Standardized handoff is critical to providing safe and effective patient care. Limited studies assess the need for developing a handoff tool for anesthesia providers. The purpose of this descriptive study was to assess the need for a standardized anesthesia handoff tool and to identify the most essential components to develop an anesthesia handoff tool. A descriptive survey design was used. Anesthesia providers were asked to complete an online survey.

Fifty-three (64%) of 82 respondents did not currently use a systematic process during anesthesia handoff. Most (73%) believed they were given inadequate information, and 40 (48.8%) sometimes discovered information that was not shared by the prior anesthesia provider. The most frequently provided components by respondents were airway type, airway difficulty, analgesia, anesthetic type, invasive lines, patient medical history, procedure, and vital signs. The most frequently received were airway difficulty, invasive lines, medical history, and procedure. Most participants perceived that anesthesia providers currently provide inadequate handoff. Anesthesia providers indicated the most essential components for effective anesthesia handoff were airway difficulty, invasive lines, medical history, procedure and case-specific concerns, allergies, medications, and plan/goals. The study findings guided the development of the concise and efficient TIME (transaction, induction, maintenance, emergence) anesthesia handoff tool.

Keywords: Anesthesia, checklist, communication, handoff, handover.
The conceptual framework developed for this research study was a combination of 2 theories, including the transactional model of communication and the cooperative shift change. The transactional model of communication describes 2 communicators who both send and receive information. The model also considers the environment as part of the experience, consisting of the external noise in the physical location as well as the physiologic and psychological experience of the communicators. Another theory, the cooperative shift change theoretical framework for air traffic controllers, was developed during shift change. This framework consists of 4 phases: end of shift, arrival, meeting, and taking post. In the end-of-shift phase, the controller coming onto duty (incoming controller) learns as much as possible about what is going on with air traffic. In the arrival phase, the incoming controller sits in and observes the scene, gaining situational awareness. In the meeting phase, brief verbal communication guided by a checklist occurs between the 2 controllers. Finally, the taking-post phase distributes equal responsibility to both the incoming and outgoing controllers to confirm that accurate situational awareness and essential information is discussed.

Combined, the cooperative shift change framework and the transactional model of communication result in the observation, transaction, and confirmation (OTC) conceptual framework for handoff between anesthesia providers (Figure 1). Similar to the arrival phase of the cooperative shift change framework, the observation phase consists of the incoming anesthesia provider gaining as much information as possible about the transfer-of-care situation before proceeding to the handoff location. During this time, the anesthesia provider should collect information about the surgeon, procedure, anesthesiologist, and location.

The transaction phase of the OTC conceptual framework uses the transactional model. This phase is similar to the meeting phase of the cooperative shift change framework and includes the details of the transactional model. The incoming and outgoing anesthesia providers have a brief conversation, ideally using a structured checklist or tool, in which information is given and received between the 2 communicators. To optimize this phase, consideration is given toward reducing distracting external noises such as music, talking, and equipment. Examples of physiologic distractors of the communicators are stress, fatigue, and illness. Psychological factors are differences in willingness, years of experience, gender, power, role, and attitude between the anesthesia providers.

The final phase of the OTC conceptual framework is the confirmation phase. After the transaction phase, both communicators should provide verbal feedback confirming that all information has been shared accurately and completely, enabling the incoming provider to adequately provide anesthesia to the patient for any length of time. The OTC phases provide a framework consistent with existing concepts for transfer of responsibility of events and communication.

**Materials and Methods**

- **Research Design and Sample.** A descriptive survey was conducted. The objectives of this study were to assess the need for a standardized handoff tool and to provide information on current handoff processes between anesthesia providers as well as their opinions on the most essential aspects to include in the anesthesia-specific handoff tool. The project describes anesthesia handoff procedures and attitudes as they currently exist, and the results provide insight for future studies.

A convenience sample of anesthesia providers practicing in the greater Chicago, Illinois, area at 2 large, academic institutions was used. The sample included Certified Registered Nurse Anesthetists (CRNAs), student registered nurse anesthetists, anesthesia residents, and anesthesiologists working at 4 hospitals. Participants met the inclusion criteria of being English-speaking, legally permitted to provide anesthesia in the state of Illinois in—
dependent or under direct supervision of an anesthesia provider, having a minimum of 6 months of providing anesthesia, and currently practicing anesthesia.

Approval from the appropriate institutional review boards was obtained. No physical or psychological risks were anticipated to be associated with this research. Because of the voluntary nature of the survey, participation by subjects implied that they did not feel uncomfortable or embarrassed by completing the survey.

- **Instrument.** The study survey included multiple-choice questions regarding demographics, a needs assessment for a standardized handoff tool for anesthesia providers, current anesthesia handoff practices, and essential components of anesthesia handoff. The survey questions were influenced by the existing questionnaire developed by Wright for her study and development of the PATIENT protocol. Modifications were made to best answer the research questions of this study.

- **Data Analysis.** Raw data were securely downloaded from Qualtrics. Data collected from the surveys were analyzed using Microsoft Excel for Mac 2011 version 14.5.3 (Microsoft Corp) and SPSS for Mac version 23 (IBM Corp) using descriptive statistics to describe frequencies and means.

### Results

As seen in Table 1, of the 82 study participants, most were anesthesiologists (n = 34, 41.5%) or currently in anesthesia residency (n = 27, 32.9%), whereas 17 were CRNAs (20.7%) and 4 were student registered nurse anesthetists (4.9%). Most respondents (n = 62, 75.6%) spend more than 36 hours per week providing anesthesia and have been providing anesthesia for 2 to 5 years (n = 28, 34.1%). There was a slightly greater number of male participants (n = 44, 54.7%) than female (n = 38, 46.3%), and most identified their ethnic origin as white (n = 58, 70.7%).

- **Perceived Need for a Standardized Handoff Tool.** To address the study question about the perceived need for a standardized handoff tool for anesthesia providers, subjects were asked whether they currently used a systematic process for handoff from one anesthesia provider to another. Of the 82 responses, 53 participants (64.6%) denied currently having a systematic process for anesthesia handoff. The remaining 29 respondents (35.4%) could provide a free-typed description of their current handoff process. There were 21 free-typed responses composed of about 20 categories with the most frequently described being patient history, medications given, plan/goals, and case-specific concerns. In addition, airway management, type of surgery, and IV access were frequently free-typed as part of current handoff processes.

Participants were also asked how often they believed they were given inadequate information during transfer of care (Table 2). Nineteen respondents (23.2%) thought they were given inadequate information most of the time or always. Half of the respondents (n = 41, 50%) believed they sometimes were given inadequate information. When asked about how often they thought they gave inadequate information to others during transfer of care, 31 participants (37.8%) replied they sometimes gave inadequate information and 11 (13.4%) believed they gave inadequate information most of the time or always. To answer how often they discovered something that was not discussed during handoff, 40 (48.8%) believed they sometimes discovered something that was not discussed and 8 participants (9.8%) thought they discovered something that was not discussed most of the time or always.

- **Essential Components of Standardized Handoff Tool.**
- **Current Practice of Handoff.** Participants were given a list of 18 components of handoff that have previously been identified in the literature. These included ASA class, airway type, airway difficulty, allergies, analgesia, antibiotics, antiemetics, anesthetic type, invasive lines, intake/output, patient medical history, patient surgical history, position, procedure, neuromuscular blockade status,
surgeon, ventilatory status, and vital signs. Participants were then asked how often they provided each of the 18 components to others as well as how often they received each of the 18 components during handoff or transfer of care. Table 3 displays the frequencies for each of the top 9 components that were used in current handoff vs ideal handoff. Of these top 9, the following 8 were the most frequently provided components in current practice: airway type, airway difficulty, analgesia, anesthetic type, invasive lines, patient medical history, procedure, and vital signs. The components that participants most frequently received from others during handoff were airway difficulty, invasive lines, medical history, and procedure.

• Ideal Handoff Practice. In addition, participants were asked which components are essential to anesthesia handoff. The most essential components identified were airway type, airway difficulty, allergies, anesthetic type, invasive lines, patient medical history, procedure, and vital signs. The components that participants most frequently received from others during handoff were airway difficulty, invasive lines, medical history, and procedure.

Participants were asked to rank the components of the PATIENT protocol in order from most essential (1) to least essential (12). As shown in Table 4, the components

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Mode</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient</td>
<td>2.4</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Airway</td>
<td>2.9</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Procedure</td>
<td>3.6</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Anesthesia</td>
<td>4.2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Allergies</td>
<td>6.0</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>IVs and other invasive lines</td>
<td>6.1</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>ETCO₂ (ventilation)</td>
<td>6.9</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>Narcotics</td>
<td>8.4</td>
<td>11</td>
<td>8</td>
</tr>
<tr>
<td>Position</td>
<td>8.5</td>
<td>6</td>
<td>9</td>
</tr>
<tr>
<td>Antibiotic</td>
<td>8.7</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>Twitches</td>
<td>9.3</td>
<td>12</td>
<td>11</td>
</tr>
<tr>
<td>Temperature</td>
<td>11</td>
<td>12</td>
<td>12</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>Table 4. Components Ranked in PATIENT Protocol (N = 78)</th>
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<td>Abbreviations: ETCO₂, end-tidal carbon dioxide; IV, intravenous.</td>
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<tr>
<td>Ranked most essential (1 point) to least essential (12 points), indicating a lower score is more essential.</td>
</tr>
</tbody>
</table>

that were ranked most essential were patient and airway. These were followed by procedure, allergies, anesthesia, and IVs and other invasive lines. Temperature and twitches both ranked least essential.

• Comparison Between Ideal Handoff Tool and Rank PATIENT Protocol. The top 5 ranked components of the PATIENT protocol are patient, airway, procedure,
anesthesia, and allergies. The top 5 components of the ideal handoff are airway difficulty, procedure, patient medical history, invasive lines, and vital signs. Of these, patient medical history, airway difficulty, and procedure are consistent with the same PATIENT protocol components. In addition, allergies, and invasive lines are also consistently ranked highly among the ideal handoff and the PATIENT protocol. Anesthesia was determined essential in the PATIENT protocol but was not essential to an ideal handoff tool.

**Proposal of the TIME Anesthesia Handoff Tool.** Considering the OTC conceptual framework, major findings from this study, and the importance of systemic checklists and mnemonics to handoff and anesthesia-specific workflow, the authors propose the “TIME” anesthesia handoff tool (Figure 2). This figure illustrates how the TIME anesthesia handoff tool is integrated into the OTC conceptual framework. The incoming provider enters the correct location; sees the outgoing provider; and notices the surgeon, patient position, procedure being performed, monitors, and type of anesthetic. These are all objective qualities that are simply observed. The letter T in the TIME mnemonic represents the initiation of this the next phase: transaction. The incoming provider exchanges information with the outgoing provider. The outgoing provider begins the transaction by providing information regarding the patient, including medical history and allergies, components determined to be essential to handoff. Next, the I represents the induction phase and information regarding airway, invasive lines, and medications given during induction are discussed. The M stands for the maintenance phase, during which information specific to the case is shared, such as timing of case, what interventions have been done or need to be completed, and maintenance medications including analgesics and neuromuscular blockers. The E of TIME represents emergence. A statement regarding the plan for emergence or goals for the case and medications such as anesthesia reversal agents and antiemetics are included during this phase. Finishing the OTC conceptual framework is the confirmation phase, during which feedback and further verification that all information is accurate and understood complete the handoff.

**Discussion**

Most anesthesia providers participating in this study believed that handoff from their peers lacked information necessary to adequately care for their patient. About half of participants admitted they themselves sometimes, most of the time, or always gave inadequate information to others. Although providers might perceive their personal practice more confidently than their peers’ practice, many acknowledged they also contributed to inadequate handoff, further supporting it as an area in need of standardization. The results from this study indicate that most participants perceive that both their peers and themselves currently provide inadequate handoff. A standardized handoff tool specific for anesthesia providers can help improve memory, increase efficiency, decrease adverse outcomes, and enhance communication.9,10

For evaluation of the factors that anesthesia providers believed were most essential to handoff, participants were asked questions regarding their current and ideal handoff practices. Participants currently give and receive

![Figure 2. A New Anesthesia Handoff Tool: “TIME”](image-url)
information on airway difficulty, invasive lines, medical history, and procedure in handoff. Six of 7 of the components participants believed to be essential to an ideal handoff were consistent with the components currently used during handoff. Analgesia was always provided by at least 85% of respondents as part of their current handoff practice but was not determined to be an essential factor. One component, allergies, was deemed essential to handoff but was not provided in current practice.

Airway difficulty, invasive lines, medical history, and procedure are the most essential components of anesthesia handoff based on the components that are currently given by and received from most providers, as well as those determined to be essential to an ideal handoff. Of the top 5 ranked components of the PATIENT protocol,\(^6\) patient, airway, and procedure are consistent with the most essential components determined by this study. The allergies component was ranked among the highest of the PATIENT protocol and was believed to be one of the most essential components by participants; however, as mentioned, it was not one of the factors currently used.

Considering open-ended responses by participants who currently use a standardized method for handoff, medications given, plan/goals, and case-specific concerns should also be considered essential because they are frequently used in current practice; however, they were not options on survey questions. Use of a more generic medications category as an open-ended response on the survey encompasses the specific medication classes such as analgesia, antibiotics, antiemetics, and anesthetics. Participants view medications as an important part of handoff, including but not limited to analgesia and antibiotics. The higher ranking and more frequently provided answer in the open-ended responses identifies medications to be an essential component of handoff. In addition, case-specific concerns were frequently free-typed and could be interpreted as part of the procedure component from the list provided by the survey. The free-typed response of plan/goals does not have an associated survey component and should be determined as one of the most essential components to include in anesthesia handoff. Therefore, any proposed anesthesia handoff tool should minimally address airway difficulty, invasive lines, medical history, procedure/case-specific concerns, allergies, medications, and plan/goals.

The TIME handoff tool was developed to be a concise and efficient tool for anesthesia providers to use during transfer of care. Using the results of this study and the influence of Wright’s PATIENT protocol,\(^6\) the authors created the acronym TIME. The OTC conceptual framework introduced in this article provides the foundation for handoff. This framework was strongly considered during development of an acronym that could be concise, efficient, and applicable to any situation involving anesthesia handoff. Because the transaction phase of the OTC framework is when the interaction between providers occurs, the letter T was important to the acronym. Next, an anesthesia-specific organization of events was decided to be a logical and adaptable way to efficiently communicate the most essential components of a case from one anesthesia provider to another. An anesthetic is often divided into 3 phases: induction, maintenance, and emergence. From this, the letters I, M, and E were added to complete the TIME acronym.

The TIME handoff tool differs from the PATIENT protocol in length and organization. In the TIME handoff tool, there are 4 letters to the acronym, each representing a chronological order of events that can be addressed at any point in a case to any provider. This creates an efficient method to organize the important components of handoff. In contrast, the PATIENT protocol consists of a 7-letter acronym with each letter representing 1, 3, or 4 components of handoff. This protocol also includes components that were determined to be not essential to handoff.

Several limitations for this study were identified. The nonrandom sampling procedures may have introduced selection biases and impaired the generalizability of the results. Study participants were recruited from only 2 institutions in the Chicagoland area. The handoff practices and perceptions greatly vary depending on practitioners, geographic location, and workplace. Although this would suggest that the findings of this study are not generalizable to other anesthesia providers, the demographic distribution of study participants is quite representative of the CRNA profession as a whole. The results of this study can provide a foundation for similar studies with a broader study population to best generalize the results. The survey itself had limitations. The list of handoff factors was limited and very specific. As recognized earlier, medications as a general category rather than divided into classes could have yielded different results. Thus, the study may not have captured the potential factors influencing handoff. Another limitation of this study includes use of a convenience sample, a single-informant self-report method, and a cross-sectional design. An inherent limitation is the limited number of existing anesthesia-specific handoff tools to which the TIME tool can be compared.

Anesthetics provided by a CRNA can be more effective and more efficient and can result in fewer adverse outcomes if an appropriate standardized tool is used.\(^{11,12}\) The findings of this research contribute to changing the handoff practice of CRNAs by identifying a need for standardization and identifying the most essential components of handoff. Employers of CRNAs should consider adopting the TIME handoff tool as a standard of practice to promote more effective and efficient communication. Improved communication with other anesthesia providers can also enhance the collaborative and teamwork environment for all anesthesia providers involved.
Similar to the 2-phase study conducted by Wright, the proposed TIME handoff tool can be implemented and evaluated in the future for its feasibility and acceptability. Specifically, research on education of the OTC conceptual framework and integrating TIME into the electronic charting system is a direction for future research. If leadership recognizes the value of this research, implementation and dissemination throughout the department can occur. The literature review completed for this study supports handoff education, electronic integration, and checklist mnemonics. Given the limited sample size and survey limitations, more research on existing anesthesia handoff practices is needed. Currently, there is no protocol or standard of practice for transfer of care between anesthesia providers in these institutions. The needs assessment conducted through a descriptive survey provides information on current handoff processes between anesthesia providers as well as anesthesia providers’ opinions on the most essential aspects to include in handoff.

This study found that most participants perceive that both their peers and themselves currently provide inadequate handoff. The most essential components to include in anesthesia handoff as a result of this study should minimally address airway difficulty, invasive lines, medical history, procedure/case-specific concerns, allergies, medications, and plan/goals. Thus, guided by the conceptual framework of OTC and the major findings of this study, the TIME anesthesia handoff tool is proposed as a concise, efficient handoff tool to be used during transfer of care between anesthesia providers in these institutions.

REFERENCES

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DISCLOSURES
The authors have declared no financial relationships with any commercial entity related to the content of this article. The authors did not discuss off-label use within the article.

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