical data and the manually-entered miscellaneous charges noted above. The parent tables of data are linked to the billing queries to report the primary billable services. The tables developed in Microsoft Access for the manual billing modules are:

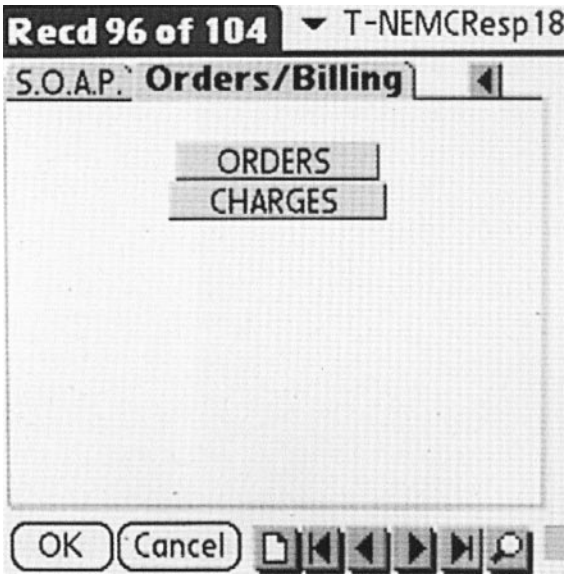

Fig. 3. Screen from which the user selects ORDERS or CHARGES. The CHARGES command launches the manual-entry billing module.

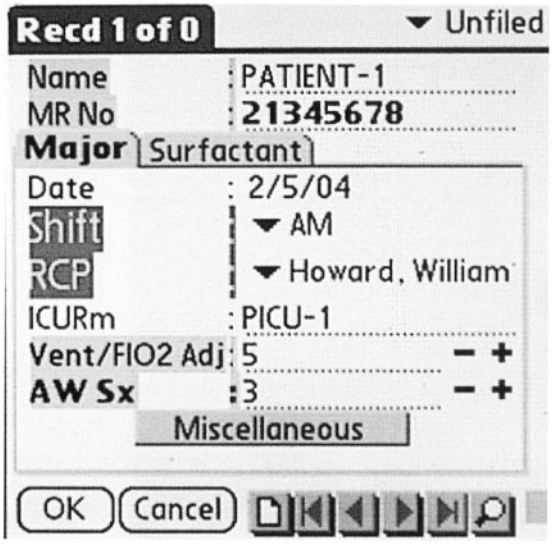

Fig. 4. The 2-tabs (Major and Surfactant) screen for entering miscellaneous patient charges. In the Major tab the respiratory therapist uses the auto-increment feature (ie, taps the plus or minus sign) to enter the number of adjustments he or she made to the ventilator or the fraction of inspired oxygen (F_{IO_2}) and the number of airway suctionings during his or her shift, for that patient. At the bottom of the Major tab is a "one-to-many" link button, which facilitates a "one-to-many" relationship link to the database used for billing all miscellaneous services. The Surfactant tab is for billing administration of artificial surfactant. As in the Major tab, the therapist uses the auto-increment feature (ie, taps the plus or minus sign) to enter the number of times surfactant was administrated.

- Charges - Adult and pediatric ICU patients
- Charges - Neonatal ICU patients

Table 3. Fields of the Billing Module's Manual Entry Component

Tab	Field Name	Clinician Interface
Major	Patient name MR number Date ICU and room number	The patient name, MR number, date, and ICU/room number are linked to the primary EDCP database and are automatically filled in.
	Respiratory therapist (list)	The PDA displays a list of respiratory therapists from which the practitioner selects his or her name.
	Shift	For the Shift field, the clinician selects from a drop-down list.
	Ventilator/F_{IO_2} adjustment AW Sx (airway signs and symptoms)	These 2 fields are billable and are used to document the number of respective occurrences on each shift. Using the auto-increment feature (tapping the stylus on the plus or minus indicator) increases or decreases the number of ventilator adjustments and airway suctionings performed for that patient on that shift.
	Miscellaneous	Selecting the Miscellaneous button displays a screen for entering various miscellaneous charges.
Surfactant	Patient name and MR number	The patient name and MR number are linked to the primary EDCP database and are automatically filled in.
	Surfactant	Using the auto-increment feature (tapping the stylus on the plus or minus indicator) increases or decreases the quantity of surfactant administrations performed for that patient on that shift.
Miscellaneous	Patient name MR Number Date ICU and room number	The patient name, MR number, date, and ICU/room number are linked to the primary EDCP database and are automatically filled in.
	Shift	In the Shift field the clinician selects from a drop-down list.

MR = medical record
ICU = intensive care unit
EDCP = Electronic Data Capture Project
PDA = personal digital assistant
F_{IO_2} = fraction of inspired oxygen

- Miscellaneous Charges - All patients
- Coding - All billable services

The Charges table includes the number of ventilator and F_{IO_2} adjustments, the number of airway suctionings, and the number of surfactant treatments administered. The Miscellaneous Charges table stores nonprimary billable products identified in Table 2. These tables have relationships with a Coding table. That relationship attaches a specific hospital code to each billable service in the department's charge master. Relationships to the Coding table have also been established with the Primary Service and Medication Treatment Time record fields of the parent EDCP database table. Together, the related tables are used to construct queries and subsequent reports of all billable services. Our billing secretary uses those reports for charge entry.

Billing Reports

The billing reports were designed in Microsoft Access and are constructed from the clinical data that the RT captures with the PDA, which is synchronized to the desktop-computer database. Our billing secretary uses the reports for patient charge entry. Database tables noted in the previous section are the basis for constructing queries for these reports. Queries were developed to target and highlight each patient's primary and miscellaneous billable services within the time constraints selected by the charge-entry secretary. The available time constraint queries are daily, weekend, holiday weekend, and prior 2 days. These queries are the foundations that filter time-constrained data into the production of billing reports.

Figure 7 shows the primary respiratory care services within the principal billing report. The mode field from the

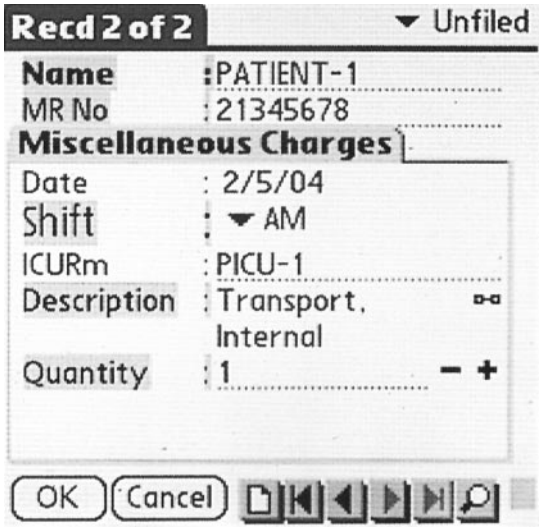

Fig. 5. Screen for entering miscellaneous charges. Selecting the "database join" icon on the right side of the Description field displays the miscellaneous billable charges listed in Table 2.

Fig. 6. Palm Model Tungsten T-2 personal digital assistant in its cradle. Pressing the HotSync button downloads the clinical and billing data to the hospital's network server database.

parent database is used to designate the primary service. That is the field that we identify and use for the automatic billing component displayed in our main billing report. That report also displays, for each patient, all billable service codes, the number of ventilator checks performed, the number of inhaled medication treatments administered, and the date and elapsed time of the billing sequence. The hospital-specific service codes are generated using the "IIF function"[14] of Microsoft Access once the primary service is identified. The IIF function inspects the mode field of the parent EDCP and returns billing service code values. At my institution, several itemized services are unique to the specific primary service and are included as part of the patient bill.

Figure 8 shows an example of a miscellaneous-charge report. Table 4 shows the specific report groups, report names, when to use them, and their billing time frames.

Selecting Microsoft Access on the desktop computer and loading the EDCP parent file, a single one-click Billing command button menu selection (Fig. 9) activates a multi-step macro (a macro is a set of one or more actions that each performs a particular operation, such as opening a form or printing a report; macros automate many common tasks in databases). A single macro in the billing module (1) initiates multiple query activation, which appends all network server database table data (the server database is where the clinical staff HotSync their PDAs) to the department's computer, (2) activates specific time-constrained billing queries, and (3) prints out the group reports. Charge-entry is ready for input by our billing secretary after each report is printed.

Analysis of Outcome

The automated component of the billing system represented 95% of the respiratory care department's charge capture. Therefore, accuracy was considered essential. Accuracy verification was conducted in a 1-week parallel pilot test that compared this project to the traditional method of billing patients, using standard department charge forms. Both the automated services (see Table 1) and the manual-entry components (see Table 2) accurately compared to the manual entries performed by the staff on charge forms. However, there were occurrences in the pilot test comparison in which the automated component captured services not billed for by the staff.

Second, the clerical burden required of the staff has decreased by approximately 10 min each shift for each clinician. This decrease is because they are no longer required to bill for 95% of the services that they provide. Finally, PDAs in the hands of the staff provides them with a tool for billing at the time that a miscellaneous patient charge occurs. Having a point-of-service charge-capture tool, they no longer have to remember what services were provided, using the traditional method, at the ends of their shifts.

Revenue Loss

Prior to this project, billing was performed manually using a pre-printed paper form on which staff entered their charges daily for each patient. A motivator of this project was the historical observation that patient charges were seldom accurate or complete. A conservative estimate by our billing secretary indicated that, without her intervention, 15 patients were not billed 4 primary charges each

Tufts New England Medical Center Respiratory Care - Adult and Pediatric ICUs - Daily Billing Report 2/6/2004 12:46:12 PM

ICURm	Pt NAME	MR NO	DATE	Time	Primary Service	Quantity	Billing Code
					Nasal Cannula	1	X 1X72507692
PICU-09	Patient-1	123456	Start Date: 2/5/2004	10:27:32 AM			X 72507486
			Bill Date Stop:2/5/2004	6:07:01 PM			72507726x1
			Total Hours: 7.7			1	X 72507403
			Service Days = 0.3			1	X 72566847
							X 72555709
					MDIs:	4	X 72555485
					Vent Checks	4	X 56402951
					SIMV	1	72507510x1
CTU-7	Patient-2	678910	Start Date: 2/5/2004	12:26:30 AM			X 72507486
			Bill Date Stop: 2/5/2004	7:55:25 PM			72507726x1
			Total Hours: 19.5				72507700X2
			Service Days = 0.8			1	X 72507403
						1	X 72507569
							X 72512015
						1	X 72566847
							X 72555709
							72507551x3
					MDIs:	4	X 72555485
					Vent Checks:	4	X 56402951
					HFOV	1	X 72507346
PICU-4	Patient-3	556688	Start Date: 2/5/2004	12:02:30 AM			X 72507510
			Bill Date Stop: 2/5/2004	11:55:25 PM			X 72507486
			Total Hours: 23.9				X 72507700
			Service Days = 1			1	X 72507403
						1	X 72507569
							X 72512015
						1	X 72566847
							X 72555709
							72507551x3
					MDIs:	9	X 72555485
					Vent Checks:	12	X 56402951

Fig. 7. Example of a principal billing report, showing the primary respiratory care services.

Tufts New England Medical Center Respiratory Care
Adult, NICU, and Pediatric ICU - Daily Billing Report of Miscellaneous Charges 5/6/2004 1:01:10 PM

ICURm	NAME	MR NO	DATE	Shift	Description	Quantity	Billing Code
CCU-1	Patient-1	123467	2/5/2004	AM	AW Sx	3	X 72507551
					Vent/FIO2 Adj	4	X 72555352
CCU-2	Patient-2	789104	2/5/2004	PM	AW Sx	3	X 72507551
					Transport, Internal	1	X 72507338
					Vent/FIO2 Adj	1	X 72555352
CCU-4	Patient-3	181987	2/5/2004	PM	AW Sx	5	X 72507551
					CODE 99	1	X 72553639
					Vent/FIO2 Adj	4	X 72555352
CTU-6	Patient-4	986987	2/5/2004	AM	Pt. Mechanics	1	X 72507700
					Vent/FIO2 Adj	5	X 72555352

Fig. 8. Example of a miscellaneous-charge report.

per week, or 60 billable services weekly on average. She identified gaps in service on the billing forms and considered it reasonable to "fill in the blanks" for the missing charges. Of concern was whether the patient received the same services throughout the billing cycle and were charged accurately.

Inaccuracies could result if the patient did not receive the same respiratory care service on days the clinical staff failed to perform billing. For example, on the nonbilled days, a weaning patient might receive mechanical ventilation rather than continuous humidification through a tracheostomy collar, depending on his or her success with weaning. Those different services have a substantial patient charge difference. Filling in the missing days on the billing form with the same services that were delivered earlier in the week may create billing inaccuracies. Patient services that were never captured onto the billing forms, such as new starts, was further reason for concern.

Assuming that missed charges are of concern, the potential annual loss of the 60 patient services weekly, without manual or automated intervention, represented substantial gross patient revenue. Our average price of $370 for each of these services (see Table 1) indicates a weekly loss of $22,200 and an annual loss of $1,154,400. This compares to projections provided by manufacturers of commercial systems, who claim that lost charges represent 1–10% of the budgeted revenue in respiratory care departments. Based on those claims we could have been losing a sizable sum, ranging from $240,000 to $2,400,000 of gross patient service revenue from our annual budget of

Table 4. Report Groups, Report Names, When to Use Given Reports, and Billing Time Frames

Group Report Name	Report Name	When to Use	Days of Billing Displayed
Daily	Primary Charges - Adult and pediatric patients Primary Charges - Neonatal patients Miscellaneous charges	Tuesday through Friday	Previous 24 hours (midnight to midnight)
Standard weekend	Primary Charges - Adult and pediatric patients Primary Charges-Neonatal patients Miscellaneous charges	Monday morning	Friday, Saturday, and Sunday
Long weekend	Primary Charges - Adult and pediatric patients Primary Charges - Neonatal patients Miscellaneous charges	Tuesday following a long holiday weekend	Friday, Saturday, Sunday, and Monday
Prior 2 days	Primary Charges - Adult and pediatric patients Primary Charges - Neonatal patients Miscellaneous charges	Following a day off in the middle of the week.	2 days inclusive prior to the current day

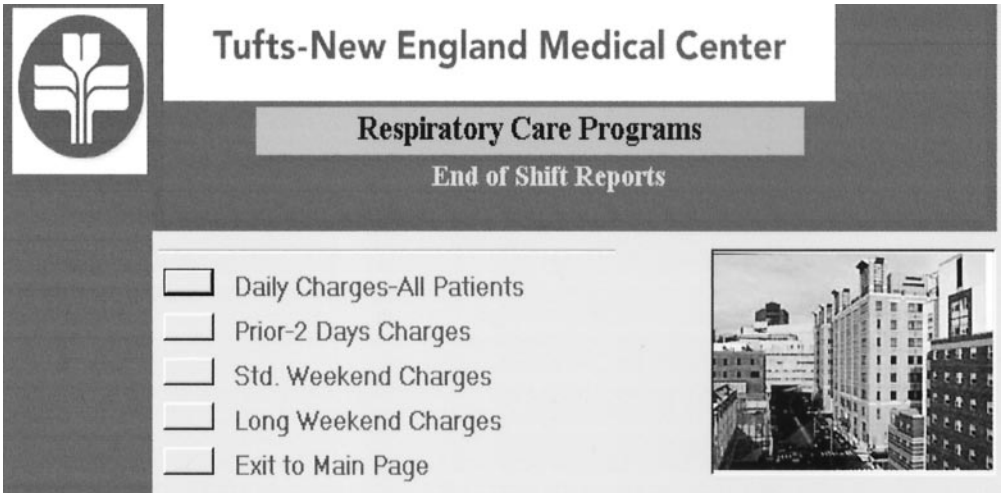

Fig. 9. The Reports screen in the Microsoft Access database on the desktop computer. After downloading data from the personal digital assistant, the clinician clicks on the command button that represents their assigned intensive care unit. That single click activates a macro that (1) appends clinical and patient charge data to tables in the desktop computer's database, (2) activates queries, and (3) sends the report to a laser printer.

over $24,000,000, depending on the actual amount of unidentified charges.

Since the implementation of the billing module, a 2-month audit has confirmed previous speculation. The number of patients billed during 2 months (126.3 ICU patients/mo) with the automated module of EDCP for billable services (see Table 1) compared favorably to the previous 12-months (110.5 ICU patients/mo). This increase was consistent with our critical care census data reported by our finance department. Several miscellaneous charges were also compared for the 2 months after implementation against the prior 12 months (Table 5). Those data demonstrate an annualized charge capture increase of more than $900,000 from the previous year. EDCP accurately captures and produces patient charges, which exceed the current fiscal year budget, which was developed on last year's actual service.

Summary and Topics for Discussion

The automated and manual-entry billing components of the EDCP represent an accurate patient charge system for RTs. Favorable features of the automated billing component include the capture of 95% of our patient billing and the elimination of clerical time by clinical staff, who were previously required to perform charge entry onto billing forms, which took approximately 10 min per RT per shift. With 6 RTs per shift and 2 shifts each day, that totaled 120 min saved per day, which is 730 hours per year that have

Table 5. Miscellaneous Charges During February-March 2004 Versus During Fiscal Year 2003

Billed Service	Billed Feb-Mar 2004	Avg/Day Feb-Mar 2004	Avg/Day During Fiscal Year 2003	% change From Fiscal Year 2003	Patient Charge ($ each)	Increase in Annual Volume From Fiscal Year 2003 (no.)	Increase in Annual Gross Patient Service Revenue From Fiscal Year 2003 ($)
BiPAP	119	2	1.5	35.8	240	190.9	45,820
Cardiopulmonary resuscitation	22	0.4	0.36	0.6	709	0.8	591
Continuous nebulization	543	9.1	6.45	40.4	64	950.3	60,816
P_{ETCO_2} measurement	77	1.3	0.85	50.6	96	157.4	15,112
Metered-dose inhaler treatments	5,302	88.4	63.48	39.2	67	9,077.8	608,215
Mechanical ventilation	2,127	35.5	34.5	2.8	399	347.3	138,553
Transport (internal)	185	3.1	2.76	11.5	411	122.5	50,348
Ventilator/F_{IO_2} adjustment	3,291	54.9	53.3	2.9	47	580.3	27,272
							$946,727

BiPAP = bilevel positive airway pressure
P_{ETCO_2} = end-tidal partial pressure of carbon dioxide
F_{IO_2} = fraction of inspired oxygen

been recouped and made available for the delivery of respiratory care.

Eliminated was the need to remember which services were provided during the 12-hour long shift. This feature was also made convenient using the manual-entry component. Having immediate access to their PDAs, the staff no longer has to return to the department offices where the billing forms were located, to perform charge entry. Instead, they can record all miscellaneous charges at the time of service, which we expect will result in better compliance with billing procedures.

One might ask, why stop with printing out billing reports and not proceed to upload the charge data directly to the hospital billing system? Although that might seem to be a reasonable idea, it would require extensive programming and cooperation from the information services department. Considering that (1) a small percentage of captured charges collected by respiratory care departments is recoverable, and (2) respiratory care departments are typically small, compared to the remainder of hospital services, there was no urgency to develop an expensive system to accommodate this project. Therefore, even though the expectation remains that respiratory care captures every billable charge, we developed a system that is less time consuming for the practitioners and more accurate than the former manual-entry system. With those 2 features alone the project is worthwhile, even though the end result of entering the charges by our billing secretary into the hospital billing system has not changed from our previous pen-and-paper system, except for a few advantages. The new system saves the secretary a few steps in that it automatically adds the total number of ventilator checks, inhaled medication treatments, ventilator adjustments, et cetera, over the course of the specific billing period. Prior to this system, all of those procedures were manually added individually for each patient before entering them into the hospital charge-entry system.

It is reasonable to consider that other departments that manually perform billable patient services (eg, physical therapy and anesthesia) may also find this type of system attractive. As noted above, PDA software for the physician and nursing professions have substantial limitations, including noncustomization and inability to download to a database. Those features would be favorable for long-term digital storage and reporting capabilities.

Once again, our clinical staff made this project successful with their constructive suggestions and by allowing me the time to develop a workable solution to our billing problems. These changes resulted in a replacement of manual entry forms in our department. Acceptance by the staff has been encouraging. Our billing secretary claims that the reports are much easier to read, and the clinical staff welcomed the time saved by not having to enter the majority of patient charges.

Feedback from the hospital's administration has been favorable, and it is anticipated that long-term internal audit reports will demonstrate favorable variance of automated patient billing compared against services provided. With the availability of the PDAs, each clinician now has the opportunity to provide point-of-care billing using a familiar device, with all of the convenience that it offers—and at the location of the procedure. We believe that this project demonstrates multiple advantages over traditional charge capture systems.

REFERENCES

1. Goss L, Carrico R. Get a grip on patient safety: outcomes in the palm of your hand. J Infus Nurs 2002;25(4):274–279.
2. Topps D, Hall D. Electronic procedure logs: taking it further. Acad Med 2002;77(7):756.

3. Jahan A, Gretter B, Smith MP. The anesthesiologist's guide to personal digital assistants. Reg Anesth Pain Med 2002;27(2):193–196.
4. Carroll AE, Saluja S, Tarczy-Hornoch P. Development of a personal digital assistant (PDA) based client/server NICU patient data and charting system. Proc AMIA Symp 2001:100–104.
5. Bird SB, Zarum RS, Renzi FP. Emergency medicine resident patient care documentation using a hand-held computerized device. Acad Emerg Med 2001;8(12):1200–1203.
6. Brody JA, Camamo JM, Maloney ME. Implementing a personal digital assistant to document clinical interventions by pharmacy residents. Am J Health Syst Pharm 2001;58(16):1520–1522.
7. Bergeron BP. Enterprise digital assistants: the progression of wireless clinical computing. J Med Pract Manage 2002;17(5):229–233.
8. Enders SJ, Enders JM, Holstad SG. Drug-information software for Palm operating system personal digital assistants: breadth, clinical dependability, and ease of use. Pharmacotherapy 2002;22(8):1036–1040.
9. McCreadie SR, Stevenson JG, Sweet BV, Kramer M. Using personal digital assistants to access drug information. Am J Health Syst Pharm 2002;59(14):1340–1343.
10. Howard W. Development of an affordable data collection, reporting, and analysis system. Respir Care 2003;48(2):131–137.
11. Mabrey J. PDAs in orthopaedics. Program and abstracts of the American Academy of Orthopaedic Surgeons 68th Annual Meeting; February 28-March 4, 2001; San Francisco, California. Instructional course lecture.
12. Wood G. PDA use in a level one trauma center. In: PDAs in orthopaedics. Program and abstracts of the American Academy of Orthopaedic Surgeons 68th Annual Meeting; February 28-March 4, 2001; San Francisco, California. Instructional course lecture.
13. Chen PP-S. The entity relationship model - Towards a unified view of data. ACM Transactions on Database Systems, 1976;1:1:9–36.
14. Microsoft corporation. IIf Function [description]. 2004. Available at: http://msdn.microsoft.com/library/default.asp?url=/library/en-us/office97/htmL/output/F1/D6/S5B242.asp. Accessed August 20, 2004.