

Development of a Module for Point-of-care Charge Capture and Submission Using an Anesthesia Information Management System

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Background: The use of electronic charge vouchers in anesthesia practice is limited, and the effects on practice management are unreported. The authors hypothesized that the new billing technology would improve the effectiveness of the billing interface and enhance financial practice management measures.

Methods: A custom application was created to extract billing elements from the anesthesia information management system. The application incorporates business rules to determine whether individual cases have all required elements for a complete and compliant bill. The metrics of charge lag and days in accounts receivable were assessed before and after the implementation of the electronic charge voucher system.

Results: The average charge lag decreased by 7.3 days after full implementation. The total days in accounts receivable, controlling for fee schedule changes and credit balances, decreased by 10.1 days after implementation, representing a one-time revenue gain equivalent to 3.0% of total annual receipts. There are additional ongoing cost savings related to reduction of personnel and expenses related to paper charge voucher handling.

Conclusions: Anesthesia information management systems yield financial and operational benefits by speeding up the revenue cycle and by reducing direct costs and compliance risks related to the billing and collection processes. The observed reductions in charge lag and days in accounts receivable may be of benefit in calculating the return on investment that is attributable to the adoption of anesthesia information management systems and electronic charge transmission.

This article is accompanied by an Editorial View. Please see: Abouleish AE, Conlay L: Automated anesthesia charge capture and submission: Wave of the future, or bridge to nowhere? *ANESTHESIOLOGY* 2006; 105:5–7.

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Received from the Department of Anesthesiology, Mount Sinai School of Medicine, New York, New York. Submitted for publication June 2, 2005. Accepted for publication February 23, 2006. Support was provided solely from institutional and/or departmental sources. Presented at the Annual Meeting of the American Society of Anesthesiologists, Atlanta, Georgia, October 25, 2005.

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DESPITE advances in electronic medical record keeping and the adoption of these systems for clinical activities, there is evidence that the use of electronic medical records to generate automated point-of-care physician charges and submission is very limited. A recent survey by the Spyglass Consulting Group found that of 102 physicians who use and are familiar with healthcare information technology systems, only 21% used automated charge capture (personal communication, Gregg Malkary, Managing Director, Spyglass Consulting Group, Menlo Park, California, January 2005). In contrast, back-office claims submission for most payers, including Medicare, has migrated completely to electronic billing.¹

McKenzie² described several important components of electronic billing systems: acquisition of data, transmission to customers or billing companies, payment, and posting on the corporate receivables system. The complex nature of the data transfers and the difficulties inherent in creating interfaces between different vendors' products are factors that complicate the wide implementation of electronic billing systems.

In 1991, our institution began the use of an anesthesia information management system (AIMS) for electronic medical record keeping (CompuRecord®; Philips Medical Systems, Andover MA) in certain operating rooms. The anesthesia information management system was fully implemented in all operating room locations by 1998. Currently, approximately 30,000 anesthetics are captured per year. CompuRecord has a billing charge generation module, but this would not generate a complete charge voucher in our tertiary care center. Examples of items that are not supported by the CompuRecord module include charge generation for transesophageal echocardiography, ultrasonic vessel finder usage, and some of the data needed to generate the concurrency matrix for a teaching institution. We therefore needed to construct a customized billing data extraction application.

The current report describes the design and implementation of an automated point-of-care anesthesiology electronic charge capture system that extracts data from the anesthesia information management system and transmits it to a billing vendor. We hypothesized that the new billing technology would improve the effectiveness of the billing interface and enhance financial results of the practice.

Table 1. Raw Data Tables from Anesthesia Information Management System

Case information	Date of service, case identifying information, patient identifying information, patient clinical information, procedure information, practitioner identifying information, procedure location
Case times	Anesthesia start and end times
Case combo selections	Nested pick-list selections for individual cases (including audit-trail flags)
Case text	Free text entered by user
Combo configurations	System configuration table defining the various "combo" selection trees/menus available to users for each case
Case dates	Relief dates
Decoder	Table linking numeric-encoded values in tables (e.g., case combo selections) to readable (alphanumeric) text descriptions

Materials and Methods

We analyzed the effectiveness of the billing interface and financial results of the practice by measuring two parameters: days in accounts receivable and charge lag days.

At the vast majority of anesthetizing sites, the anesthesia information management system collects data derived from anesthesia monitors and machines, clinician-entered items, and data from interfaces with other hospital systems. A subset of the information that is resident in the electronic patient record constitutes the data set that is required to create a valid and compliant physician bill. For the small proportion of handwritten anesthesia records performed in off-site locations or during computer malfunctions, the data relevant to billing are entered manually into the CompuRecord system.

The CompuRecord anesthesia information management system creates a binary file of case information, some of which is duplicated in a relational database, based on user configuration of the system. The relational database has several relevant tables. Each table contains data elements (fields) of various data types that are described below.

Separate sets of tables are populated based upon the specificity of the data to the patient or to the individual anesthesia record, more commonly known as the "case." The largest percentage of the data relevant to an anesthesia bill is derived from those that are recorded using nested pick-lists (aka, drop-down lists) that are specific to an individual case. These combinations of lists of related elements of various data types are referred to as "combos."

Combo pick-lists contain groupings of data fields, links to more deeply nested combos, and free text entry fields. The most common data fields are "static" predefined alphanumeric strings (e.g., "cricoid pressure" or "37 French") that are assigned a numerical code. For efficiency of storage, only the numerical code is stored in the relational database combo table. The mapping of the numerical code to the predefined alphanumeric string is recorded in another (index) table. Additional data types include numbers, dates, times (formatted text), and Boolean categories. For example, choosing an endotracheal tube from a list of airway devices leads to another series

of pick-lists of elements, including the types of tubes (e.g., standard or double lumen), tube sizes, and indications whether the tube was placed by the anesthesia care team or was *in situ*. The majority of such selection trees also contain an "other" field for entry of alphanumeric strings of free text for circumstances where predefined choices are inappropriate.

Some case-specific text fields that are unrelated to combos are stored in a separate table. For example, the procedure/operation performed is populated by the text associated with the full set of Current Procedural Terminology codes (American Medical Association, Chicago, IL), one or more of which are selected by the anesthesiologist. Text searching enables rapid selection of the applicable Current Procedural Terminology code(s) from the complete list. Because surgical and diagnostic procedures are continually updated and sometimes difficult to code accurately, the text field for procedure/operation performed is editable by the anesthesia care team for later review by a certified procedural coder. Dates, procedural events (e.g., procedure/surgery start time), and electronic signatures are stored using an internal encoding system. This information is stored in various tables.

In addition to these classic relational database tables of case-specific and patient-specific information, the data archiving module also writes information from each case to specific reports that combine patient-specific and case-specific data that are the source of much of the information relevant to patient billing. These report tables (table 1) are vendor (*i.e.*, Philips Medical Systems, Andover, MA) specific and cannot be configured by the system administrator.

To create a bill that complies with regulatory requirements and will result in timely payment, each bill for service must include a minimum set of elements. Other additional elements that may not be present in any particular bill are included, as appropriate.

A custom set of tables (table 2) was created in which to assemble all of the data necessary for billing purposes from the existing database. These tables are populated and processed by a series of complex queries using Microsoft Access® (Microsoft, Redmond, WA). The queries perform three basic functions that are the founda-

Table 2. Reports Provided by Electronic Charge Voucher System to Billing Vendor

Billing worksheet	Table containing records for complete and incomplete bills for anesthesia services, populated with data from tables described in table 1 during bill creation/processing (see appendix)
Missing data worksheet	Worksheet containing various Boolean items indicating which required data elements are missing from cases in the billing worksheet
Incomplete bill archive	Table of records with structure identical to billing worksheet containing only incomplete bills
Complete bill archive	Table of records with structure identical to billing worksheet containing complete bills
Incomplete progress report	Table containing data that have been updated by clinicians from cases that were previously incomplete
Added cases	Table of records with structure identical to billing worksheet containing data from past cases not submitted in a previous billing cycle due to late arrival of data (e.g., transient network failure)

tion of the billing system. The first is an initial extraction of information from the anesthesia information management system database that populates a billing worksheet for each new case that is identified. The second function

is the screening of each billing worksheet to ensure that all necessary information is present. The third function is the updating of the billing worksheet with additional information that becomes available after the initial bill-

Table 3. Electronic Charge Contents and Validation Principles

Parameter Group	Elements	Business Rules
Personnel	Anesthesiologist(s) (up to 3) Resident(s) (up to 2) CRNAs (up to 2) Attending attestation statements	1. At least one attending anesthesiologist required. 2. Each clinician must have a corresponding e-signature. 3. Attending attestation required.
Personnel relief	Relief clinicians Relief date/time	1. Each relief clinician must have an associated date/time. 2. Each relief date/time must have an associated clinician.
Surgical procedure information	CPT codes Procedure performed (editable text) Procedure start and end times	1. CPT codes optional. 2. Procedure performed and start/end times are required.
Patient information	Date of birth Medical record number ASA physical status Preoperative diagnosis Postoperative diagnosis	1. All are required.
Anesthesia information	Primary anesthetic technique	1. Required.
Anesthesia modifiers	Autotransfusion Hemodilution Deliberate hypotension Deliberate hypothermia Hypothermic circulatory arrest	1. All are optional.
Anesthesia modifiers	Arterial line placement Central venous line placement Pulmonary artery catheter Jugular bulb catheter Temporary pacemaker insertion Ultrasound usage and indication for vascular cannulation Transesophageal echocardiography	1. All are optional. 2. If present, must have attending attestation of personal performance or medical direction.
Billing information	Special billing instructions PACU care provided during case Case related to global package	1. All are optional.

ASA = American Society of Anesthesiologists; CPT = Current Procedural Terminology; CRNA = certified registered nurse anesthetist; PACU = postanesthesia care unit.

Table 4. Missing Data Report Elements

1. Service date
2. Internal case ID
3. Case number
4. Medical record number
5. Patient name
6. Patient date of birth
7. Attending anesthesiologist 1
8. Attending anesthesiologist 1 e-signature
9. Attestation comments
10. Attending anesthesiologist 2
11. Relief date/time 1
12. Attending anesthesiologist 2 e-signature
13. Attending anesthesiologist 3
14. Attending anesthesiologist 3 e-signature
15. Relief date/time 2
16. CRNA 1 e-signature
17. CRNA 2 e-signature
18. ASA classification
19. Performed procedure
20. Primary anesthetic technique
21. Preoperative diagnosis
22. Postoperative diagnosis
23. Surgeon
24. Anesthesia start time
25. Anesthesia end time

ASA = American Society of Anesthesiologists; CRNA = certified registered nurse anesthetist; e-signature = electronic signature; ID = identification number.

ing worksheet creation. (The billing worksheet contents are described in the appendix and are subject to change over time.)

One of the tasks inherent in the data extraction process is the necessity of identifying the most current information for a particular case. The relational database design includes both an event index (to indicate the latest information) as well as an include/exclude flag (to indicate deleted information). These design elements are required to create an audit trail of modifications that occur within a case record over time. This complicates the design of the queries that extract the information that is included in the final bill.

The screening function serves to verify that all necessary data are present. The necessity and related business rules applicable to the billing worksheet fields are listed in table 3. Records that pass this screening process are placed in a queue for transmission to the billing vendor. Deficient records are placed in a separate queue, with an associated detailing of the missing elements (table 4). The details of missing required data are transmitted automatically by e-mail to the clinicians involved so they can make necessary changes to the electronic case records.

The data extraction and screening process is performed every business day as a batch process that creates four reports. The first is the queue of new cases that occurred in the time period since the last batch run that have passed the screening process. The second is a report of occasional older cases that were not processed

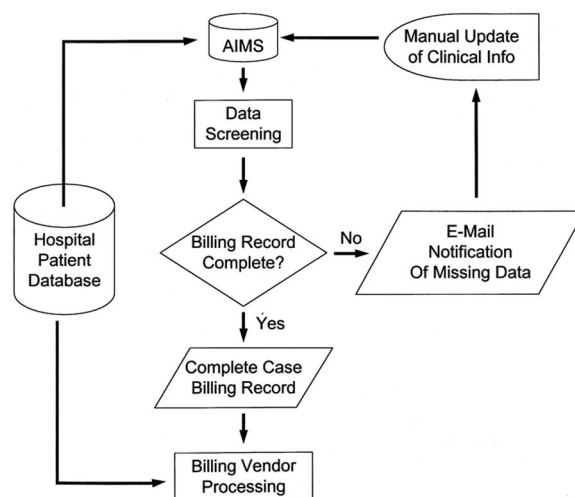


Fig. 1. Illustration of the process of electronic billing voucher creation. Information is extracted from the anesthesia information management system (AIMS) database, and a billing worksheet is populated. If the billing record is complete, it is transmitted to the billing vendor. Subsequent reprocessing of the anesthesia records is repeated until each electronic bill voucher is complete. If the record is incomplete, e-mail is sent to the attending anesthesiologist requesting completion of the anesthesia record. With transmission of the electronic billing voucher to the billing vendor, additional data from the hospital patient database are incorporated.

in previous batch runs due to transient hardware/network failures that subsequently pass the screening process. The third report consists of all new and older cases that would have been in the first two reports but did not pass the screening process. The final report includes cases previously found to be incomplete that have been reprocessed and incorporates any new or modified information provided by the clinician as described above. This final report also indicates whether the case has finally passed the screening process and is ready for billing. Patient demographic and financial/insurance information is transmitted to the billing vendor separately from the hospital information technology group.

Figure 1 presents an overall illustration of the process of electronic billing voucher creation.

There was a bimodal implementation of the electronic transfer of data to the billing vendor. In the first phase (June 2004), the vendor began receiving daily reports in comma-delimited format but continued to perform manual entry of the data. Approximately 2 months later, the vendor began direct importation of the data into its custom billing application.

Results

Revenue Opportunities

Charge lag is defined as the number of days between the date of service and transmission of charge data to the payers. The average charge lag decreased by 7.3 days in the period after the implementation as compared with

Charge Lag During 2004

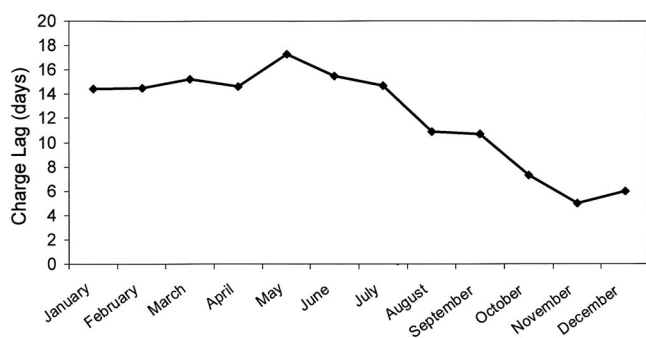


Fig. 2. Charge lag between date of service and transmission to payer. In June 2004, the billing vendor began receiving electronic data, but full implementation occurred over a 2-month period. The average charge lag decreased by 7.3 days in the last 5 months of 2004, compared with the months preceding electronic charge transmission.

the 7-month period preceding the implementation (fig. 2).

We also compared the total days in accounts receivable, controlling for fee schedule changes and credit balances for comparable intervals in the preimplementation and postimplementation periods (January through July 2005, compared with January through July 2004). Total days in accounts receivable equals the total dollars in accounts receivable for the period monitored, divided by the average dollars in gross billing per day. The total days in accounts receivable changed from 100.6 days to 90.5 days (10.1-day decrease) after implementation. The total accounts receivable in the periods monitored was corrected for confounding variables, such as interim fee schedule changes and credit balances that would have altered average daily gross charge and total dollars in accounts receivable. Although accounts receivable write-off policies were applied consistently throughout the period, it is not possible to account for seasonal variations in collection rates or write-offs in the snapshots calculated at the end of each period. The reduction of total days in accounts receivable represented a one-time revenue gain equivalent to 3.0% of total annual receipts. Table 5 details additional information to illustrate the scope of the practice.

Cost Savings

Electronic charge transmission eliminates labor costs for manual entry of charge data and eliminates the concomitant human errors inherent in transferring data from handwritten documents. This change reduced labor costs for charge entry by 1 full-time equivalent or approximately \$32,000 per year. Eliminating the need to print, transport, file, and manually retrieve handwritten billing vouchers provides additional cost savings of approximately \$10,000 per year. In addition, 0.5 full-time equivalent of staff assigned to this function was available for other duties.

Table 5. Revenue Cycle Data

Month	Cases*	Billed RVG Units	FTE Count	Charge Lag, days	Days in A/R
1/04	1,356	26,620	59.6	14.4	97.1
2/04	2,049	38,516	59.6	14.5	104.5
3/04	1,929	39,801	58.6	15.2	101.2
4/04	2,159	41,698	58.6	14.6	101.8
5/04	1,959	39,178	57.6	17.3	103.0
6/04	2,864	53,592	56.6	15.5	99.6
7/04	2,142	42,111	59.5	14.7	96.7
8/04	2,588	50,142	60.5	10.9	89.1
9/04	2,185	41,275	60.5	10.7	92.6
10/04	2,270	42,468	58.9	7.3	100.1
11/04	2,420	45,998	58.9	5.0	101.9
12/04	2,334	43,541	59.1	6.0	100.0
1/05	1,864	33,520	59.1	7.5	99.8
2/05	2,466	44,806	58.5	8.2	96.2
3/05	2,522	46,382	57.5	7.8	90.7

* Excluding obstetrics and pain management.

A/R = accounts receivable; FTE = full-time employee equivalents; RVG = American Society of Anesthesiologists Relative Value Guide.

Cost Avoidance

The daily billing process identified missing signatures, required data, and contradictory or conflicting data fields, such as relief events. This automatic process prevented submission of incomplete and/or noncompliant bills. This resulted in a nonquantifiable decrease in denials, rework, and potential compliance penalties. Approximately 3% of our electronic records were corrected on the basis of these reviews.

Discussion

The current report demonstrates that the implementation of an automated electronic anesthesia charge voucher system decreased the lag time between anesthesia services and charge transmission to payers. This has been associated with an initial increase in total days in accounts receivable as more charges were compressed into a shorter time interval, followed by a sustained improvement that was valued as a one-time revenue gain equivalent to 3% of annual receipts. Ongoing savings related to elimination of a full-time equivalent dedicated to transport, transcription, and handling of handwritten vouchers are additional benefits.

Manual processes, which distance the anesthesiologist from the eventual generation of a bill, have inherent sources of errors and omissions that negatively affect reimbursement. These problems include illegibility, lost or missed cases, incomplete charges, incomplete or inaccurate coding,³ discrepancies between the clinical documentation and the billing voucher, and delays in submission. It is estimated that the average physician loses approximately 10% of potential revenue due to billing mistakes made at the point of care.⁴ It is further estimated that it costs six times the administrative ex-

pense to reprocess a claim than to correctly process it the first time.⁵

Anesthesia information management systems tend to be well accepted by clinicians but have limited market penetration. In a survey, clinicians responded that they experienced a subjective improvement in their quality of work with the use of electronic anesthesia records compared the handwritten records, and after adaptation to a given system, many users reported that they would be reluctant to return to paper records.⁶ The further reported benefits of electronic anesthesia records include more accurate recording of physiologic variables,⁷ enhanced medicolegal defense and risk management,⁸ times savings,^{9,10} and increased time devoted to patient monitoring (vigilance).¹¹ Market penetration, however, has been estimated to be only 3–5% in the United States, as reported on the Anesthesia Patient Safety Foundation Web site.[#]

One of the major reasons for this low market penetration is the capital expenditure associated with anesthesia information management system implementation.¹² Data such as those in the current report may help anesthesia practices develop return-on-investment calculations to support the acquisition of an anesthesia information management system. Although a reduction in days in accounts receivable can be assigned a monetary value with some degree of certainty, there remain other less tangible economic benefits of anesthesia information management system billing voucher generation, including enhancements to compliance, concurrency matrix calculations, and managed care negotiations.

Improved billing and regulatory compliance result when electronic charges are generated directly from the medical record source documents. This provides the highest level of assurance that the charges reflect the level and scope of service provided. The anesthesia information management system used in the authors' institution is designed to incorporate mandatory documentation fields to remind physicians to include required attestations and supporting documentation. The anesthesia information management system serves as an automated audit mechanism to prevent incomplete or noncompliant records from proceeding to charge generation. The potential for avoiding penalties related to federal payer (Physicians at Teaching Hospitals, Office of the Inspector General, and Centers for Medicare and Medicaid Services) audits represent additional potential cost savings. Because of the cost-avoidance nature of these opportunities, they are difficult to quantify. Nevertheless, approximately 3% of our electronic records are corrected before charges are generated.

Anesthesia practices are subject to complex billing requirements, such as the reporting of concurrent care provided under medical direction and medical supervi-

sion. As a result, the synchronization of timepieces and the accurate recording of case start and stop times are critical. Electronic provision of all time intervals facilitates an accurate and timely completion of the concurrency matrix process.

The anesthesia information management system provides a critical database that can be used to value bargaining mix elements involved in negotiations with managed care entities and hospitals. Understanding the impact of contract clauses that require bundling of services or the capping of reimbursement for certain business lines allows practices to negotiate with a firm understanding of the costs and potential tradeoffs represented by contract terms. They also provide a valuable source of information tracking the introduction of new services that may need to be added to fee schedules upon contract renegotiation.

Others have reported that electronic claim submission results in faster reimbursement. Wang *et al.*¹³ performed a cost-benefit analysis in an ambulatory primary care setting to analyze the financial effects of electronic medical record systems. They estimated that billing capture would increase by 2% and the supplying or prompting of required billing fields would decrease billing error losses by 35–95%. They calculated a potential net benefit of \$86,400 per provider with the use of an electronic medical record over a 5-yr period. In a survey of healthcare providers, electronic transaction processing resulted in a lower average cost per claim, a lower average rejection rate for initial and follow-up claims, and a shorter turnaround time on accounts receivable than paper-based claims.¹ In a tertiary care pediatric practice, the effects of the conversion to electronic bill submission from attending physicians to the billing vendor was analyzed.¹⁴ This resulted in the receipt of patient charges in 6–13 fewer days by the billing vendor, and a significant decrease in the lag time between patient service and charges being posted to the patients' accounts by 9–17 days. At 14 days, 93% of the electronic bills were posted to the patient's accounts compared with 19% of the paper bills. There were no significant differences in collection rates. A case study of an 8-physician orthopedic surgical group reported that the proportion of lost and/or missed bills was reduced from 6% to 0% after implementation of a handheld personal computer-based point-of-care charge system.⁵ They also reported a reduction of 85% in the mean lead time for claims submission (from 33 days to 5 days), a reduction of 30% in write-offs for late claims, as well as a reduction of 0.25 full-time equivalent. A 70-physician general surgical group also reported a complete elimination of write-offs for late claims, as well as a significant reduction in lost claims.¹⁵ Electronic bill submission has also been demonstrated to result in significant cost savings to anesthesiology groups. In an audit by a Japanese anesthesia group, charges generated by a handwritten billing sheet were

[#] <http://www.apsf.org/initiatives/infosys.msp>. Accessed June 8, 2006.

compared to anesthesia bills generated by an anesthesia information management system.¹⁶ This electronic billing system derived costs from the anesthesia information management system and calculated fees according to the Japanese national healthcare insurance system. This electronic system was demonstrated to be accurate compared with the manual bill generation system and prevented ¥2.5 million (approximately \$20,000) in billing losses per month.

The limitations of the current report relate to concurrent changes that occurred in departmental operations at the time of implementation of electronic charge transmission. The adoption of a productivity-based compensation model provided incentive to anesthesiology faculty for more complete billing documentation, such as selecting Current Procedural Terminology codes that most fully describe the services performed, 100% case capture, and documenting all reimbursable services, ancillary procedures, and patient status modifiers. Therefore, an unknown proportion of the observed increase in the average daily charges is related to a concurrent focus on physician education and incentives leading to better billing documentation and/or increased productivity. Other factors that would affect the valuation of the decrease in days in accounts receivable include changes in the charge fee schedule, managed care organization participation status, and operational and collection policy changes that affect the gross collection rate. Despite these immeasurable effects, the relative parity between the reduction in charge lag and the reduction in days in accounts receivable suggests that the results reported are related mainly to electronic charge transmission.

In many healthcare organizations, the anesthesia information management system is purchased by a hospital that is a distinct financial entity that receives no financial benefit from the anesthesia billing process. In many institutions, therefore, a partnership between the hospital (that receives the financial benefit of a capital purchase) and the anesthesia practice group must be created that accounts for the purchase, ongoing expenses, and financial advantages of an anesthesia information management system. Data sharing between the two entities is also an important consideration in creating a successful partnership.

One of the costs of implementing an automated anes-

thesia charge voucher system from an anesthesia information management system data source is the programming requirements. At the authors' academic institution, the existing departmental programming personnel diminished the investment needed to create the charge voucher system. Many institutions would have to consider this cost in their return-on-investment calculations.

In conclusion, anesthesia information management systems yield financial and operational benefits by speeding up the revenue cycle and by reducing direct costs and compliance risks related to the billing and collection processes. The observed reductions in days in accounts receivable may be of benefit in calculating the return on investment that is attributable to the adoption of an anesthesia information management system and electronic charge transmission.

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Appendix: Raw Data Extracted or Calculated from Electronic Anesthesia Record

Data Element	Data Type	Multiple Instances Allowed?	Required?	Table Source
Patient name	Alphanumeric	N	Y	Case information
Medical record number	Alphanumeric	N	Y	Case information
Sex	Alphanumeric	N	N	Case information
Birth date	Date/time	N	Y	Case information
Date of service	Date/time	N	Y	Case information
Age, yr	Number	N	N	Calculated
Patient class	Alphanumeric	N	N	Case information
Performed procedure	Alphanumeric	N	Y	Case information
Primary technique	Alphanumeric	N	Y	Case information
Secondary technique	Alphanumeric	N	N	Case information
Position	Alphanumeric	N	N	Case information
Surgical field avoidance	Boolean	N	N	Combo included
ASA status	Number	N	Y	Case information
Emergency	Boolean	N	N	Case information
Primary surgeon	Alphanumeric	N	Y	Case information
Attendings	Alphanumeric	Y	Y	Case information
Residents	Alphanumeric	Y	N	Case Combo selections
CRNAs	Alphanumeric	Y	Y	Case combo selections
SRNAs	Alphanumeric	Y	N	Case combo selections
Electronic signatures	Boolean	N	Y	Case Combo Selections
Attestation statement	Boolean	N	Y	Case combo selections
Anesthesia start	Date/time	N	Y	Case times
Anesthesia end	Date/time	N	Y	Case times
Duration of anesthesia, min	Number	N	N	Calculated
Relief time	Date/time	N	N	Case text
Person relieved 1, 2, 3	Alphanumeric	Y	N	Case combo selections
Person relieving 1, 2, 3	Alphanumeric	Y	N	Case combo selections
Relief events	Date/time	Y	N	Case text
Preoperative diagnosis	Alphanumeric	N	Y	Case text
Postoperative diagnosis	Alphanumeric	N	Y	Case text
Age less than 1 yr	Boolean	N	N	Calculated
Age greater than 70 yr	Boolean	N	N	Calculated
Intraarterial line 1	Boolean	N	N	Case combo selections
Intraarterial line 2	Boolean	N	N	Case combo selections
Central venous line or introducer 1	Boolean	N	N	Case combo selections
Central venous line or introducer 2	Boolean	N	N	Case combo selections
Pulmonary artery catheter	Boolean	N	N	Case combo selections
Jugular bulb catheter	Boolean	N	N	Case combo selections
CPT codes	Alphanumeric	Y	N	Case combo selections
TEE CPT code(s)	Boolean	Y	N	Case combo selections
TEE ICD-9 code(s)	Alphanumeric	Y	N	Case combo selections
Deliberate hypotension	Boolean	N	N	Case combo selections
Deliberate hypothermia	Boolean	N	N	Case combo selections
Hypothermic circulatory arrest	Boolean	N	N	Case combo selections
Hemodilution	Boolean	N	N	Case combo selections
Autotransfusion	Boolean	N	N	Case combo selections
Ultrasonic vessel finder use	Boolean	N	N	Case combo selections
Indication(s) for vessel finder use				
Previous attempts unsuccessful	Boolean	N	N	Case combo selections
Difficult anatomy	Boolean	N	N	Case combo selections
Coagulopathy	Boolean	N	N	Case combo selections
Nerve block	Boolean	N	N	Case combo selections
Other	Alphanumeric	N	N	Case combo selections
Teaching regulations	Boolean	N	N	Case combo selections
Case concurrent	Boolean	N	N	Case combo selections
PACU care during case	Boolean	N	N	Case combo selections
Case related to transplant in Mount Sinai	Boolean	N	N	Case combo selections
Bill patient for co-pay/deductible only	Boolean	N	N	Case combo selections
Billing comments	Alphanumeric	N	N	Case text
Internal case ID	Number	N	Y	Case information
Case number	Alphanumeric	N	Y	Case information
QV modifier	Alphanumeric	N	N	Research modifier
Location	Alphanumeric	N	N	Case information
Case complete	Boolean	N	N	Updated by billing program

ASA = American Society of Anesthesiologists; CPT = Current Procedural Terminology; CRNA = certified registered nurse anesthetist; ICD-9 = International Classification of Diseases, 9th edition; ID = identification number; PACU = postanesthesia care unit; QV = indicates routine care given under an approved clinical trial; SRNA = student registered nurse anesthetist; TEE = transesophageal echocardiography.