Individual QI projects from single institutions

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There's an App for That; Improving Communication during Pediatric Cardiothoracic Surgery

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ABSTRACT

Introduction: Waiting while a loved one is in surgery can be a very stressful time. Current processes for updating families vary from institution to institution. Providing timely and relevant updates, while important to the family, may strain a surgical team's operational system. In our initial experience with the Electronic Access for Surgical Events (EASE) application (app), we tested the extent to which its implementation improved communication with patient families. **Methods:** We compared compliance data collected pre-EASE (December 2013 through September 2014) and post-EASE implementation (October 2014 until December 2015). **Results:** Although the pre-EASE compliance rate for bi-hourly updates was 46% (118/255) of cases, post-EASE implementation achieved a compliance rate of 97% (171/176). A 2-sample test of proportions confirmed a significant improvement in compliance after the introduction of EASE technology ($P < 0.001$). Analysis of the 177 noncompliant cases in the pre-EASE period indicated that noncompliance occurred most frequently at the end of the case (97/177, 55%) when the patient remained in the operating room > 2 hours after the last update to the family. We also observed noncompliance at the beginning of the case (46/177, 26%), when the patient arrived in the operating room > 2 hours before the time of the first update. Family satisfaction scores that rated their experience during surgery as "Very Good" improved from 80% pre-EASE implementation to 97% postimplementation. We sustained this improvement for 1 year. **Conclusions:** A mobile technology app (EASE) improved both frequency and compliance with surgical updates to families, which resulted in a statistically significant increase in family satisfaction scores. *(Pediatr Qual Saf 2018;3:e055; doi: 10.1097/pq9.0000000000000055; Published online March 29, 2018.)*

INTRODUCTION

The stress of surgery on patients and families, especially due to uncertainty from lack of information during the long wait times of complicated surgeries, makes improved communication with the care team a desirable source of comfort.[1–3] Sources of anxiety for family members stem from fear of death, uncertain outcomes, financial concerns, and uncomfortable hospital situations.[4] Depending on the procedure, a patient could be away from their loved ones for 4–12 hours. The most anxious time for families of surgical patients is the wait during the intraoperative period.[5–8] Intraoperative progress reports, especially for pediatric surgery, may ease the patient's family's anxiety during this time.[6,9–14]

In satisfaction surveys at our urban, tertiary-care children's hospital administered in October 2014, patient families expressed dissatisfaction with communication during prolonged surgical procedures. Parents were approached with 2 options for communication updates: phone updates to the waiting room that would be approximately every 2 hours, or the digital updates via the application approximately every 2 hours. Nearly 75% of families reported a preference for digital over phone updates during surgery. To address this dissatisfaction and to fulfill parental expectations, our quality improvement (QI) initiative resulted in implementing a mobile health application (app), the Electronic Access to Surgical Events (EASE), and assessed its ability to improve communication with patient families during pediatric cardiothoracic surgery.

The cardiothoracic surgery protocol at our institution pre-October 2014 required families to check-in with a receptionist when their child was taken to the surgery suite. The

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expectation on surgical staff was regular updates to families every 90–120 minutes. This communication occurred primarily by a telephone call to the waiting room, but also in person. To receive surgical updates, the family had to remain in the surgical waiting room for the duration of the cardiac surgery procedure (4–12 hours). If the family left the waiting area during the surgery, they ran the risk of missing an update from the surgical team. Institutional QI data from this period indicated that compliance with the protocol for updating patient families occurred in only 31% of cardiac surgeries. Noncompliance was primarily due to families not being present in waiting area and surgical staff not available to meet with families. Furthermore, institutional survey data and interviews of patient families suggested that this communication protocol increased family anxiety during surgery as the time between updates increased and families had to remain in the waiting area during the entire procedure.

In October 2014, the cardiothoracic surgery care team implemented the EASE mobile device application (EASE Applications, LLC, Orlando, Fla.). The team installed EASE on the families' mobile devices before the scheduled surgery. We instructed the cardiothoracic surgical care team to use EASE to provide patient families a comprehensive progress update at least every 2 hours during the surgery. Here, we document our initial experience with EASE and its impact on improving communication with patient families. We hypothesized that staff compliance with bi-hourly updates would increase after EASE implementation, and overall family satisfaction rates would improve.

METHODS

Institutional review board approval was exempt from this study, due to the QI nature of the project. We collected baseline data preimplementation of the EASE application (app), from December 2013 until September 2014, and post-EASE implementation data from October 2014 until December 2015.

An advanced practice nurse (APN) sees all cardiothoracic surgery patients before surgery. During this presurgical visit, the APN educates the family on the events that will be occurring on the day of surgery. The APN also introduces the family to the EASE application and, after obtaining consent, downloads it on the family's smart mobile device.

The study inclusion criteria included all congenital cardiac surgery cases requiring cardiopulmonary bypass (CPB) for which the APN predicted that surgery time would exceed 3 hours from start to finish. The APNs enrolled 176 (41%) of 431 eligible patients for the EASE study. Some families chose not to enroll due to unfamiliarity with the technical communication style, lack of availability of a smartphone, or English not being their primary language. After obtaining consent to enroll in the study and download the EASE app, the APN noted the consent in the patient's chart to alert the surgical team of the families planned participation in EASE. The operating room nurse documented communication times in the patient's medical record. We collected and analyzed the communication data retrospectively. Immediately following surgery, the surgeon met with the family to give them an update on the surgery. Once the surgeon left the room, study personnel administered to the families a satisfaction survey, Survey Monkey® (Survey Monkey, Palo Alto, Calif.), on a mobile device and allowed them to complete the survey privately. We also analyzed these data retrospectively.

EASE Mobile Device Application (App)

The EASE app (EASE Applications, LLC, Orlando, Fla.) used in this study is compliant with the Health Insurance Portability & Accountability Act of 1996. It establishes a secure connection from an operating room mobile device (iPad) (Apple Inc., Cupertino, Calif.) to the families' mobile device through a unique quick response code. The operating room clinician (circulator) connects the operating room iPad with the family's mobile device, while in the preoperative holding area of the hospital (before transporting the patient to the surgical suite). This process is integrated into the typical workflow pattern of a circulating nurse, so additional staffing is not required. The EASE app also allows automatic updates, at the consent of the primary caregiver, to be sent to other family members and friends desiring information at the same time as the primary caregiver. Using this secure connection, the operating room clinician updates the family by 1-way communication throughout the surgery with photographs, text messages, and videos. For added security of protected health information, the updates disappear within 45 seconds of viewing and cannot be saved on either the sending or receiving devices (Fig. 3, Appendix A). The EASE app automatically notifies the clinician's sending device at 30-minute repeating intervals.

After implementation of EASE, we scripted communication with families as event-based updates that occurred during critical stages of the surgical procedure. Critical stages of the surgical procedure include intubation, monitoring line placement, surgical incision, initiation of CPB, and beginning surgical repair to name a few. Communication was sufficiently frequent that families would feel connected to the patients' progress during surgery. Families received updates at specific times during surgery (Fig. 1). Updates begin before initiating CPB when the cardiologist performs a transesophageal echocardiogram. During this diagnostic test, the clinician sends the family a video of the cardiologist pointing to the defect, followed by multiple text updates at 30-minute intervals. At the conclusion of the surgery, the cardiothoracic surgeon sends the family a video update of the surgical repair and the patient's status. Before the patient leaves the operating room and is transported to the cardiothoracic intensive care unit, the family receives a photograph of the patient lying comfortably on the hospital bed. This step ends the EASE session.

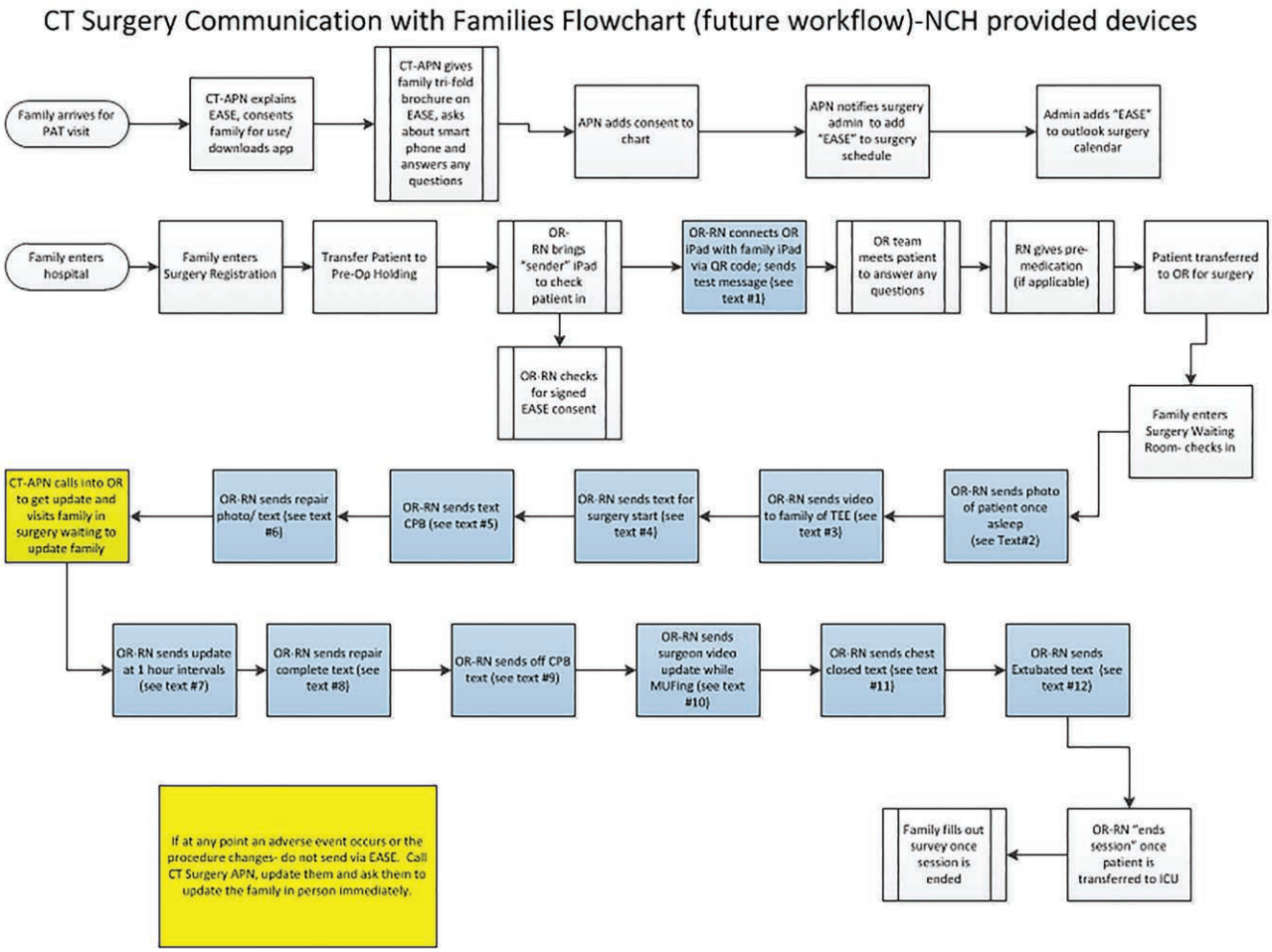

Fig. 1. Process flow map with the integration of EASE. Blue boxes indicate expected surgical progress communications to be sent to participating family members. CT-APN, cardiothoracic APN; PAT, preadmission testing.

We defined compliance with the communication protocol both before and after EASE implementation as communication to the family at the start and end of the surgery, and at intervals of 2 hours or less. Data of update times were recorded by the waiting room staff who received all updates: phone or digital for pre- and post-EASE patients.

Statistical Analysis

We used a 2-sample test of proportions to determine whether the proportion of surgeries in compliance with the protocol increased after EASE introduction in October 2014. Patient sex, age, The Society of Thoracic Surgeons-European Association for Cardio-Thoracic Surgery (STAT) risk of mortality score, the surgery time, and the time of day surgery began (before noon versus afternoon) were examined as predictors of noncompliance in multivariable logistic regression models fitted separately to the pre-EASE and post-EASE periods.[15] Analyses were performed using Stata/IC 13.1 (College Station, TX: StataCorp, LP), and $P < 0.05$ was considered statistically significant. We also used a statistical process control chart (SPC P chart) to track the change in compliance post-EASE implementation.

RESULTS

The study was deemed exempt from the institutional review board due to the QI nature of the study. The study enrolled 431 patients (245 male, 186 female; 4.9 ± 8.2 years), of whom 176 (41%) underwent surgery after the implementation of the EASE app. In Table 1, we present a comparison of pre-EASE and post-EASE cases. Surgical time increased from 5.5 ± 2.2 hours in the pre-EASE period to 6.0 ± 1.9 hours in the post-EASE period ($P = 0.017$). We achieved compliance with bi-hourly updates in 46% (118/255) of cases before EASE implementation and 97% (171/176) of cases after EASE implementation. A 2-sample test of proportions confirmed significant improvement in compliance after the introduction of the EASE technology ($P < 0.001$). Among 177 noncompliant cases in the pre-EASE period, noncompliance occurred most frequently at the end of the case (97/177, 55%) when the patient remained in the operating room > 2 hours after the last update to the family. Noncompliance also occurred at the beginning of the case (46/177, 26%), when the patient arrived in the operating room > 2 hours before the time of the first update. Similarly, among the 5 noncompliant cases in the post-EASE period, noncompliance occurred

Table 1. Characteristics of Cardiac Surgery Cases before and after EASE Implementation (N = 431)

	Pre-EASE (N = 255)	Post-EASE (N = 176)	
Variables	**Mean (SD) or N (%)**	**Mean (SD) or N (%)**	***P****
Age (y)	4.9 (8.5)	4.9 (7.8)	0.921
Female	104 (41)	82 (47)	0.232
STAT score†	2.4 (1.4)	2.2 (1.2)	0.145
Surgery time (h)	5.5 (2.2)	6.0 (1.9)	0.017
Surgery start in afternoon	20 (8)	7 (4)	0.104
Compliance with communication protocol	78 (31)	171 (97)	< 0.001

**P* values by chi-square test for categorical variables and independent *t* test for continuous variables.
†Twenty-four cases missing data.

Table 2. Multivariable Logistic Regression Models of Noncompliance with Communication Protocol, before and after EASE Implementation

	Pre-EASE (N = 235)			Post-EASE (N = 172)		
Variables	**OR**	**95% CI**	***P****	**OR**	**95% CI**	***P****
Age (y)	0.96	(0.92–1.00)	0.051	0.76	(0.45–1.28)	0.304
Female	0.92	(0.49–1.75)	0.807	1.17	(0.16–8.84)	0.878
STAT score	0.96	(0.74–1.24)	0.753	0.47	(0.15–1.45)	0.189
Surgery time (h)	1.89	(1.46–2.44)	< 0.001	1.73	(1.01–2.97)	0.046
Surgery start in the afternoon	5.71	(1.32–24.69)	0.020	8.92	(0.59–134.00)	0.113

**P* values by chi-square test for categorical variables and independent *t* test for continuous variables.

at the beginning of 1 case, and at the end of 3 cases. Family satisfaction scores rating their experience during surgery as "Very Good" pre-EASE was 80%. After the implementation of EASE, family satisfaction improved to 97%. We have sustained this improvement for 1-year post implementation.

After excluding 24 cases with missing data on the STAT score, multivariable logistic regression models were fitted separately to pre-EASE and post-EASE cases to identify factors associated with noncompliance (Table 2). The STAT score is a mortality tool used to categorize difficulty in congenital heart surgery. In the pre-EASE period, each additional hour of surgery time was associated with 89% greater odds of noncompliance [odds ratio (OR) = 1.89; 95% confidence interval (CI): (1.46, 2.44); $P < 0.001$), whereas the odds of noncompliance increased almost 6-fold for cases beginning in the afternoon compared with cases beginning in the morning (OR = 5.71; 95% CI, 1.32–24.69; $P = 0.020$). In the post-EASE period, prolonged surgery time remained associated with greater odds of noncompliance (OR = 1.73; 95% CI, 1.01–2.97; $P = 0.046$). No other factors examined were associated with the odds of noncompliance in this analysis.

Figure 2 shows a statistically significant change in percentage of surgical cases with compliant communication times after EASE implementation in October 2014. The compliance improved from an statistical process control baseline of 46% to over 97%. We sustained this improvement through December 2015.

DISCUSSION

In this QI project, the implementation of the EASE application during cardiothoracic surgery has allowed our pediatric hospital to increase compliance with timely surgical updates and to improve family satisfaction scores. Because 11% of our families did not have access to a smartphone, our institution purchased iPod Touch (Apple Inc., Cupertino, Calif.) devices to loan to families without access to a smartphone once we implemented EASE, 1 month after the pilot period. We anticipate that this loaner program will continue to improve enrollment in this program. Recent updates to the EASE software allows for translation from English to Spanish. Bilingual availability should also augment our enrollment by providing access for Spanish-only speaking families. The inclusion criteria required at minimum a 3-hour operative time and CPB cases; this was decided to ensure that all updates were sent at the predetermined events. Due to these inclusion criteria, our enrollment rate was low by design. Once the team was comfortable with the new technology, the EASE application was made available to all cardiothoracic surgery patients, which was 2 months after implementation.

The integration of mobile technology has allowed transfer of communication responsibilities from our APN team to our operating room nursing staff. This transition in responsibility has allowed our APNs to stop spending time updating families and delegate this task to the operating room nurse. The operating room nurse, who is present with the patient, now provides the real-time update to the family. The operating room staff was amenable to this extra responsibility because they felt the technology was simple and easy to use.

The significant improvement in compliance with timely communications seems to have a direct correlation to our improved family satisfaction scores. No other changes were made during this time to the waiting room environment, communication process, or surgical-waiting

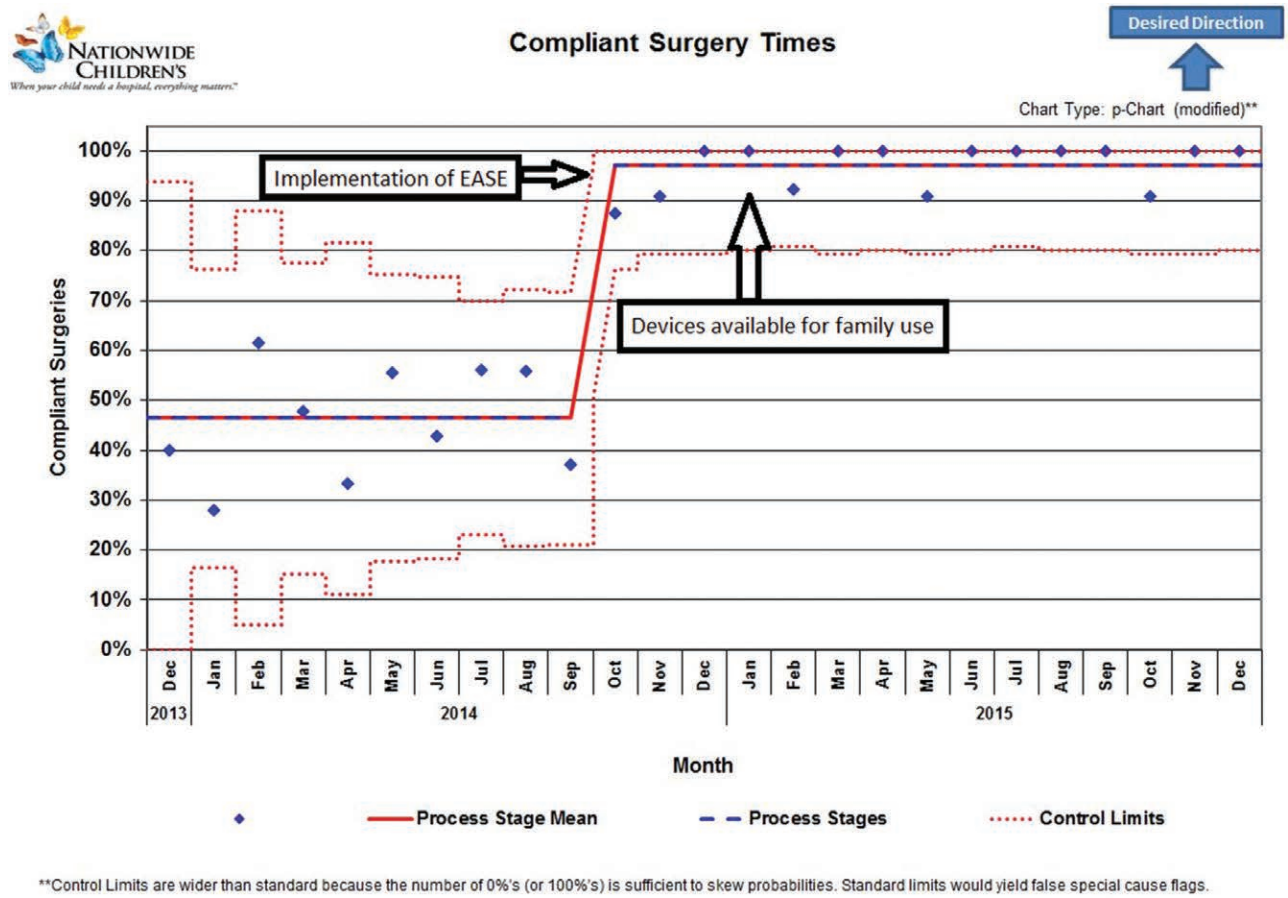

Fig. 2. p-Chart of monthly compliant surgeries.

process. The cases where noncompliance occurred seemed to be at the very beginning of surgery when the preoperative time took longer than the average or at the very end of the surgery when extubation took longer than expected. Some centers use institution-wide satisfaction surveys, as does our institution; however, separating out feedback based only on the intraoperative experience is not possible with these surveys. Thus, we utilized a specific survey for our cardiothoracic surgery patients during this time. We were unable to access satisfaction from other families during this period, other than through the institution-specific surveys. For a list of all survey questions, please see Appendix A and related Figures 1–3, available as **Supplemental Digital Content 1** at ***http://links.lww.com/PQ9/A21***.

Although the length of surgery time between study periods was statistically significant, the difference was only 30 minutes and not clinically significant. However, the length of surgery time did correlate with increased noncompliance. This noncompliance may be due to a longer period of surgical repair when significant events are not occurring within 2 hours that would normally prompt staff to send an update. Post-EASE app implementation, compliance with updates to the family as it related to the length of surgery did not show a significant trend for the time of day (morning or afternoon start time), whereas compliance did show a significant trend for the time of day in the pre-EASE period. Noncompliance is presumably due to the staffing burden that may occur with afternoon and evening cases. The improved compliance post-EASE implementation may be due to the embedded reminder alerts that occur on the app that prompt staff to continue to send updates every 30 minutes.

Within Health IT, Mobile health (mHealth) remains in the early stages of development, yet it is in high demand from both consumers and clinicians due to a shared desire for expanded use and plausible capabilities. One of the challenges is that these demands are grounded on an expectation of outcomes and benefits versus demonstrated proof of concept. A gap exists between current mHealth capabilities and the ever-changing, technology savvy generation of patients who are seeking immediate connection with their health care team. This gap between capabilities and consumer expectations was a consistent theme found in more than 500 mHealth studies reviewed for this project.[16]

Multiple publications state that there is a lack of literature to support whether mHealth's impact on delivery impacts patient care, outcomes, or satisfaction.[16,17–20] Despite this lack, investors and innovators are moving forward without evidence. The development seems inevitable. Although there is a continual

demand from consumers and clinicians to integrate mHealth into care, convincing hospital administrators to fund these projects is difficult without outcome data to prove efficacy.[21]

Financial incentives from the Federal Government may play a role in enticing hospital administrators to utilize various tools, including mHealth, to quantify patient satisfaction. An article published by *The Wall Street Journal* regarding the Affordable Care Act states that "nearly $1 billion in payments to hospitals over the next year will be based on patient satisfaction".[22] mHealth tools have been successfully utilized for data collection, assessment, delivering interventions, and there has been some demonstration that they can have an impact on patient satisfaction.[23–29] To impact patient satisfaction and compliance with prescribed care, we must align new technologies with the change in health care focus from "doctor-centric" to "patient-centric." This new focus can be fostered by adding the patient as a participant in the care plan.[30] A recent analysis by Press Ganey validated that actively engaging patients coupled with solid patient experience scores typically translate into lower 30-day readmission rates.[31]

The purpose of this study was to improve communication with families and staff during the intraoperative period and to improve their satisfaction and experience during surgery while decreasing their anxiety levels. In a recent publication from The Beryl Institute, Jason and Wolf[32] identified that simply being in a hospital is fear-invoking to a family. Until this fear is alleviated by improved communication, a family's ability to think or relate is inhibited. This inhibition negatively impacts their experience and translates to lower satisfaction scores.[32]

We have now launched EASE for all cardiothoracic surgery patients and anticipate continued improvement in family satisfaction scores for timely surgical updates that result from the use of this user-friendly, HIPAA-compliant technology.

DISCLOSURE

The authors have no financial interest to declare in relation to the content of this article.

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