

# Miscoding Rates for Professional Anesthesia Billing: Trial Results - Software Solution

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## Abstract

*Background:* Accurate anesthesia billing requires selection of Anesthesia Current Procedural Terminology (Anesthesia CPT-4) codes that are in concordance with the American Medical Association CPT-4 (AMA CPT-4) codes selected by the surgeon. We present a study examining the impact of a novel software at addressing sources of coding error. *Methods:* An exploratory coding trial was performed using a constructed surgical procedure data set (n=142). Two expert anesthesia coders coded each procedure using standard surgery-to-anesthesia conversion techniques. Coding accuracy was subsequently determined by consensus of experts and the type of error (if present) was categorized. After analyzing the process and sources of error, a software solution was developed. Using two different but similarly constructed data sets, the trial was repeated with the new software solution (n=298) and after an enhanced version (n=334). Results were reported using descriptive statistics. *Results:* There was a 38% error rate using standard coding; 16% from selecting the wrong body region, 11% from under coding and 6% from over coding the anesthesia CPT-4 code. After design and implementation of the software, the error rate was reduced to 4% and then to 3% using the enhanced version. *Conclusions:* Using the current cross-referencing system to determine Anesthesia CPT-4 codes has the potential for error. Using a computerized system has the potential to diminish this error. Further investigation is warranted to determine whether miscoding is elevated in other settings and if this solution can be more broadly applied.

**Key words: Anesthesia Billing, CPT-4 Coding, AMA Codes, ASA Codes, Software**

## 1. Introduction

Accurate billing for anesthesia services requires careful documentation of multiple, complicated procedures and adherence to strict regulatory rules. At the same time, maintenance of essential medical record charting must also occur. Adequately managing these burdens, applying the appropriate and correct billing codes, and properly charg-

ing insurers for medical services is essential to the financial viability of an anesthesia practice. To address these concerns many anesthesiologists either code themselves or more frequently rely on administrative staff and outside companies to process their bills. This process represents a significant investment of time and effort for anesthesiologists and their staff, and when present the lack of direct physician oversight of the final bill can result in over cod-

ing or under coding errors, both of which are undesirable. Proper anesthesia coding requires the coder to accurately identify the proper Anesthesia Current Procedural Terminology (Anesthesia CPT-4) code either during the case or more likely using information provided by the surgeon communicated on a billing sheet which may or may not have been reviewed by a surgical coder (see Figure 4). The information an anesthesia coder may therefore utilize includes a verbal description of the surgical procedure with or without the appropriate code from the American Society of Anesthesiologists Relative Value Guide (RVG) [1]. The RVG is a 54 page compendium of Anesthesia CPT-4 codes that are linked to the American Medical Association Current Procedural Technology (AMA CPT-4) codes which surgeons use to describe their procedures. The RVG corresponds to a larger 249 page book called *Crosswalk: A Guide for Surgery/Anesthesia CPT Codes* [2]. When this process is properly performed, the Anesthesia CPT-4 code should match the AMA CPT-4 code and the code with the highest value submitted. While seemingly straightforward, this process is often complicated and fraught with potential errors. To our knowledge, computer automation of the crosswalk process has not been previously evaluated as a means of process improvement.

The current text of both books makes it difficult to locate certain procedure codes when they do not correspond to a specific body part and frequently requires the need to cross reference multiple pages. Additionally, surgery frequently involves numerous procedures indicated by AMA CPT-4 codes that may not be indicated on the surgical schedule and may not be conveyed to the anesthesiologist. As a result selecting an Anesthesia CPT-4 code from the verbal surgical description or the text of the surgical schedule may not be in concordance with the selected AMA CPT-4 code chosen by the surgeon, resulting in error. Currently there is limited information about the overlap between AMA CPT-4 codes and Anesthesia CPT-4 codes and the potential for errors when the anesthesia practice documents a surgical procedure. There have been several attempts at using computerized billing in anesthesia [3,4], including a recent study by Spring, et al [3] which showed that automating generalized alphanumeric error detection in anesthesia billing can have significant positive impact on the process. However, none have specifically identified the exact step at which errors can occur during the crosswalk translation or development and implementation of software solutions to target and eliminate errors during these steps.

There is considerable evidence from other medical specialties indicative that procedure coding is an inherently imprecise art [5, 6]. A recent report by the US Office of Inspector General noted that between 14.7-20.8% of Medicare discharges had discrepancies in the diagnosis and procedures submitted using the International Classification of Diseases, Ninth Revision, Clinical Modification codes [7]. Further, there is evidence that errors in coding may not be solely a function of the complex billing process in the

United States [13], and therefore could conceivably be due to the difficulty in translating complex procedures into a standardized billing mechanism, regardless of where the coders are drawing their information from. Anecdotally, the fact that anesthesia coding requires the additional "crosswalk" step from surgeon to anesthesiologist may predispose it to an even greater likelihood of error than other fields. Likely from acknowledgment that both under coding (which can reduce total billing) and over coding (which can pose legal ramifications under the False Claims Act [8].) can threaten a hospital's longevity, various groups have investigated implementing automation of various forms to streamline the coding process -- computerized dictation templates in dermatology [9] and an intranet-based system for billing in an intensive care setting [10] are but two examples. It remains the case, however, that there are few readily accessible solutions to address this issue within the field of anesthesiology.

In hopes of targeting the information gap on the surgery-to-anesthesia conversion and deciphering whether or not automation may prove efficacious, we present a study quantifying the error rate between Anesthesia and AMA CPT-4 codes. This study then goes one step further, developing an automated software solution to resolve this crosswalk translation and offering analysis of its effect on coding error after implementation.

## 2. Methods

Approval to obtain data from the Duke Ambulatory Surgery Center (ASC) Database (containing over 35,000 outpatient procedures over a six-year period) was obtained from the Department of Anesthesiology and the Duke Institutional Review Board. Using de-identified information, three fictitious data sets were compiled for analysis. As this was an exploratory study, no formal sample size calculations were completed and randomization was not undertaken:

- (1) Initial coding assessment prior to the implementation of a software solution (n=142)
- (2) Coding assessment after the implementation of a software solution (n=298)
- (3) Final coding assessment after evaluating the initial software and implementing additional features into the program code with the goal of enhancing process accuracy (n=334)

Each sample was designed to reflect common procedures normally coded in daily practice, such as mastectomy, arthroscopic surgeries, cholecystectomy, etc. The following variables were provided for each record: procedure description, AMA CPT-4 codes, patient age and gender. These variables mimic the usual information set received by coders to establish the anesthesia professional billing code prior to computation for concurrency. To mimic real conditions, approximately 12% of all patient observations had missing AMA CPT-4 codes in each data set (frequencies of 17, 35, and 40, respectively). The 12% rate of miss-

ing AMA CPT-4 codes was based on results of a pilot study conducted at the Duke ASC. The lack of AMA CPT-4 codes occurs when surgeons have delays in providing this information. In this situation, coders have to rely on surgical descriptions to execute the crosswalk translation.

For all three assessments, each AMA CPT-4 code was manually checked by the first author (RP) and one professional coder using the 2005 Relative Value Guide and 2005 Crosswalk to determine the ideal Anesthesia CPT-4 code or gold standard. The two "coders" were blinded from each other initially. Thereafter their codes were compared, and when there was disagreement between the two, these records were reviewed and a consensus reached. This created a list of 'gold standard' codes, used as benchmark references throughout the trials.

### 2.1. Trial 1: Standard Coding by Professional Coders

Two professional anesthesia coders, uninvolved with the establishment of benchmarks and with an average of 15 years of experience in coding, coded the initial dataset. All 142 sample patient encounters were classified using the same routine coding procedures used in their daily practices. The ascribed codes were then manually evaluated and compared to the gold standard by two of the authors (RP, SK). The records were then classified into one of five categories if a major miscoding flaw was present:

- 1) wrong body region assigned
- 2) under coding if the crosswalk implementation or memorization problem resulted in an Anesthesia CPT-4 code of lesser monetary value than clinically indicated
- 3) over coding if the crosswalk implementation or memorization problems resulted in an Anesthesia CPT-4 code of greater monetary value than clinically indicated
- 4) Errors from lack of an AMA CPT-4 code
- 5) Errors from misinterpretation of the Anesthesia CPT-4 codes.

This categorization scheme was chosen through a Delphi study[14,15] involving two anesthesiologists and one surgeon observing the array of potential miscoding patterns. Ultimately, they determined that these 5 classifications would capture most of the variance across different patterns while keeping the categories to a minimum. These

results were then tabulated and reported using descriptive statistics.

### 2.2. Software Development

To address the potential sources of error, an evaluation of the existing billing system for the Duke ASC was mapped and evaluated (Figure 4). The following steps were identified in the professional anesthesia billing process. 1) After the surgical procedure is performed, the surgeons generate an AMA CPT-4 code in the billing office. 2) Next the AMA CPT-4 code is written in a surgical report by a professional surgical coder and submitted electronically to the anesthesia billing office. Then anesthesia coders use the 2005 Crosswalk manual to translate AMA CPT-4 codes into Anesthesia CPT-4 billing codes. Concurrency guidelines and respective modifiers are applied to the initial Anesthesia CPT-4 codes. 3) Finally, Anesthesia CPT-4 codes are submitted to third party payers. Because the crosswalk process may require the checking of multiple pages of two different manuals for each code, this point in the system was identified as a primary potential source of coding errors.

Based on this evaluation a computerized software program was designed with the following aims: (1) Automate the crosswalk translation between AMA CPT-4 codes and Anesthesia CPT-4 codes, thus avoiding memorization errors by coders, and (2) assist coders and clinicians in the choice of the most appropriate anesthesia code that accurately represents the highest level of complexity for procedure underwent by each patient.

The software was developed in JAVA language. The prototyping method was selected to facilitate user understanding. Prototyping techniques were used for requirement gathering and definition. The following steps were executed in software development: (1) use case diagram, (2) class diagram, (3) class coding, (4) usability tests, and (5) application implementation. It should be noted that this software is distinct from the proprietary ASA crosswalk database that was actually used to populate its menus. Figure 4: Crosswalk process.

### 2.3. Interface

The software application was designed for repetitive use, simplicity, and economy of movements. The first screen contains search fields for AMA CPT-4 codes and also for AMA CPT-4 codes descriptive words (Figure 1). The descriptive words generate a list of AMA CPT-4 codes with their respective description (Figure 3).

CPT Search

Please enter all CPT codes for an individual patient:

- 
- 
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- 
- 
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- 
- 
- 
- 
- 

Please enter keywords for description search:

[CLEAR FIELDS](#) [CPT ASA SEARCH](#)

**Figure 1:** Computer screen image from software application designed for linking the AMA CPT-4 code.

The descriptive words generate a list of AMA CPT-4 codes with their respective description (Figure 2).

CPT Search

Please enter all CPT codes for an individual patient:

- 
- 
- 
- 
- 
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- 
- 
- 
- 
- 

Please enter keywords for description search:

[Load ASA codes](#) [Help](#)

- 69433 Tympanostomy (requiring insertion of ventilating tube), local or topical anesthesia
- 69436 Tympanostomy (requiring insertion of ventilating tube), general anesthesia

[CLEAR FIELDS](#) [CPT ASA SEARCH](#)

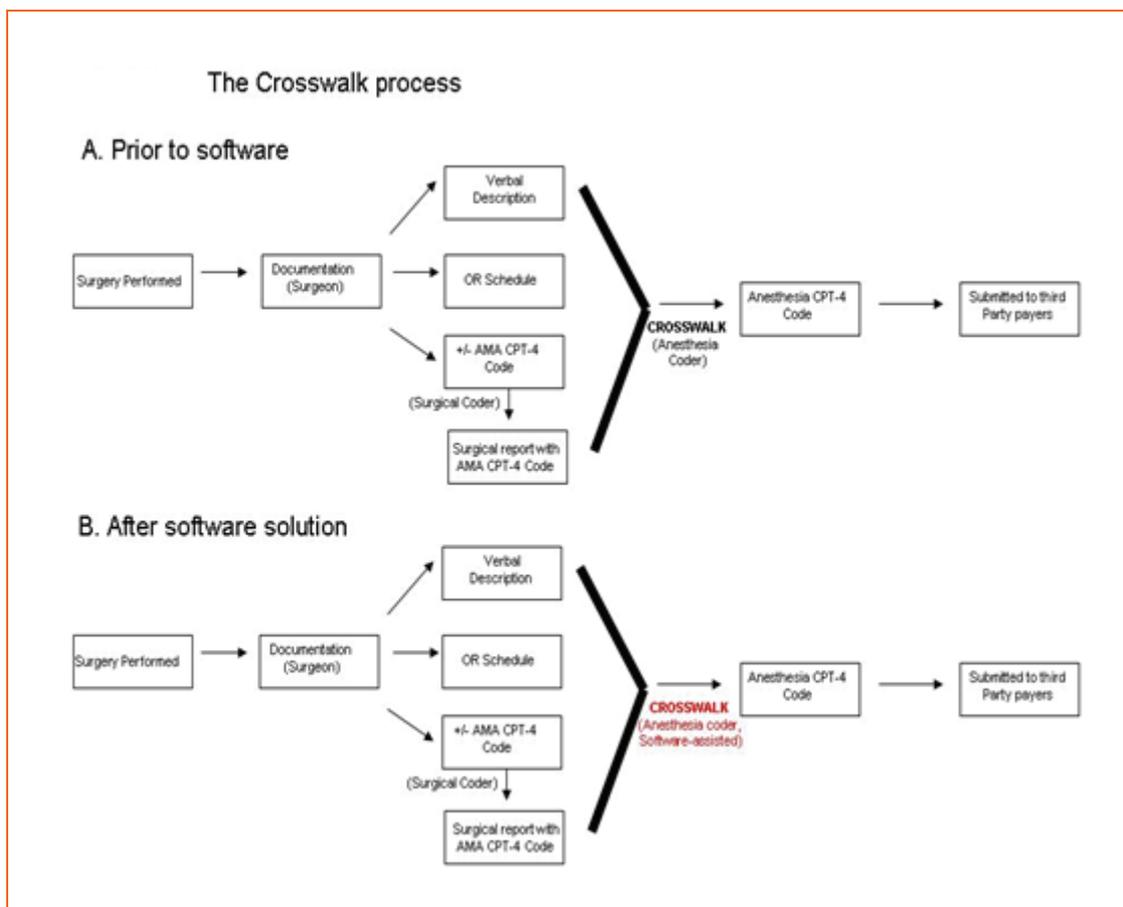
**Figure 2:** Computer screen image from the software application. The descriptive words that generate a list, of AMA CPT-4 codes with their respective description .

69433 Tympanostomy (requiring insertion of ventilating tube), local or topical anesthesia		
ASA	UNITS	DESCRIPTION
00126	4	Anesthesia for procedures on external, middle, and inner ear including biopsy; tympanotomy (Includes tympanostomy)

69436 Tympanostomy (requiring insertion of ventilating tube), general anesthesia		
ASA	UNITS	DESCRIPTION
00126	4	Anesthesia for procedures on external, middle, and inner ear including biopsy; tympanotomy (Includes tympanostomy)

**Figure 3:** Computer screen image from the software application: The screen depicts a sample results page of Anesthesia CPT-4 codes listing them by highest American Society of Anesthesiologists unit value.



**Figure 4:** The Crosswalk process.

After the user selects the AMA CPT-4 codes of choice, they are displayed with the corresponding Anesthesia CPT-4 codes in a separate window (Figure 3). This window can be printed. Although the interface was initially designed as a separate application, multiple modifications

can be made to integrate the software into other existing hospital applications.

Prior to Trial 2, usability of the software was evaluated. Usability tests followed a protocol where six different users were observed by two evaluators, and had to complete regular coding tasks. Users were free to ask questions at any point in time. Tasks included the conversion of

AMA CPT-4 codes into the most appropriate Anesthesia CPT-4 codes as well as finding Anesthesia CPT-4 codes having only a general description of the surgical procedure. The latter task was performed only after trial 2. Each participant answered a questionnaire at the end of the formal usability analysis with items about interface problems, missing features, and suggestions for overall improvement.

Additionally observational tests were carried out by watching professional coders as well as trained staff in the use of the software application for coding of real surgical cases. Similar to the initial usability tests, evaluators took note of problems encountered during the coding session regarding interface, missing features, and overall suggestions.

### **2.3.1. Trial 2: Software Implementation**

For the second trial, two anesthesiologists used the software to code the procedures in the prepared dataset. A single 15-minute training session was held prior to the coding session. Similar to the first trial the completed records were evaluated and compared to the gold standard. Miscoding flaws were then recorded. From these results, enhancements were made to the software to increase usability and reduce errors resulting from lack of an AMA CPT-4 code. A feature to search for AMA CPT-4 codes and their corresponding Anesthesia CPT-4 codes was added. This feature was then tested in the third trial.

### **2.3.2. Trial 3: Enhanced Software Implementation**

For the third trial the same anesthesiologists used an enhanced version of the software improved with an additional feature that allowed for search of descriptive words in CPT codes. Similar to the other trials the completed records were evaluated and compared to the gold standard. Miscoding flaws were then recorded.

## **2.4. Results**

### **2.4.1. Trial 1: Standard coding by professional coders**

See table 1. The pre-software trial demonstrated that 38 % of cases had an error associated with coding. The wrong body region was selected 16% (n = 23/142) of the

time. This occurred when coders memorized a wrong crosswalk rule, resulting in a completely wrong Anesthesia CPT-4 code. An example of this occurring is when a coder selected the code for radical or modified radical procedures with internal mammary node dissection (00406 = a combined procedure with an intra-thoracic component) when the procedure actually conducted was a regular modified radical mastectomy (00404). Under coding occurred 11 % (n = 16/142) of the time. These problems occurred when coders erroneously applied a crosswalk sequence (equivalence between AMA CPT-4 and Anesthesia CPT-4 codes). This high incidence resulted from codes that were frequently used, such as ventral and incisional hernias (for which the correct code is 00832 = 6 units) were coded as anesthesia for hernia repairs in lower abdomen, not otherwise specified (code 00830 = 4 units). The incidence of over coding was 6 % (n = 9/142). This resulted from a pattern similar to the error pattern described for under coding. Examples included the use of the Anesthesia CPT-4 code for procedures on external, middle, and inner ear including biopsy (00120) for tympanostomy which has a specific code (00126); and the use of the code 00404 (radical or modified radical procedures on breast) for simple mastectomy which according to the crosswalk should be related to the code 00400 (anesthesia for the integumentary system on the extremities, anterior trunk and perineum).

### **2.4.2. Trial 2: Software Implementation**

The trial after the introduction of the software application demonstrated a decrease in total error rates to 4 % (n = 12/298). The incidence of wrong body region errors, under coding errors and over coding errors was eliminated (0 %). Errors attributed to a lack of an AMA CPT-4 code were reduced to 3% (n = 8/298) of all cases. Errors from misinterpretation of Anesthesia CPT-4 codes displayed in the software accounted for 1% (n = 4/298).

### **2.4.3. Trial 3: Enhanced Software Implementation**

The third trial had an overall error rate of 3% (n = 11/334). The incidence of wrong body region errors, under coding errors and over coding errors did not change (0 %). Errors resulting from lack of an AMA CPT-4 code were reduced to 1.5% (n = 5/334) of all cases. Errors from misinterpretation of Anesthesia CPT-4 codes displayed in the software increased slightly to 1.8% (n = 6/334).

	<b>Trial 1 - No software</b>	<b>Trial 2 - Preliminary software</b>	<b>Trial 3 - Enhanced software</b>
Total Cases	142	298	334
Total Errors (%)	61 (43)	12 (4)	11 (3)
Wrong body region (%)	23 (16)	0 (0)	0 (0)
Under Coding (%)	16 (11)	0 (0)	0 (0)
Over Coding (%)	9 (6)	0 (0)	0 (0)
Lack of AMA Code (%)	8 (6)	8 (3)	5 (1.5)
Misinterpretation of Anesthesia CPT-4 Code	5 (4)	4 (1)	6 (1.8)

**Table 1:** Results from each of the three trials.

### 3. Discussion

The results of this study demonstrate that there is a high potential for error (38%) in manually converting surgical information (usually) in the form of AMA CPT-4 codes to anesthesia CPT-4 codes. And while limited by the design of the study in terms of sample size and non-random assessment, this finding is consistent with other investigations examining procedure coding with baseline error estimates ranging anywhere from 18% [5] in radiology to 45% in family practice [6]. In our trial 1, more than one-third of all records were miscoded during this process despite the fact that the coders had years of professional billing experience. By studying the system several potential sources of error were identified. Using this information and specifically targeting the steps in the conversion or crosswalk process, a successful software solution was developed. This software dramatically reduced the error rates in the manual process by addressing the major sources of discordance. Further, the fact that the only variable modified between trials was the automation of the crosswalk process, it serves as strong evidence that this was in fact a primary source of the high error rate identified in trial 1.

The most frequent source of error (16%) was inadvertently selecting the wrong body region when converting the AMA CPT-4 codes to the Anesthesia CPT-4 codes. The prevalence of this error, in this seemingly straightforward aspect of the conversion, highlights the difficulty inherent in the coding process. It also emphasizes how subtle differences in similar sounding procedures can have very different billing requirements [e.g., radical or modified radical procedures with internal mammary node dissection (00406) vs. regular modified radical mastectomies

(00404)]. This is further exacerbated by the fact that coding personnel are required to work with two separate books with complex medical jargon using limited information, which may not offer clarification when reconciling with the procedure description. And while they do receive training in medical procedural terminology and anatomy, it can be assumed that their knowledge base is not commensurate with that of a physician. All these imply that the level of system complexity and the resultant imprecision of billing outcomes can have major financial and legal repercussions to an anesthesia practice.

Nevertheless, extrapolating these results to all anesthesia practices is clearly beyond the scope of this single center investigation and error rates may not be as high in other institutions in real clinical settings. Practices utilize varying methods to code their cases. Physician participation, shown to improve accuracy of the final coding [11], also varies by group. Conceivably, deficits in these areas could have led to the high error rate obtained in Trial 1. However, this study at the very least increases one's concern for the possibility of coding error when the crosswalk process is manually navigated. And given the fact that nearly 40 million anesthetics are delivered each year [12] and coded using this complicated conversion process, the implications for any incorrect coding whatsoever could be substantial and may warrant an automated solution. The fact that the error rates dropped both between trial 1 to trial 2 and from trial 2 to trial 3 only strengthens the notion that the crosswalk should be viewed as a primary source of coding error and that automation is one tool which may be used to address it. It is also noteworthy that the success of the software solution utilized in this study is similar to

other areas of automation in medicine where a cumbersome process is computerized. By identifying likely areas for error, examining the coding cycle, and focusing on end user needs, the implementation obstacles were minimized. In addition, the numerical nature of the AMA CPT-4 codes and the Anesthesia CPT-4 Codes further lent itself to enhanced accuracy when human interpretation is minimized.

Accurate medical coding has important implications for the financial stability of an anesthesia practice. The results of this study demonstrate some of the potential areas for error when utilizing the current system of matching the appropriate AMA CPT-4 codes used by the surgeon with the Anesthesia CPT-4 code used in the submission of anesthesia charges. Given the success of the software solution used in this study, further investigation is warranted to determine whether the miscoding rate is consistently elevated among anesthesia practices and if this solution can be more broadly applied to address it.

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## Conflicts of Interest

The authors declare no competing interests.

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