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Simulated anesthesia consent discussions demonstrate high level of comprehension and education requirements for patients: A pilot study

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ABSTRACT

Objective: Patient comprehension of informed consent and demonstration of procedural understanding is often lacking in anesthesiology. The purpose of this study was to determine if patient communication in anesthesiology is being conducted effectively, and in a manner that ensures adequate communication between anesthesia professionals and their patients regarding procedures with associated risks and benefits.
Methods: Anesthesia professionals were recorded in a simulated setting explaining anesthesia procedures of increasing complexity with one control scenario. Score means were calculated, and statistical comparisons made between discussion of anesthesia procedures and the control scenario.
Results: Calculation of means for 6 readability tests demonstrated the grade level required to understand the medical practitioners' verbal communication was high and increased with complexity of the anesthesia procedure described. The control scenario required a statistically significant lower level of comprehension for the recipient of the information.
Conclusion: In simulated settings, anesthesia professionals regularly communicate procedural details in a manner that is difficult for the general public to understand. Subjects could communicate in simple terms when discussing a control.
Innovation: This pilot study demonstrated effective methodology, using artificial intelligence technology for transcription, to assess patient comprehension of verbal communication.

1. Introduction

Obtaining informed consent for anesthetic care has long been a controversial and poorly understood topic, that necessitates deeper understanding amongst anesthesia providers to provide optimal patient care perioperatively [1]. Comprehension of informed consent has been known to be inadequate, and poor recall of risks and benefits immediately after a consent discussion has been shown to deteriorate even further following an operative procedure [2]. Nonetheless, past research has shown that the general public values thorough discussion of risks and benefits of a surgical procedure, prioritizing understanding of such factors as recovery time and options for treatment [3].

Barriers to successful discussion with patients regarding anesthesia risks and benefits include language and capacity, as well as use of technical or mitigating language [4,5]. Babitu et al. demonstrated that patients undergoing pre-anesthetic consultation failed to understand such terms as "reflux," "aspiration," and "allergy" [6]. Lack of understanding and comprehension is one factor that contributes to overall poor satisfaction with the preoperative consent process [7]. Interestingly, Inglis et al. demonstrated that providing detailed statistical anesthetic risk information does not contribute to improved patient satisfaction [8]. Contributing to difficulty in understanding the efficacy of the anesthesia informed consent is a lack of uniformity amongst institutions, some which do not require written informed consent [9], and lack of standardization when reviewing risks of such procedures as regional anesthetics [10].

Efforts to improve patient satisfaction with the anesthesia informed consent process have studied such interventions as ensuring face to face patient discussions versus telephone discussions of risks and benefits- efforts which proved no difference in patient understanding [11]. More successful initiatives have included written materials and early antenatal education for consent in obstetric anesthesia [12] and formal resident instruction on informed consent [13].

Readability of forms provided for patients is an important consideration for communication with patients regarding informed consent. Past studies have shown that surgical consent forms are often difficult to read, and are best understood by highly literate patients, but are not accessible for the public at large [14,15]. Readability can be determined by use of such scoring mechanisms as the Flesh-Kincaid reading ease scale, which assesses reading difficulty [16,17].

Other tools for measurement of readability of text include the Flesh Kincaid reading level, Simplified Measure of Gobbledygook, Gunning

Abbreviations: IRB, Institutional Review Board; CRNAs, certified registered nurse anesthetists.

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Fog, Fry, Raygor and New Dale Chall scales, which have been used to assess both consent forms and patient information leaflets for pharmaceutical clinical trials [18], and Ford, Caylor, Sticht indices for nonnarrative texts to evaluate radiotherapy consents [19].

Extensive studies have been conducted on written materials and the readability and accessibility of these communication modalities. However, the verbal discussion between provider and patient is also a crucial component of informed consent. Nonetheless, little study has been done to assess patient understanding of verbal communication between anesthesia providers and patients when discussing anesthesia plans and informed consent. The purpose of this pilot study was to use these tools determining readability to assess verbal communication in a simulated setting.

2. Methods

Approval for data curation and study protocol was received from Rutgers University Institutional Review Board (IRB); written consent obtained from all participants. Data analysis was conducted at Rutgers New Jersey Medical School, and all data stored on computer in medical school building. Participants recruited by email within the Department of Anesthesiology at Rutgers New Jersey Medical School. Potential study subjects included faculty anesthesiologists, certified registered nurse anesthetists (CRNAs) and residents with at least 6 months of training in anesthesiology.

Three simulated scenarios were created for participants in which the subjects were asked to describe the process of general anesthesia to a patient. The first scenario involved an uncomplicated patient undergoing general anesthesia for a laparoscopic cholecystectomy. The second involved general anesthesia for a patient undergoing an open abdominal aortic aneurysm repair requiring arterial line, with potential need for transfusion and central line as well as postoperative ventilation. The final scenario involved a discussion of pain management options for a pancreaticoduodenectomy (Whipple procedure) describing use of a thoracic epidural. All participants were asked to include a description of risks and benefits of all included types of anesthesia and procedures that were described as part of the simulated discussion. A discussion of alternatives was included in the final, pain management scenario, in which alternatives to a thoracic epidural for pain management was included (e.g. intravenous narcotics, alternate peripheral nerve blockade, etc.). A fourth scenario was added as a control, asking participants to describe the steps to make a peanut butter and jelly sandwich. (See Table 1 for detailed description of scenarios)

After signing consent for participation, respondents were recorded explaining the processes in Table 1 in mp3 format via microphone on an iMac using Voice Memos (v. 2.3). Audio files were then uploaded to Otter.ai website, an online platform that uses artificial intelligence to transcribe audio files into text format [20]. Text was then lightly edited in Microsoft Word to ensure proper conversion of audio into text format by listening to the subjects' mp3 file while reviewing output from Otter.ai. Text for each of the four scenarios from each subject was analyzed using readability software on Web Fx [21], which provided the following scores: Flesh Kincaid reading ease, Flesh Kincaid reading level, Gunning Fog score, SMOG Index, Coleman Liau Index, and Automated Readability Index.

Statistics regarding the four scenarios and the six readability scores was input into Microsoft Excel. The mean for each readability score in each of the 4 scenarios was then computed. Next, the scores for each of the first three scenarios, related to anesthetic care, were compared to the “control” scenario 4 using the paired one tail *t*-test to assess statistical significance. Finally, the grouped statistics were organized into vertical bar graphs.

3. Results

A total of 30 respondents completed the study, 21 of which were residents, 3 of which were faculty anesthesiologists, and 6 of which were certified registered nurse anesthetists. 21 of the 30 respondents completed all four scenarios, including the fourth scenario used as a control study regarding the assembly of a sandwich. 9 respondents did not complete this fourth control scenario, and only completed the 3 scenarios regarding anesthetic care. The recordings (and associated scores) were recorded for these 9 participants in the first three scenarios only. The mean was calculated for the four scenarios with each of the 6 readability scores assessed for 21 participants in scenarios 1 through 3, and 30 participants for all 4 simulations.

The mean Flesh Kincaid reading ease score gradually decreased from 68.8 to 66.6 to 64.2 in scenario 1 concerning general anesthesia in an uncomplicated patient receiving a laparoscopic cholecystectomy to scenario 2 with an open abdominal aortic aneurysm repair and to scenario 3 with a thoracic epidural for perioperative pain control (Table 2). This score was higher in the “control” scenario 4 at 74.5. The mean Flesh Kincaid reading level increased from 9.0 in scenario 1 to 9.8 for both scenarios 2 and 3, and was lower at 6.6 for scenario 4.

The average Gunning Fog score increased from 12.3 to 13.1 and 13.2 respectively for scenarios 1, 2 and 3. The score was 8.8 for scenario 4. The mean SMOG Index scores increased from 8.2 to 8.6 and 9.0 for scenarios 1, 2 and 3, and was 5.4 for scenario 4. The average Coleman Liau Index score was 9.0 for scenario 1, 8.9 for scenario 2, and 9.5 for scenario 3, with a smaller drop to 8.3 for scenario 4. Finally, the average Automated Readability Index was 9.1 for scenario 1, and increased to 10.0 and 9.9 for scenarios 2 and 3 respectively. This index yielded a score of 6.5 for scenario 4. These scores are displayed graphically in Fig. 1.

Using scenario 4 as a control test case, the readability scores for scenarios 1, 2 and 3 were compared individually against this standard using the student's two-sample *t*-test assuming equal variances. Table 3 lists all one-tail *p*-values comparing readability scores for anesthetic scenarios versus control. With a significance level of 0.05, significant differences were found for all 3 anesthetic care scenarios for the following readability

Table 1

Four scenarios designed for anesthesia providers to explain processes and procedures to patients in a simulated environment. Anesthetic techniques (1–3) involved progressively more complicated procedural elements, and the fourth scenario was used as a control to assess the baseline ability of practitioners to describe uncomplicated processes.

Scenario	Type	Required details of discussion
1	General Anesthesia	Placement of IV Transport to OR Anesthesia induction Need for endotracheal tube Process of emergence Transport to PACU Risks of general anesthesia
2	General Anesthesia	Brief description of general anesthesia Placement of preoperative arterial line Likely need for transfusion Likely need for central line placement Likely need for postoperative ventilation
3	Regional Anesthesia	Need for thoracic epidural Description of epidural Process of epidural placement Description of use of epidural for pain control Risks/benefits of thoracic epidural Alternatives to epidural
4	Control Scenario Peanut butter/jelly Sandwich	Selection of bread Gathering ingredients Assembly of sandwich Clean up before consumption

Table 2

Mean compilation of 6 different readability scoring modalities, comparing the four simulated scenarios.

	Scenario 1 Mean	Scenario 2 Mean	Scenario 3 Mean	Scenario 4 Mean
Flesh Kincaid reading ease	68.8	66.6	64.2	74.5
Flesh Kincaid reading level	9.0	9.8	9.8	6.6
Gunning Fog Score	12.3	13.1	13.2	8.8
SMOG Index	8.2	8.6	9.0	5.4
Coleman Liau Index	9.0	8.9	9.5	8.3
Automated Readability Index	9.1	10.0	9.9	6.5

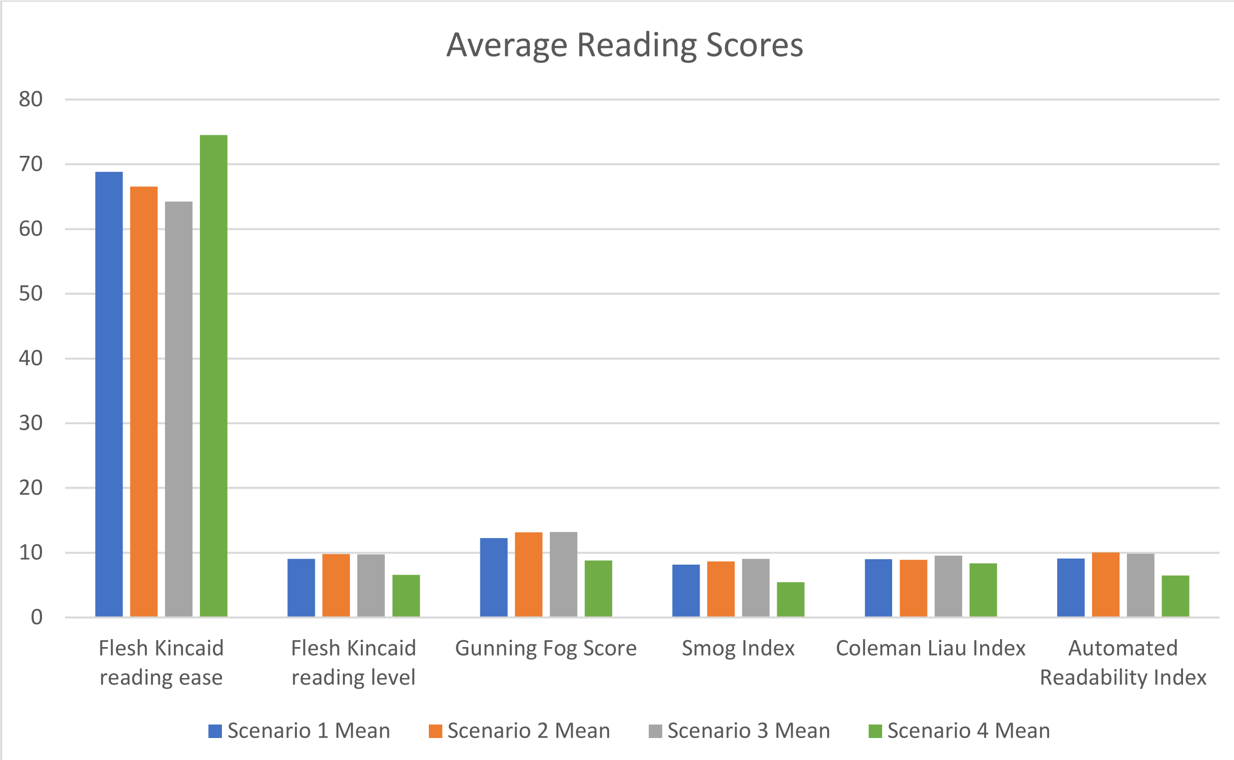

Fig. 1. Bar graph representing the mean scores for 6 different readability scoring modalities. Scenarios 1–3 involved anesthesia processes (general anesthesia for uncomplicated patient, anesthesia for an abdominal aortic aneurysm repair and thoracic epidural for perioperative pain control) and scenario 4 involved a control process to be described by study participants.

tests: Flesh Kincaid reading level, Gunning Fog score, SMOG Index and Automated Readability Index. A significant difference was found with Flesh Kincaid reading ease and Coleman Liau Index scores only when comparing scenario 3 to the control case.

4. Discussion and conclusion

4.1. Discussion

The anesthesia consent process involves communication between anesthesia professionals and a patient or designated patient representative that results in an agreement to undergo a specific procedure after understanding the required information to make a voluntary and conscious decision [11]. Although no uniform standard exists regarding the elements of an informed patient consent, these discussions at a minimum often include review of the anesthetic plan and mention of both risks and benefits [22]. Patient comprehension has been known to be a significant barrier to completion of this process in an appropriate manner. In a depressed socioeconomic patient population, with a low reading and comprehension level for many adults, this becomes an even more significant issue. The National Institute for Literacy estimates that Newark, NJ (site of this study) has the fifth highest rate of illiteracy in the nation, with 52% of adults aged 17 or older categorized as functionally illiterate, a statistic that inevitably will cause complications during communication regarding healthcare [23]. Past efforts to improve patient comprehension have included such modalities as written, audiovisual, multicomponent, or interactive digital interventions, as well as verbal discussion with test/feedback or teach-back interventions [24].

The language used in patient education materials for anesthesiology has long been known to include words that are long and abstract, complicating the ability of practitioners to obtain informed consent [25]. This is similar to findings in other specialties and settings such as the national consent forms used for invasive procedures in the United Kingdom [26] and patient education forms in community clinics in the midwestern United States [27]. Even online educational material related to anesthesiology for the major anesthesiology societies are written at levels higher than those recommended for adequate comprehension by American adults as recommended organizations such as the National Institute of Health, the American Medical Association and the United States Department of Health and Human Services [28].

Novel to this investigation was the use of readability scores that are used to evaluate written text as a proxy to assess the accessibility of verbal communication between clinicians and patients. After conversion of audio files to text, the readability scores were obtained for all 4 scenarios (3 anesthetic-care related and 1 control) using 6 different scales (Table 2, Fig. 1). Assessment of the simple means showed a steady decline in mean Flesh Kincaid reading ease scores as the complexity of the anesthesia scenarios increased from 1 to 2 and from 2 to 3. The average reading ease was higher for the control scenario 4. This was not unexpected due to the relatively simple nature of describing instructions on sandwich-making to a member of the general public, and lack of healthcare terms required for such a discussion.

Mean Flesh Kincaid reading levels also increased from scenario 1 to scenarios 2 and 3, which shared the same score, and was substantially

Table 3
Results of a student's t-test analysis to calculate *p* values using one-tail to calculate significance. The mean readability scores for anesthesia simulated scenarios 1–3 were compared to the control scenario 4. Significance level < 0.05.

Reading test	Scenario 1 vs 4	Scenario 2 vs 4	Scenario 3 vs 4
	P(T ≤ t) one-tail	P(T ≤ t) one-tail	P(T ≤ t) one-tail
Flesh Kincaid Reading Ease	0.062	0.015	0.004
Flesh Kincaid reading level	0.000	0.000	0.000
Gunning Fog Score	0.000	0.000	0.000
Smog Index	0.000	0.000	0.000
Coleman Liau Index	0.029	0.060	0.001
Automated Readability Index	0.002	0.000	0.000

lower in the control scenario. These results demonstrate a worsening of readability of the transcribed text as the anesthesia scenario became more complicated from general anesthesia in an uncomplicated patient to an abdominal aortic aneurysm (AAA) repair and finally to the use of a thoracic epidural for perioperative pain management. This may indicate that healthcare practitioners are unable to communicate in an effective manner to patients without a high level of education.

Similarly, the Gunning Fog Index was calculated, a scoring system which also estimates the years of formal education required to understand a given passage of text. This score incorporates average sentence length and complexity of words. The ideal score for readability for the general public is considered to be anything under 8, whereas any score over 12 is considered too hard for most people to comprehend [29]. Mean scores using the Gunning Fox Index demonstrated over a 12th grade reading level required to understand description of general anesthesia for laparoscopic cholecystectomy and higher than 13th grade for scenarios involving AAA repair and thoracic epidural. This average score was 8.8 for the control scenario.

Next the SMOG (Simple Measure of Gobbledygook) Index was used to assess readability and is a measure that has been demonstrated to be effective to check health-related educational material [30]. This measure incorporates the use of polysyllables and the count of sentences in a given passage of text. With this modality, the mean score increased gradually from scenario 1 to 2 and from 2 to 3, and it was significantly lower in the control scenario 4.

Similarly, the Coleman Liau index estimates grade required to comprehend a given text. It relies on calculation of numbers of characters per 100 words and the number of sentences per 100 words [31]. Similar mean Coleman Liau index scores were calculated for scenarios 1 and 2 (9.0 and 8.9 respectively) and a higher score of 9.5 for scenario 3. A lower mean score of 8.3 was calculated for scenario 4. Finally, the Automated Readability Index was calculated for all 4 scenarios. This score incorporates number of characters, words, and sentences to approximate US grade level needed to comprehend text [32]. Scenario 1 yielded a mean score of 9.1, which increased to 10.0 and 9.9 for scenarios 2 and 3 respectively. The control scenario 4 had a calculated mean score of 6.5.

The readability index mean scores were consistent with anticipated projections by the investigatory team. Broadly, the scores demonstrated increasing complexity, indicating worsening of readability/comprehension, from scenario 1 to 3. This was expected due to the difficulty in use of language to describe situations such as the need for postoperative ventilation or transfusion in scenario 2 or the risks and benefits of an epidural in scenario 3. The mean scores for readability in scenario 4 demonstrated increased accessibility of the text when describing a broadly used control scenario wherein the participant described the assembly of a sandwich, which was not anticipated to require or necessitate complex language.

The final analysis conducted used scenario 4 as a control and compared scenarios 1 through 3 against the control to assess any significant differences in data. The paired two sample *t*-test using one tail demonstrated a significant difference in statistics between scenarios 1, 2, and 3 when compared with scenario 4 when considering Flesh Kincaid reading level, Gunning Fog Score, SMOG, and Automated Readability Indices. Statistically significant differences were also found between the readability mean scores for scenario 3 when compared with 4 with the Flesh Kincaid reading ease and Coleman Liau index. This was not unexpected when evaluating the mean scores for the four scenarios, and viewing the bar graph in which the score means were charted. These *t*-test scores demonstrate that anesthesia practitioners recruited as test subjects for this investigation spoke at a significantly more difficult level when attempting to explain techniques of anesthesia to patients in a simulated setting. Nearly all t-test scores comparing anesthesia scenarios to a control revealed statistical significance, indicating that these differences could not be explained by randomness.

There are several important limits to this investigation. Importantly, this investigation was performed in a simulated environment without live patients. In addition, the "control" scenario that was used for comparison used a simple process- the assembly of a sandwich- for evaluation purposes. However, no assessment was made ahead of time that the test subject was familiar with how to make a peanut butter and jelly sandwich, or that the subject had ever eaten this food in the past. Another important limitation is the lack of data available to successfully compare how different anesthesia providers performed the study tasks. More than two thirds of the participants in the study were resident trainees, with only two faculty anesthesiologists performing the scenarios. With a larger group of participants, evenly divided amongst the three categories (residents, faculty and nurse anesthetists) one may be able to ascertain if education and/or experience enables a healthcare provider to more effectively communicate with patients in a more comprehensible manner.

4.2. Innovation

The use of artificial intelligence software, Otter.ai, to convert audio files into text was an important innovation in this pilot study. This software has not been tested for use in healthcare-related investigations, however, and likely needs additional study. Nonetheless, the text conversion was reviewed by an investigatory team member who manually reviewed the transcription of each simulated interaction while listening to the audio file to ensure accuracy. Only light editing was performed when an error was detected by the reviewer, often no more than 1–2 times per transcription. Punctuation was rarely changed during this editing and review process, and the sentence breaks were entered by the artificial intelligence software to attempt to ensure impartiality. This was important because some of the readability scores to assess text incorporate sentence size into their formulas.

Finally, it is important to consider that the readability tests and scores utilized in this study were designed to evaluate written text. They were not specifically designed to assess verbal communication. The decision was made by the investigatory team to proceed with conversion of speech to text because current tools to assess verbal comprehension are limited. The limited tools to assess verbal communication are often targeted to the evaluation of young children, such as the Assessment of Comprehension and Expression [33,34] and the Intermodal Preferential Looking (IPL) task [35], would be inadequate for the analysis conducted in this study.

4.3. Conclusion

This pilot study has identified a possible methodology to assess the efficacy of verbal communication using scores and scales intended for written material, offering an avenue for further investigation. The data obtained herein demonstrated objectively that anesthesia providers communicate in manners requiring higher levels of comprehension when describing procedures of ever-increasing complexity. This offers opportunity for both further study and interventions to decrease the comprehension requirement for patients.

Future opportunities to investigate the comprehension levels required to understand verbal discussions between anesthesia providers and patients include recording actual conversations that occur between clinicians and patients undergoing procedures- not in a simulated environment. Although anesthesia providers evaluated in this study were instructed to treat the simulated environment as an authentic patient encounter, it is possible that the clinicians deviated from the language that they normally use when describing anesthesia to patients and their families. Recording a non-simulated encounter would remove this potential confounding factor.

Next, the correlation has not been established between retention of information provided to patients and the readability scores of verbal communication. A subsequent study can assess the level of understanding in a patient and possible correlation to readability scores; evaluation of patient perception following informed consent can be conducted using written survey [36]. Evaluation of patient understanding can also assess trust in the clinician, which has been determined following discussion of surgical consent using tests such as the Trust in the Surgical Decision and Decision Regret scales [37].

Author contributors

George Tewfik: This author contributed to the concept, IRB approval, gathering of data, data interpretation, manuscript preparation and editing.

Patrick Hesketh: This author contributed to gathering of data, data interpretation, manuscript preparation and editing.

Lawrence Chinn: This author contributed to gathering of data, data interpretation, manuscript preparation and editing.

Nivetha Srinivasan: This author contributed to gathering of data, data interpretation, manuscript preparation and editing.

Andrew Abdelmalek: This author contributed to gathering of data, data interpretation, manuscript preparation and editing.

Prior presentations

Not applicable.

Summary statement

Ensuring patient comprehension when discussing anesthesia plans and consent is critically important for patient care, safety and satisfaction. This study uses readability tests for assessment of written materials to determine if anesthesia providers speak to patients in an appropriate manner in a simulated environment.

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Declaration of Competing Interest

The authors declare no competing interests.

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