



# The effect of data-entry template design and anesthesia provider workload on documentation accuracy, documentation efficiency, and user-satisfaction

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## ABSTRACT

**Introduction:** Currently, there are few evidence-based guidelines to inform optimal clinical data-entry template design that maximizes usability while reducing unintended consequences. This study explored the impact of data-entry template design and anesthesia provider workload on documentation accuracy, documentation efficiency, and user-satisfaction to identify the most beneficial data-entry methods for use in future documentation interface design.

**Methodology:** A study using observational data collection and psychometric instruments (for perceived workload and user-satisfaction) was conducted at three hospitals using different methods of data-entry for perioperative documentation (auto-filling with unstructured data, computer-assisted data selection with semi-structured documentation, and paper-based documentation). Nurse anesthetists at each hospital (N = 30) were observed completing documentation on routine abdominal surgical cases.

**Results:** Auto-filling (61.2%) had the lowest documentation accuracy scores compared to computer-assisted (81.3%) and paper-based documentation (76.2%). Computer-assisted data-entry had the best documentation efficiency scores and required the least percentage of the nurse anesthetists' time (9.65%) compared to auto-filling (11.43%) and paper-based documentation (15.23%). Paper-based documentation had the highest perceived workload scores (M = 288, SD = 88) compared to auto-filling (M = 160, SD = 93, U = 16.5, p < 0.01) and computer assisted data-entry (M = 93, SD = 50, U = 4.0, P < 0.001).

**Conclusions:** Auto-filling with unstructured data needs to be used sparingly because of its low documentation accuracy. Computer-assisted data entry with semi-structured data needs to be further study because of its better documentation accuracy, documentation efficiency, and perceived workload.

## 1. Introduction

Clinical documentation is a narrative of patient care [1] that serves as the legal record of patient encounters, assists in billing, provides data for clinical decision support, assists in communication between different providers, and is used for secondary data analysis. Documentation templates are used by clinicians to generate clinical documentation [2]. Clinical documentation is generated using templates that are either traditional paper-based forms or electronic data-entry interfaces. Electronic template designs use standard data selection methods [3] (e.g., item selection through radio-buttons or drop-down menus) or insertion of complete blocks of text (i.e., auto-filling) that must be manually edited if actual patient care deviates from the pre-defined blocks of text

[4].

Data-entry templates can be used with the data types: structured, unstructured, and semi-structured [5,6]. Data-entry templates can be used with structured data-entry designs that incorporate standard coded data that can improve documentation completeness; but because these designs are not flexible, correctness may be decreased if they fail to provide a true description of patient care [5,6]. Data-entry templates for unstructured data types involve using narrative text (user-defined comments) that incorporates natural language to provide a more correct description of patient care, but sometimes at the expense of completeness [5,7]. Data reusability is impaired by unstructured data because it is difficult to automate processing since unstructured data requires human interpretation [6,8]. Data-entry templates that use

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semi-structured data are created in electronic documentation systems by integrating structured and unstructured data simultaneously to improve correctness and completeness of the generated documentation [5].

Failure to adequately design and implement data-entry templates can result in unintended consequences such as using incorrect information to make patient care decisions, increased malpractice risk from poor documentation, and impaired clinical workflows [1]. Evidence-based guidelines to inform optimal template design are virtually absent from the published literature [9]. The purpose of this paper is to describe an exploratory study that assessed the impact of data-entry template design and anesthesia provider workload on documentation accuracy, documentation efficiency, and user-satisfaction for the purpose of identifying the most beneficial data-entry template configuration for use in future documentation interface design. For this study, template design will be evaluated in terms of how a single data-entry template (either computer-assisted, auto-filling, or paper-based) is paired to a single data type (structured, unstructured, or semi-structured).

## 2. Methods

### 2.1. Design and setting

An exploratory descriptive study using observational data collection and administration of psychometric instruments (measures for perceived workload and user-satisfaction) was conducted at three different hospitals each using different data-entry templates (auto-filling, computer-assisted data selection, and paper-based documentation) for generation of anesthesia documentation. Each site exclusively used the same type of data field (i.e., structured, unstructured, or semi-structured) for all of data elements collected in this study. Sites were selected so that each data-entry template was paired with a single data field type. The exact same documentation data elements from the minimum anesthesia dataset were collected at each site. Additionally, the sites were selected because they were similar in size and surgical cases performed. Observations were limited to general abdominal surgical procedures so that anesthesia and surgical workflows would be similar.

The first site utilized an electronic documentation system that relied on auto-filling of unstructured data that required concurrent documentation of event time with additional narrative text that described that event. For example, after documenting the time of occurrence for tracheal extubation, the documentation system required the narrative portion to be entered immediately afterwards. All possible documentation options that could be selected were displayed in a column on the left side of the computer screen. All the data-entry templates at this site used standardized narrative text that had to be manually edited if actual patient care deviated from the default information.

The second site used computer-assisted data collection (semi-structured data) that did not force the documentation of the time of occurrence at the same time as the narrative portion that described the event. For example, the time of occurrence for tracheal extubation is entered into the documentation with the narrative portion blank. The anesthesia provider may then choose to document the narrative portion immediately or at a different time.

The second site system also incorporated a context-sensitive display of documentation options that was customized to the anesthesia workflow of the organization. For example, only the option to document patient arrival to the operating room is initially visible. After patient arrival to the operating room is documented, the visual display of options changed to “anesthesia induction.” The visual display of documentation options continued to change according to the phase of anesthesia care (e.g., anesthesia start, maintenance, and emergence). This site did not use any default values.

The third site used traditional, manually completed paper-based documentation. This data-entry process was very flexible in terms of

when the anesthesia provider could choose to document patient care events. Paper-based documentation was included as a comparison for the other two sites because it is historically how documentation was completed and would provide a good evaluation to compare performance against electronic documentation systems.

### 2.2. Participants

Purposive sampling was used to recruit 10 nurse anesthetists using each type of data-entry template (N = 30). The nurse anesthetists were observed providing anesthesia for adults undergoing general abdominal surgeries (e.g., cholecystectomies) to decrease the variation that type of surgery might have on workflows observed across sites. Participant inclusion criteria included nurse anesthetists who have been practicing at their respective location for at least six months. Participant and system exclusion criteria included new graduates who have been practicing less than one year, documentation systems used for less than one year, and observation of emergency surgeries. Institutional review board approval was obtained prior to data collection at each site. It was explained to the participants that if any errors or patient safety concerns were witnessed that data collection would cease so that any concerns could be addressed immediately.

### 2.3. Data collection

Data collection involved the use of direct physical observations using a data collection tool and participant completion of psychometric instruments. Demographic data collected from anesthesia providers included total number of years using the specific data-entry template being evaluated, gender, and age.

#### 2.3.1. Data collection tool

The data collection tool for the physical observations was created by modifying a pre-existing observational data collection tool [10] used to study medication administration errors. The tool uses a touchscreen mobile personal computer running a Microsoft Access database. The content for the modified data collection tool was determined by identifying all the data fields in a typical anesthesia record and compared to the minimum anesthesia dataset [16]. A pilot test from a previous study was used to corroborate that all of the observed intraoperative anesthesia related patient care events mapped to the data fields in the tool [4]. The data collection tool was pilot tested again prior to data collection to evaluate inter-rater reliability ( $\kappa = 0.84$ ). All data collection was performed by one of the researchers (BW) to maintain consistency in measurements.

#### 2.3.2. Documentation accuracy

Documentation accuracy is defined in the literature as documentation with correct information. [11] Several studies have used percent-agreement scores to quantify documentation accuracy [4,12–15]. In this study, percent-agreement is used as a proxy for documentation accuracy because the findings will be comparable with other studies on anesthesia documentation. Percent agreement is calculated by comparing the observational data to the final electronic anesthesia record. Anesthesia providers will often ignore generation of documentation while providing direct patient care, and this has been shown to have a negative impact on documentation accuracy [11].

Observational data collected included data on nine key events: anesthesia start time, anesthesia induction time, antibiotic administration, gas flow rates (oxygen, air, and nitrous), neuromuscular function testing, fluid intake, anesthesia time out, oral airway placement, and tracheal extubation. These key events were identified in a previous study as being the major sources of documentation error in electronic anesthesia records [4]. These key events are also part of the minimum anesthesia data set and must be included in anesthesia documentation [16].

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