A pilot study of eye-tracking devices in intensive care

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Background. *Eye-tracking devices have been suggested as a means of improving communication and psychosocial status among patients in the intensive care unit (ICU). This study was undertaken to explore the psychosocial impact and communication effects of eye-tracking devices in the ICU.*
Methods. *A convenience sample of patients in the medical ICU, surgical ICU, and neurosciences critical care unit were enrolled prospectively. Patients participated in 5 guided sessions of 45 minutes each with the eye-tracking computer. After completion of the sessions, the Psychosocial Impact of Assistive Devices Scale (PIADS) was used to evaluate the device from the patient's perspective.*
Results. *All patients who participated in the study were able to communicate basic needs to nursing staff and family. Delirium as assessed by the Confusion Assessment Method for the Intensive Care Unit was present in 4 patients at recruitment and none after training. The device's overall psychosocial impact ranged from neutral (−0.29) to strongly positive (2.76). Compared with the absence of intervention (0 = no change), patients exposed to eye-tracking computers demonstrated a positive mean overall impact score (PIADS = 1.30;* $P = .004$*). This finding was present in mean scores for each PIADS domain: competence = 1.26, adaptability = 1.60, and self-esteem = 1.02 (all* $P < .01$*).*
Conclusion. *There is a population of patients in the ICU whose psychosocial status, delirium, and communication ability may be enhanced by eye-tracking devices. These 3 outcomes are intertwined with ICU patient outcomes and indirectly suggest that eye-tracking devices might improve outcomes. A more in-depth exploration of the population to be targeted, the device's limitations, and the benefits of eye-tracking devices in the ICU is warranted. (Surgery 2016;159:938-44.)*

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The need for effective patient communication is heightened during critical illness. However, approximately 40% of patients in the intensive care unit (ICU) require mechanical ventilation, precluding them from verbal communication.[1] These patients are at risk for adverse events owing to limited movement, difficulty communicating, and their inability to signal for help. They are also prone to negative psychological outcomes. Ineffective communication in the ICU may lead to ICU psychosis in both patients and family members.[2-5] Maintaining patient safety and reestablishing a positive psychosocial state are crucial in intensive care.[6-8] These conditions are particularly difficult to achieve without patient communication.

Critically ill patients requiring mechanical ventilation typically receive an endotracheal tube or tracheostomy tube. With a tracheostomy tube, several methods of maintaining communication are possible, including a 1-way speaking valve, leak speech, and digital occlusion. All require tracheostomy cuff deflation,[9-11] which may not be tolerated. Thus, with an endotracheal or tracheostomy

Research performed at The Johns Hopkins Hospital.

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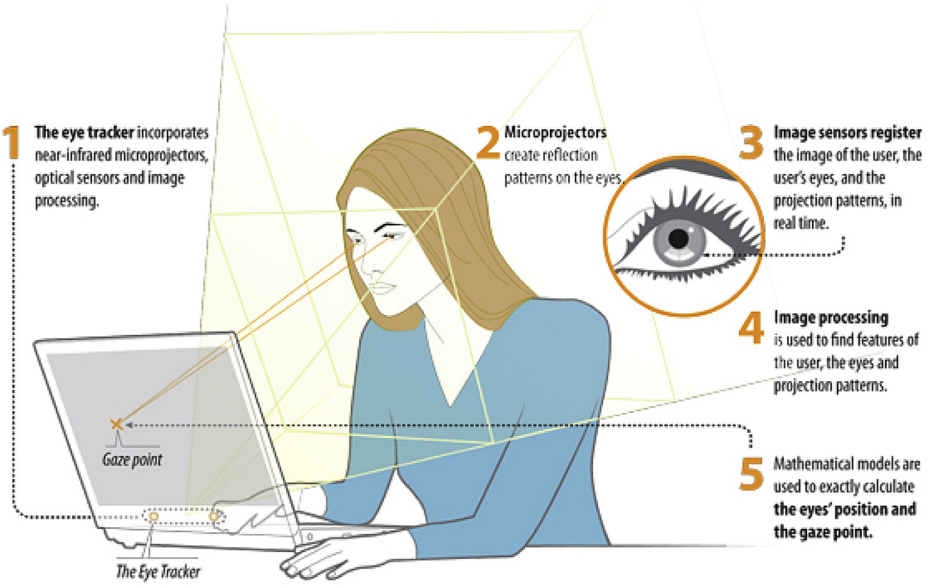

Figure. Eye-tracking communication devices.

tube, patient communication often relies on facial expressions, gestures, and writing. Augmentative and alternative communication systems including picture recognition or writing boards are often employed as well. These modes of communication may prove ineffective and can result in frustration for the patient and health care staff.[12]

In this situation, an advanced technological aid such as an eye-gaze computer may address the unmet communication need. Eye-tracking communication devices detect eye movement and position then integrate the data to create a gaze point for computer screen selections (Figure).[13] Patients with amyotrophic lateral sclerosis have typically been the target population for these devices.[14,15] Another suggested use as a communication device in the ICU has not been well-examined.[16] To date, only 1 study has assessed eye-tracking communication devices in the intensive care setting.[17]

The objective of this study was to implement eye-tracking devices in intensive care as a communication aide and to elucidate the resulting psychosocial impact. We hypothesized that the device would be used successfully by patients for communication and would have a significant positive impact on the patient's psychosocial status.

METHODS

Design and patients. This study was a pilot prospective trial conducted in 3 tertiary ICUs noncontinuously over 10 months between June 2013 and May 2014. The study attempted to prospectively enroll all eligible patients during normal working hours (Monday–Friday, 9 AM–5 PM). Participants were recruited from the surgical ICU, medical ICU, and neurosciences critical care unit at The Johns Hopkins Hospital, Baltimore, Maryland. The Johns Hopkins Medicine Institutional Review Board approved the study.

Patients in participating ICUs who were mechanically ventilated or dysarthritic were screened. From these patients, nursing, speech language pathology, or occupational therapy staff identified those who were cognitively capable of communicating but failed to do so with available methods. Study staff subsequently approached these patients and included those who were sufficiently awake and alert as assessed by the Richmond Agitation Sedation Scale (RASS). Patients were excluded from the study if they were unable to demonstrate understanding through eye/head/physical movement, were unable to comprehend English, had eye injuries limiting their vision, were significantly sedated/agitated (RASS > 2 or RASS ≤ -2), or could communicate through writing or verbally.

The eye-tracking device. The Tobii C12 eye-tracking computer (Model C12 Communication Device, Tobii Technology, Stockholm, Sweden) has a camera-based eye-tracking system in which the camera and light source are permanently affixed to a monitor. The computer uses infrared diodes to produce reflection patterns on the corneas in the user's eye. Two specialized sensors capture corneal reflections at 30–40 Hz (or 30–40 images per second) to determine where the patient's eyes are looking and their position in 3-dimensional

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