

Automated Documentation Error Detection and Notification Improves Anesthesia Billing Performance

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Background: Documentation of key times and events is required to obtain reimbursement for anesthesia services. The authors installed an information management system to improve record keeping and billing performance but found that a significant number of their records still could not be billed in a timely manner, and some records were never billed at all because they contained documentation errors.

Methods: Computer software was developed that automatically examines electronic anesthetic records and alerts clinicians to documentation errors by alphanumeric page and e-mail. The software's efficacy was determined retrospectively by comparing billing performance before and after its implementation. Staff satisfaction with the software was assessed by survey.

Results: After implementation of this software, the percentage of anesthetic records that could never be billed declined from 1.31% to 0.04%, and the median time to correct documentation errors decreased from 33 days to 3 days. The average time to release an anesthetic record to the billing service decreased from 3.0 ± 0.1 days to 1.1 ± 0.2 days. More than 90% of staff found the system to be helpful and easier to use than the previous manual process for error detection and notification.

Conclusion: This system allowed the authors to reduce the median time to correct documentation errors and the number of anesthetic records that were never billed by at least an order of magnitude. The authors estimate that these improvements increased their department's revenue by approximately \$400,000 per year.

TO obtain reimbursement for anesthesia services in the United States, clear and complete billing documentation is required. This documentation includes specific time and event elements relating to the preanesthetic evaluation, intraanesthetic management, and postanesthetic care. The absence of even a single element or the presence of a wrong element can lead to the rejection of a claim for services rendered. Therefore, it is important that anesthesia practices identify and correct such documentation errors on anesthesia records to maximize

revenues. Beyond its primary importance for revenue generation, billing documentation can also provide valuable evidence of proper medical care.¹ Achieving the goal of clear and complete documentation in every anesthetic record is a challenge, particularly in settings where anesthesiologists simultaneously direct the care of multiple patients and their primary focus of attention is on patient care and teaching.

The advent of computerized anesthesia information management systems (AIMS) provides opportunities to develop novel tools and solutions to persistent problems in anesthesia practice, especially those related to consistent task execution and completion. Recently, it has been demonstrated that computerized automatic process monitoring and automatic alerts yield clinically important improvements in outcomes when applied to medical orders.^{2,3} This suggests that other aspects of the care process, including seemingly mundane tasks such as billing documentation, would benefit from this approach.

In the beginning of 2003, our department transitioned from recording intraoperative patient data using pen and paper to using an AIMS (Saturn; Draeger, Telford, PA) for documentation. The primary purpose of this transition was to facilitate correct data capture,⁴ to minimize recording errors,⁵ and to reduce the cost and time associated with generating bills by simplifying the billing process. However, after the transition to this system, it was apparent that a significant number of our records could not be submitted for payment even months after the date of service because they contained deficiencies and errors related to documentation that precluded billing.

We hypothesized that we could reduce documentation errors, improve billing performance, and capture lost revenue by developing software and instituting a computerized system that would automatically search electronic anesthetic records for documentation errors and alert anesthesia personnel in near real time. This report describes this system, its implementation, and its impact on our documentation and billing performance.

Materials and Methods

Design and Development of the Billing Alert System

Descriptions of clinical and billing events were written as structured comments into our AIMS (Saturn), and each was assigned a unique alphanumeric identifier. We then used the Visual Basic (Microsoft, Redmond, WA)

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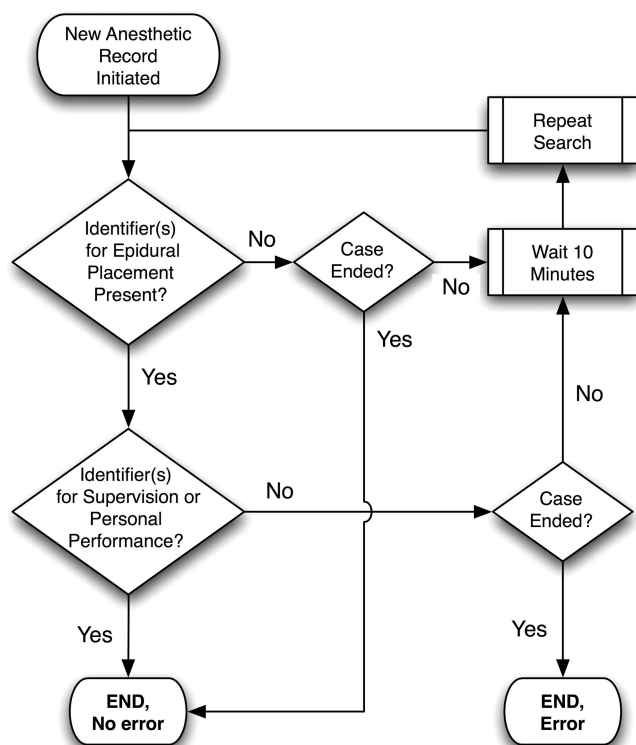


Fig. 1. Flow diagram of logical steps applied by the Anesthesia Billing Alert System (ABAS) for the placement of an epidural catheter. The appearance of a statement in the anesthesia record indicating the placement of an epidural catheter prompts a search by the ABAS for documentation by the staff anesthesiologist indicating that he either placed the catheter himself or medically directed its placement. If such documentation is not found by the end of anesthesia care, a documentation error has occurred.

programming language to create custom software, the Anesthesia Billing Alert System (ABAS), as a logical system to search electronic records automatically every 10 min for clinical and billing event statement alphanumeric identifiers and their time stamps. Identifiers found during this search were automatically tested by the ABAS against at least 58 validation rules. For example, if the ABAS searched an electronic anesthetic record and found an identifier indicating the placement of an epidural catheter in a patient, then it would define the absence of an identifier indicating the presence of a staff anesthesiologist during epidural placement (either medically supervising or personally performing) as a documentation error (see fig. 1 for a flow diagram illustrating this example).

Upon detecting a documentation error, the ABAS automatically generated a page or pages that were sent *via* an automatic interface to our institution's XML-based Web paging service; XML is an open standard for the exchange of data between systems over the Internet. Automated pages were directed to the appropriate clinician(s) identified on the anesthesia record. These pages alerted clinicians to the existence of a documentation

error and indicated to them the specific nature of the error that was found using alphanumeric text.

The physical implementation of the AIMS in each operating room (OR) was typically on the left side of the anesthesia machine, immediately to the right side of a supine patient. The goal was to facilitate and encourage the documentation of events contemporaneously with their occurrence by putting the AIMS immediately at hand. Nevertheless, as a matter of practice, many busy clinicians do not fully document every event immediately. Therefore, a grace period was defined for each event before which the clinician would not be paged. Typically, the end of a grace period was defined by the start of another event and/or the end of anesthesia care. For example, the end of the grace period for documenting a staff anesthesiologist's presence during the induction of anesthesia was defined as the time when either emergence from anesthesia or the end of anesthesia care was recorded.

Medically directed providers (*i.e.*, residents and certified registered nurse anesthetists) are frequently involved in the anesthetic care of our patients along with staff anesthesiologists, so rules were also defined to identify whom the ABAS would page for specific documentation problems. The absence of a statement indicating the presence of a staff anesthesiologist for required events (*e.g.*, anesthetic induction) or procedures (*e.g.*, epidural catheter placement) generated an alphanumeric page to the staff anesthesiologist of record. Typically, other documentation errors generated a page to the medically supervised provider of record. Failure of the medically supervised provider to correct the error on the anesthetic record within 15 min resulted in a second page to the supervised provider and a page to the staff anesthesiologist, thereby escalating the error correction process.

The ABAS was also programmed to automatically page all members of the anesthesia care team on the first and third postoperative days to remind them of any documentation errors that it determined remained uncorrected. Similarly, the ABAS was programmed to automatically e-mail all members of the anesthesia care team on the second and fourth postoperative days to remind them of their uncorrected documentation errors. The e-mail sent by the ABAS on the fourth postoperative day also indicated the total anesthesia charges related to the case, and a copy of this e-mail was sent to the Department's Vice Chairman for follow-up. As a matter of courtesy, ABAS pages were not sent at night or on weekends.

Figure 2 shows the architecture of the AIMS-ABAS system. Each OR has an AIMS computer mounted to the anesthesia machine. Accommodations to facilitate complete and contemporaneous documentation, such as mounting the AIMS computer and touch screen on the left side of the anesthesia machine, close to the patient,

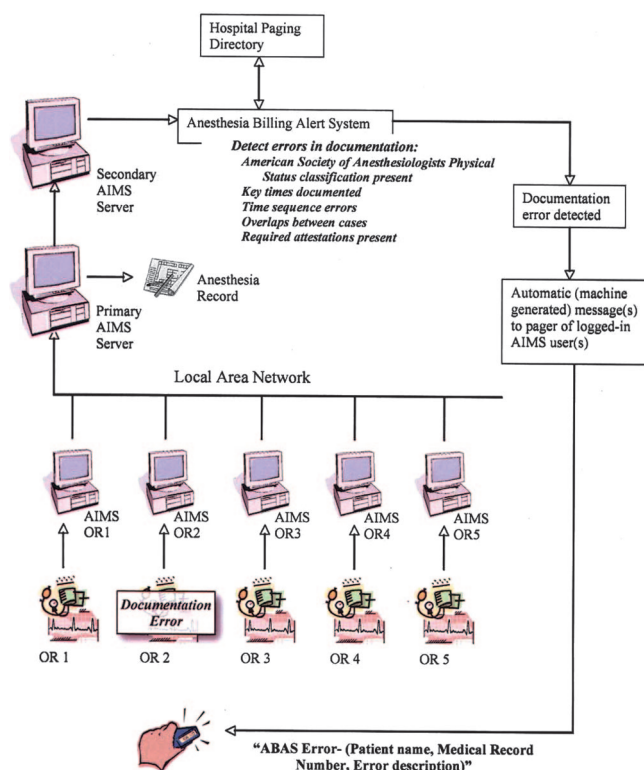


Fig. 2. The architecture of the anesthesia information management system (AIMS) (operating room [OR] workstations, primary and secondary servers), and the Anesthesia Billing Alert System (ABAS) with its paging system notification loop. The clinicians listed in the electronic anesthesia record for which the error occurred are paged either during the case or after it ends to notify them of their documentation error(s). Common errors are listed in the figure. These include failure to document "key times," such as the start of anesthesia care; inadvertent creation of "time sequence errors," wherein events seem to occur out of order (e.g., induction of anesthesia precedes start of anesthesia care); and apparent "overlaps between cases," in which the end of anesthesia care event for one case incorrectly occurs after the start of anesthesia care for a subsequent case. The ABAS also checks for "required attestations" regarding medical direction of the case, as well as specific medical procedures by the staff anesthesiologist.

were made in almost all ORs. The AIMS server continuously replicates the AIMS database on a backup server, and this replica database is the substrate for the ABAS. A synopsis of the types of billing documentation errors sought by the ABAS is also given in figure 2.

Testing and Implementation of the ABAS

Beginning in April 2004, only departmental administrative staff were notified of documentation errors detected by the ABAS. In May 2004, a test group of 16 clinicians were selected to receive automatic notification pages from the ABAS regarding their own cases. Feedback from these clinicians was used to further refine the logical rules and the notification processes. During this gradual rollout period, the ability of the ABAS to correctly identify documentation errors was also confirmed by comparing its results with those obtained by administrative staff manually examining each anesthetic record. The

ABAS with its page notification function was introduced to the remainder of our department in July 2004. In October 2004, the e-mail notification function was added, fully implementing the ABAS. After implementation of the ABAS, validation rules were added or deleted as required by changes in third-party payer rules for billing documentation.

Assessment of Documentation and Billing Performance

The database compiled by the ABAS, which contained all events related to the adequacy of billing documentation, was queried to assess the effectiveness of the ABAS in detecting documentation errors and improving billing performance. This database was compared with historic data of 5,580 records obtained in the 3 months preceding rollout of the ABAS (*i.e.*, January through March 2004). Performance metrics included the number of anesthetic records that were never submitted for payment because they contained documentation errors, the percentage of records containing documentation errors at day's end on the date of service, the number of days required to correct these documentation errors, and the average number of days before an anesthetic record could be released to our billing service for billing.

Acceptance of the Anesthesia Alert System

To gauge acceptance of the ABAS by our staff, we administered a two-question survey in April 2005. We asked staff to compare the automated process to our previous manual system for documentation error identification and notification.

Statistical Analyses

Continuous data were compared by Student *t* test. The time required to correct documentation errors before and after implementation of the ABAS was compared using Kaplan-Meier survival curve analysis. In this analysis, each record containing a documentation error was followed over time until the error was corrected (which allowed billing) with right-censoring after postoperative day 90 (before implementation of the ABAS) or postoperative day 30 (after implementation of the ABAS). In all statistical comparisons, $P < 0.05$ was considered significant.

Results

Full Study Period: January 2004 through March 2005

For each month between January 2004 and March 2005, figure 3 shows the total number of anesthetic records produced in our ORs and the number of such records that were never submitted for payment because they contained billing documentation errors. At the end

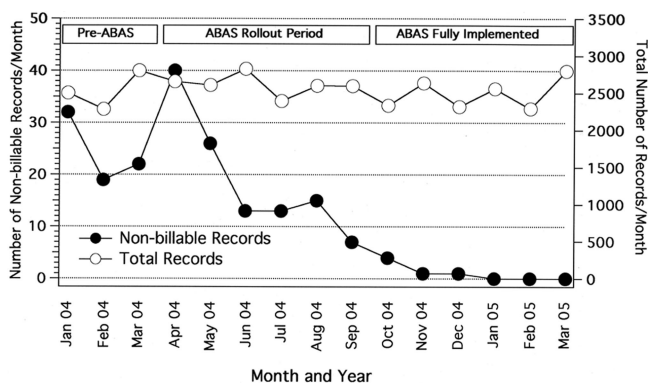


Fig. 3. For each month between January 2004 and March 2005, the plot shows the number of operating room records that were never submitted for payment because they contained uncorrected documentation errors that precluded billing (●) and the total number of anesthetic records produced (○). The Anesthesia Billing Alert System (ABAS) was gradually introduced between April and September 2004.

of the 3 months preceding implementation of the ABAS, our department produced 32 (January 2004), 19 (February 2004), and 22 (March 2004) anesthetic records that were never submitted for payment because they contained uncorrected documentation errors (fig. 3). These 73 records represented 1.31% of all anesthetic records produced during those 3 months. During the ABAS rollout period (April 2004 through September 2004), the number of such records decreased. During the entire final 6 months of the study period (October 2004 through March 2005) when the ABAS was fully implemented, only 6 of 14,930 anesthetic records (0.04%) were never submitted for payment because they contained uncorrected documentation errors.

Comparison of January through March 2004 (before ABAS Implementation) with January through March 2005 (after ABAS Implementation)

A more detailed analysis of the impact of the ABAS on the occurrence and correction of billing documentation errors was performed by comparing records from cases performed during the 3 months preceding implementation of the ABAS with that obtained during the same 3-month period 1 yr later when the ABAS was fully implemented. By comparing records obtained during the same 3 calendar months (January, February, and March), we eliminated any potential differences relating to the average experience level of resident physicians performing anesthesia and documenting events. In the 3 months preceding implementation of the ABAS, $3.8 \pm 0.8\%$ of all anesthetic records contained one or more billing documentation errors at day's end on the date of service that precluded billing for the case (fig. 4). One year later, the percentage of such records was $5.4 \pm 0.8\%$, a value that is not statistically different from the pre-ABAS value ($P = 0.0724$). Furthermore, an additional $10.3 \pm 0.3\%$ of all records created between January and March 2005 con-

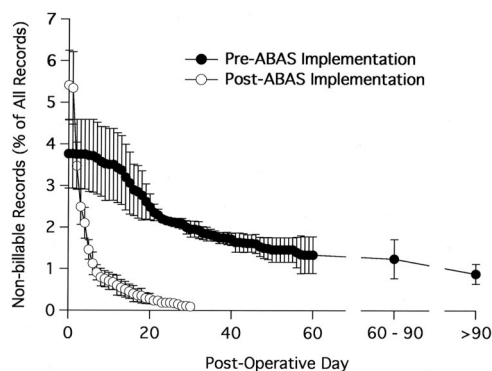
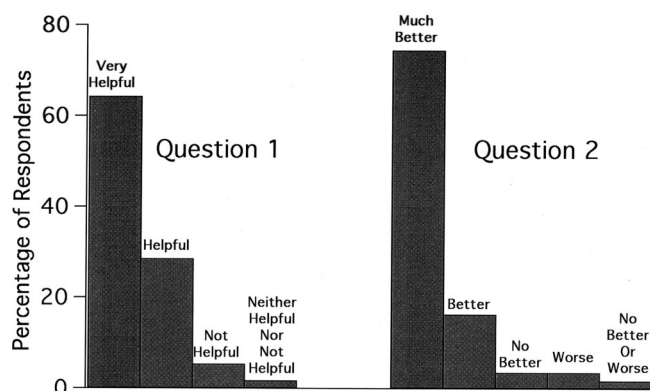


Fig. 4. Effect of the Anesthesia Billing Alert System (ABAS) on the documentation error correction rate. Data before the implementation of the ABAS (before ABAS implementation; ●) were obtained from all cases with dates of service in January, February, and March 2004, whereas data obtained after full implementation (after ABAS implementation; ○) were obtained from all cases with dates of service in January, February, and March 2005. The data points are the mean percentages of records with errors for each postoperative day after the date of service. The error bars indicate the SDs for the 3 months and are indicative of the month-to-month variability. After implementation of the ABAS, the time required to correct one half of all records containing documentation errors that precluded billing was 3 days versus 33 days before implementation of the ABAS ($P < 0.0001$; Kaplan-Meier survival, not shown).

tained documentation errors on the date of service that would have precluded billing had they persisted, but were corrected before day's end after the ABAS transmitted its first error alert via alphanumeric page.

The percentage of records that remained nonbillable because of documentation errors decreased on successive postoperative days as anesthesia providers made corrections after error notification (fig. 4). However, the correction rate was substantially faster after implementation of the ABAS. In the 3 months preceding ABAS implementation, the median time required to correct documentation errors was 33 days. Furthermore, $1.2 \pm 0.5\%$ and $0.9 \pm 0.2\%$ of all records contained uncorrected documentation errors that precluded billing between 60 and 90 days and more than 90 days, respectively, after the date of service. This time frame is critical because our nongovernmental contracts specify a 60- to 90-day time limit for submitting a claim after the date of service. One year later and after full implementation of the ABAS, the median time required to correct documentation errors was reduced to 3 days ($P < 0.0001$ vs. before ABAS), and by postoperative day 30, only $0.09 \pm 0.05\%$ of records remained nonbillable because of documentation errors.

The average duration of time that elapses between the date of service and the date on which billing information is forwarded to our billing service reflects the time required to review anesthetic records, identify documentation errors within these records, and notify clinicians of their errors. As the final step before billing information is forwarded to our billing service, clinicians must correct any documentation errors found in their records.



Question 1: In regards to the intra-operative paging: I find the pages:

Question 2: In regards to the record correction process today as compared to the process before the paging initiative: I find the correction process with paging:

Fig. 5. Satisfaction survey results. A brief two-question survey was distributed to 89 operating room-based staff anesthesiologists in April 2005 to gauge the level of satisfaction with the automated error detection and notification process. The survey was completed by 56 staff (63%), and their replies are tabulated.

Before implementation of the ABAS, this time averaged 3.0 ± 0.1 days and was reduced by 63% to an average of 1.1 ± 0.2 days after implementation of the ABAS.

Staff Acceptance

Our intent in developing and implementing the ABAS with its automated notification capability was to improve documentation error correction and billing performance while easing the burden of documentation on clinicians. However, we recognized that the anesthesia staff might find the automated pages to be a nuisance. Therefore, we administered a two-question survey to our staff anesthesiologists in April 2005 to search for major dissatisfaction with the system. We asked them to compare the ABAS paging system to the previous method of documentation error notification. Under the previous system, clinicians were notified of their documentation errors by page or e-mail by support staff 1 or more days after the date of service, after manual review of the records. The results of the survey are shown in figure 5. Of the 63% of all OR-based staff anesthesiologists who completed the survey, 93% rated the use of the ABAS intraoperative paging system as "helpful" or "very helpful," and 91% rated it as "better" or "much better" than the previous manual system for identifying and notifying them of their documentation errors.

Discussion

The use of computerized process monitoring and automatically generated reminders in medicine dates back to at least 1976, when McDonald⁶ noted that practice performance by medical house officers improved when automated reminders tailored to individual patients were

offered, but declined to baseline after the reminders were no longer provided. Regardless of the level of training, performance was poor in the absence of reminders and rose dramatically (again independent of training level) when reminders were provided. From this, McDonald concluded that poor performance was caused by overwhelming task demands, rather than any correctable deficiency in the practitioners themselves.⁶ In the current OR environment, with its large number of critically ill patients and production pressures, we believe that this conclusion is likely to be more true than ever.

The framework for cycles of continuous quality improvement through process measurement and process control originated with Shewhart⁷ and was further developed by Deming.⁸ Both were proponents of statistical process control, a method of continuous performance measurement and comparison to previous performance, as a quality monitoring tool. In the OR environment, statistical process control identifies nonrandom variation in clinical and operational process outcomes.⁹⁻¹³ Any process will experience natural variability due to unintended and uncontrollable sources of variation. A process may experience more systematic variability that often arises from nonrandom "assignable causes," and when operating in this state is called "unstable" or "out of control." Conversely, a process experiencing only chance variation is said to be in "statistical control" or "stable," even if the results do not meet the desired target. Although we do not explicitly show that our billing processes were in statistical control before implementing the ABAS, our data show that it was consistently suboptimal during the 3 months before implementing the system and note that anesthetic records produced in July 2003 (6 months before the beginning of our study) had a similarly high number of persistent documentation errors.

A central notion of Deming and Shewhart's work is that when the average worker cannot reliably achieve the desired level of performance using the tools, methods, and systems provided, the onus is on the organization to provide the means (through better tools, materials, methods, and systems) to improve performance. The ABAS is our department's response to the perceived need to provide its members with better systems and tools to achieve better billing documentation.

The combined ABAS error detection-paging alert system can be considered to operate as a form of decision support. Clinical decision support systems are likely to improve outcomes if they work automatically as part of the clinical workflow, provide useful recommendations, operate at the time of decision making (rather than afterward), and are mediated by a computer.² Such systems can improve performance, but there is the risk that users will learn to depend on them, rather than on vigilance, for identifying errors. Alternatively, automatic

process control systems may improve performance by reducing the initial error rate. Changes in the documentation error rate of clinicians before and after the full implementation of the ABAS can shed some light on this distinction. If the system serves as a teaching tool that improves clinicians' ability to remember to complete billing documentation, one would expect the initial error rate to have decreased by learning process after implementation of the ABAS. However, figure 4 clearly indicates that the initial error rate for billing-related documentation was not lower after implementation of the ABAS. In fact, the initial error rate tended to be higher (albeit not significantly so), suggesting that clinicians might be relying on the system to find their errors. One might even worry that vigilance has relaxed, but the fact remains that performance improved.

With its dependence on short messages sent to the pagers of clinicians, our system can best be categorized as a "status display" driven by an automatic process control system. Such systems improve performance provided that their output is valid and accurate.^{14,15} To succeed in the eyes of busy clinicians, automatic process control systems must be reliable and convenient. Therefore, they require high-quality data input, a foolproof process model of normal procedure, and a direct and prompt way to alert clinicians when errors occur. Robust data (*i.e.*, data that are uniformly and completely gathered, such as that recorded by automated systems^{4,5}) can be compared with little risk of error to a process model of expected procedure using software that applies business rules written to automatically identify errors when they occur and report them with little delay. By incorporating an alerting system (*i.e.*, an automated paging and e-mail system to send alerts regarding documentation errors), we have removed the requirement for clinicians to check or remember every detail about whether documentation is complete, while at the same time improving overall performance. Therefore, the ABAS contains all of the elements required for a completely automated process monitoring and process exception detection system: (1) automatic data collection, (2) a model of the expected process, (3) rules for comparing the actual process to that expected based on the model, and (4) a prompt alerting system that is not easily ignored.¹⁶ The ABAS requires no human intervention at any point in the process to detect and announce billing documentation errors.

In a recent report, Reich *et al.*¹⁷ described the use of an automated electronic charge capture system that includes a screening function to verify the presence of all necessary billing information on anesthesia records and notify staff of their errors. Using this system, documentation errors were identified and corrected in approximately 3% of all electronic records, and the average charge lag and accounts receivable were reduced by 7.3 and 10.1 days, respectively. They concluded that the

reduction in accounts receivable resulted in a one-time revenue gain equivalent to 3% of total annual revenue.

Based on our current case volume and contract rates, we estimate that our department collects an additional \$390,000 per year in revenue that is directly attributable to the ability of the ABAS to reduce the number of anesthesia records with persistent documentation errors. If the 2-day reduction in time required to submit bills to our billing service translates into a 2-day reduction in accounts receivable, a short-term investment rate of 4% on our cash balance would generate an additional \$10,000 per year. Finally, the ABAS allowed our department to redeploy a member of our administrative staff whose primary responsibility was to manually review anesthetic records to assess the adequacy of billing documentation. These favorable results may be compared with the ABAS development cost of \$180,000 (including all hardware) and an ongoing annual cost of \$37,500 for one half of a full-time equivalent programmer/analyst to maintain the system.

Beyond its importance for billing, accurate documentation is important for medicolegal reasons. In a recent case report by Vigoda and Lubarsky,¹⁸ unrecognized documentation deficiencies and discrepancies recorded by an AIMS were thought to have increased the liability of anesthesia clinicians after a negative surgical outcome. In response to this case, computer software was developed to review the computerized anesthetic records of cases performed in the previous 24 h. Although the results of using this software were not quantified in the report, the authors reported "dramatic improvements" in the quality of documentation.

A potential limitation of our results is that the use of custom software could impede wider implementation, limiting the general impact of the ABAS. However, our software was written using standard approaches in a standard programming language and is meant to be independent of any one vendor's product. In fact, we are currently making the transition to another AIMS (Meta-vision Suite; iMDsoft, Needham, MA) and find that the ABAS also functions properly with that system. Although the ABAS provides obvious potential financial incentives for AIMS manufacturers, we have been careful not to ally ourselves with any specific vendor. Hence, our system is built to work with server-based data tables rather than as a part of the proprietary AIMS software. This philosophy also drives the decision to send alerts *via* short messaging devices such as the hospital paging system (a system that can be extended to mobile telephones capable of short messaging), rather than implementing alerts through the AIMS itself.

In summary, the ABAS improved our billing performance as reflected in the significantly decreased lengths of time required to correct documentation errors in our anesthetic records and to release our records for billing. In addition, the ABAS reduced the number of anesthetic

records that could never be billed because they contained documentation errors that remained uncorrected beyond the time limit specified by our contracts. Based on the cost and revenue figures reported above, the time to return on investment was one half year.

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