

# Use of a Computer Agent to Explain Anesthesia Concepts to Patients



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## Abstract

**Introduction:** During the pre-anesthetic interview, patients are presented with a great volume of information in a short time: basic concepts of anesthesia, risks involved, and post-operative instructions. Inadequate communication skills are known to result in patients' misunderstanding and physicians typically provide patients with too much information, decreasing the patient's ability to recall important details.<sup>1</sup> Current information regarding patients' ability to retain information during their pre-anesthetic interview comes from a few small studies using generic videotapes.<sup>2</sup> Recall was poor at best, and any improvements may have been from simple repetition, rather than any unique feature of the video. Without effective communication, a patient may not understand the proposed anesthetic plan, or effectively consider options that are presented. We therefore sought to use a novel technology in our pre-anesthetic clinic to improve how patients receive information and make decisions.

**Methods:** The objective of this study was to determine if a group of residents guided by faculty could design an animated computer agent using simple text-to-speech technology and no advanced programming skills to explain key concepts of anesthesia to patients. We were also interested in understanding how this technology could improve patient information recall, and facilitate the informed consent process. After receiving IRB approval, a group of five residents and five faculty created a simple script using Microsoft Word which explained the concepts of general anesthesia, regional anesthesia, monitored anesthesia care and included pre-operative instructions (i.e. NPO after midnight). We then sent this script to a group of collaborators who created an animated software program using a method previously reported.<sup>3</sup> Patients in our pre-anesthetic clinic were then enrolled in our study. After agreeing to participate, patients were randomized to either receive a standard pre-operative visit with an anesthesia provider or to receive the standard visit and undergo explanation of anesthesia using the computer agent. Responses to a short post-test were compared between groups according to level of health literacy.

**Results:** We were successful at creating a short, simple, easy to use computer animation without advanced technical skills. Preliminary analysis of our data revealed that patients found the computer animation helpful and easy to use. Additionally, patient recall of information was significantly greater in the group of patients who underwent teaching with the short computer module.

**Discussion:** Our interactive computer animation enhanced patient knowledge retention and increased patient satisfaction scores with their pre-operative visit. Feedback indicated that patients appreciated being able to stop and repeat parts of the animation, as well as being able to review information at their own pace. We hypothesize that the increased information recall was due to the ability of the interactive computer animation to prime patients to receive knowledge during their pre-anesthetic interview.

## Introduction:

Studies have consistently demonstrated that the current informed consent process is inadequate and flawed. The majority of our patients are laypeople with limited baseline medical literacy, yet during pre-operative anesthesia visits they receive an overwhelming amount of medical information including:

- basic concepts of anesthesia
- risks involved
- post-operative instructions
- medication adjustments

Furthermore, this information is conveyed to the patient in a very short time period. This hinders the informed consent process and is problematic when trying to provide patient centered care.

Inadequate communication skills are known to result in patients' misunderstanding and physicians typically provide patients with too much information, decreasing the patient's ability to recall important details.<sup>1</sup> Current information regarding patients' ability to retain information during their pre-anesthetic interview comes from a few small studies using generic videotapes.<sup>2</sup> In those prior studies, recall was limited, and the small improvements shown were likely to have been from simple repetition.

Without effective communication, a patient may not understand the proposed anesthetic plan, or effectively consider options that are presented. **We therefore hypothesized that the use of a computer relational agent could improve patient understanding of the anesthesia process and allow for improved informed consent.** Specifically, we were interested in understanding how the use of this novel technology in our pre-anesthetic clinic could improve how patients receive information and make decisions.

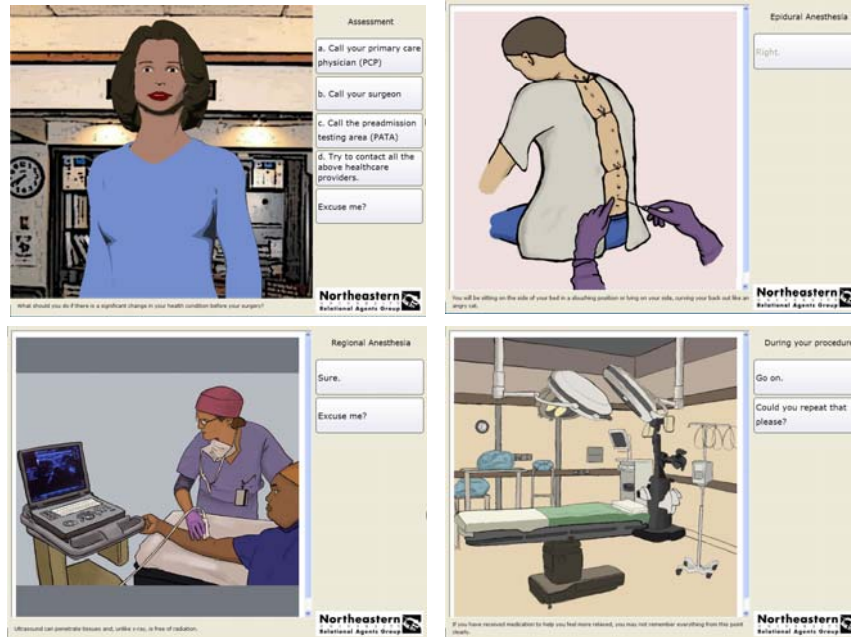
## Methods:

Our overall study objective was to determine if we could design an animated computer agent using simple text-to-speech technology and no advanced programming skills to explain key concepts of anesthesia to patients. We were also interested in understanding how this technology could improve patient information recall, and facilitate the informed consent process.

After receiving IRB approval, a group of five residents and five faculty created a simple script using Microsoft Word which explained the following concepts:

- general anesthesia
- regional anesthesia
- monitored anesthesia care
- pre-operative instructions

**Figure 1 – Images from the computer animation; (a) Computer Agent Assessment of Patient Knowledge; (b) Explanation of Epidural Anesthesia; (c) Explanation of Regional Anesthesia; (d) Discussion of the Operating Room Environment**



We then sent this script to a group of collaborators in the Relational Agents Group at Northeastern University who created an animated software program using a method previously reported (see Figure 1).<sup>3</sup> Next we enrolled patients who presented to our pre-anesthetic clinic in our study. After agreeing to participate, patients were randomized using a block randomization to either:

- receive a standard pre-operative visit with an anesthesia provider
- receive a standard pre-operative visit with an anesthesia provider after undergoing explanation of anesthesia using the computer agent

Responses to a short post-test were compared between groups.

## Discussion:

We were successful at creating a short, simple, easy to use computer animation without advanced technical skills by partnering with the Relational Agents Group at Northeastern University.

Our interactive computer animation enhanced patient knowledge retention and increased patient satisfaction scores with their pre-operative visit.

Feedback indicated that patients appreciated being able to stop and repeat parts of the animation, as well as being able to review information at their own pace.

We hypothesize that the increased information recall was due to the ability of the interactive computer animation to prime patients to receive knowledge during their pre-anesthetic interview.

In the future, we plan to assess the impact of this technology on patient adherence to pre-anesthetic instructions (e.g. medication adjustments and the need to fast after midnight).

## References:

1. Sandberg, E., Sharma, R., Wiklund, R., Sandberg, W. (2008) "Clinicians Consistently Exceed a Typical Person's Short-Term Memory During Preoperative Teaching," *Anesth Analg*, 107(3): 972-8.
2. Done M., Lee A. (1998) "The use of a video to convey preanesthetic information to patients undergoing ambulatory surgery," *Anesth Analg* 87(3):531-6.
3. Bickmore, T., Pfeifer, L., and Paasche-Orlow, M. (2009) "Using Computer Agents to Explain Medical Documents to Patients with Low Health Literacy", *Patient Education and Counseling*, 75(3): 315-320.

**Table 1 – Post-Test Results (p=0.004)**

Post-Test Results	Control	Intervention
Number of Participants	23	19
Average Score, SD (% correct)	11.6, 4.2 (64%)	14.8, 2.3 (82%)

## Results:

We enrolled 42 patients in our pilot study. Results from our short post-test revealed that patients' knowledge about basic anesthesia concepts improved with the use of the relational agent (64% vs 82%, p=0.004) as described in Table 1.

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