

# Enhancing the Quality of the Anesthesia to Postanesthesia Care Unit Patient Transfer Through Use of an Electronic Medical Record–Based Handoff Tool

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**Purpose:** Anesthesia to postanesthesia care unit (PACU) handoffs are often incomplete, imprecise, and highly variable with respect to information transfer, and therefore can jeopardize patient safety. A standardized anesthesia to PACU electronic medical record (EMR)-based patient handoff checklist was implemented and evaluated for its effect on the information transfer.

**Design:** An observational preimplementation and postimplementation design was used.

**Methods:** Assessment of the completeness and accuracy of information transfer during the PACU handoff was performed for a convenience samples of 100 patients preimplementation, 3 weeks postimplementation, and 3 months postimplementation.

**Findings:** The mean percentage of total handoff checklist items addressed significantly increased 3 weeks and 3 months postimplementation compared with baseline.

**Conclusions:** The use of a standardized anesthesia to PACU EMR-based handoff checklist significantly increased the percent of accurate information transferred without considerably affecting the duration of the PACU handoff process.

**Keywords:** handoff, anesthesia, postanesthesia care, patient safety.

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**HANDOFF COMMUNICATION** is the act of transferring patient health information from the original provider to another provider who is assuming the patient's care.<sup>1</sup> The handoff is used to assist providers in the delivery of safe, consistent care of the patient.<sup>1</sup> Petrovic et al<sup>2</sup> noted that perioperative handoffs are a period of high risk not only because of the patient's physical transport and postprocedure physiology, but also because information about the patient must be successfully transferred between health care

personnel. Communication breakdown between health care providers results in two-thirds of the reported sentinel events, and greater than 50% of these miscommunications occur during patient care transfer.<sup>3</sup> Previous research has found that an increased risk for incomplete or ineffective information transfer occurs commonly between anesthesia providers and postanesthesia care unit (PACU) nurses during PACU handoffs, resulting in significant postoperative adverse events and decreased patient safety.<sup>4-9</sup> An analysis of 790

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PACU handovers by Milby et al<sup>5</sup> determined that many handovers had inadequate and missing information. A systematic review by Segall et al<sup>8</sup> concluded that postoperative patient handovers were incomplete, imprecise, informal, filled with intrusions, and inconsistent. A number of observational studies evaluating PACU handoffs demonstrated that a nonstandardized report process can result in information loss, medical errors, and adverse events. These events are widespread and constitute a significant clinical problem.<sup>5-7,10</sup>

Evidence from both the United States and Europe indicates that unstructured PACU handoffs represent a significant clinical problem and a threat to patient safety, and as a result, the Joint Commission requires a standardized approach to handoffs between health care providers. Indeed, the value of a standardized PACU handoff process is widely supported in the literature.<sup>9,11-15</sup> In these studies a standardized PACU handoff checklist significantly increased the information transferred from anesthesia providers to PACU nurses during the handoff. In addition, the PACU nurses reported increased satisfaction with the PACU report process when anesthesia providers used the checklist to provide the handoff report.<sup>3,9,13,16,17</sup> The improvement in information transfer and increased satisfaction with a standardized transfer process was achieved without uniformly increasing the duration of the PACU handoff process.<sup>9,11-15</sup> In addition, Weigner et al<sup>18</sup> demonstrated a significant and sustained improvement in the adult and pediatric PACU handover processes after simulation-based interprofessional patient handoff training using an electronic medical record (EMR)-based PACU handoff system.

There is compelling evidence that standardized PACU handoff checklists and protocols effectively incorporated into clinical practice have resulted in a significantly improved PACU handoff process by increasing the information transferred and enhancing patient safety.<sup>3,9,11-17</sup> Use of a standardized handoff checklist has also secondarily increased PACU nurses' overall satisfaction with the PACU report process.<sup>3,9,13,16</sup> In addition, electronic handoff checklists have been shown to significantly increase the amount of information transferred to the next health care

provider during the report process.<sup>19</sup> In current practice however, postoperative PACU handoffs are often unorganized, and the information transferred with the patient highly variable.<sup>20</sup> The postoperative handoff report commonly occurs in a bustling PACU while the PACU nurse is initiating patient monitoring and obtaining and evaluating vital signs. Thus, the handoff may be informal and brief, resulting in communication failures between the anesthesia provider and the PACU nurse.<sup>6</sup> Provision of a complete and comprehensive postoperative handoff report from the anesthesia provider to the PACU nurse is vital to maximize safe, effective, and efficient patient care.

The purpose of this project was to develop a standardized anesthesia to PACU handoff policy and procedure, incorporate a standardized patient handoff checklist into the hospital's EMR, educate the anesthesia providers and PACU nursing staff on its use, and determine if there was improvement in the completeness and accuracy of patient information transfer as a result of implementing this practice change. The project was undertaken in response to PACU nurses' and hospital administration's desire to increase the quality and quantity of information transferred during the anesthesia to PACU handoff process.

## **Purpose**

The primary objective of this quality improvement project was to implement a standardized electronic handoff tool to optimize patient information transfer between anesthesia providers and PACU nurses.

## **Specific Aims**

1. Develop a brief evidence-based PACU handoff tool for use during patient transfer of care between anesthesia providers and PACU nurses.
2. Incorporate the PACU handoff tool into the hospital's EMR and implement use of the tool.
3. Compare preimplementation and postimplementation data regarding
  - a. the completeness and accuracy of patient information transfer during the handoff;
  - b. the duration of the report during patient transfer; and

- c. PACU nurse satisfaction with the handoff tool and process.

## Project Methods

### Design

A preimplementation and postimplementation design was used to evaluate the completeness and accuracy of information transfer during anesthesia to PACU handoffs in a convenience sample of surgical patients. An existing published PACU handoff checklist was used to assess information transfer at baseline, before its formal introduction and implementation, and at two time points after implementation. In addition, duration of the PACU handoff report was determined and nurses' satisfaction with the electronic handoff process was measured before and after implementation (Figure 1).

### Organizational Setting

The project was implemented in a community hospital in the Southeastern United States, which has 186 inpatient beds and performs 3,951 inpatient and 10,315 outpatient surgeries per year.<sup>21</sup> In addition,

there are 19 operating rooms (ORs), 18 PACU 1 beds, and 11 PACU 2 beds. Patients are transferred to PACU 1 after surgery if they are being admitted, at age less than 14 years, or received a general anesthetic, or to PACU 2 if they are going home after surgery, are older than 14 years, and did not receive a general anesthetic. Patients are transferred from PACU 1 to PACU 2 by the PACU 1 nurses once they have met the PACU 1 transfer criteria. Only the anesthesia providers to PACU nurse handoffs were observed in this study.

### Sample

A convenience sample of 100 handoffs between anesthesia providers and PACU nurses was observed by the same observer before implementation of the EMR-based checklist, and 3 weeks and 3 months postimplementation, for a total of 300 observations. There were 50 observed handoffs at each of the three data collection time points for PACU 1 and 50 at each data collection time point for PACU 2. Forty individual anesthesia providers were observed participating in handoffs including Certified Registered Nurse Anesthetists, Student Registered Nurse Anesthetists, Anesthesiologists, and Anesthesia Assistants. Most handoffs

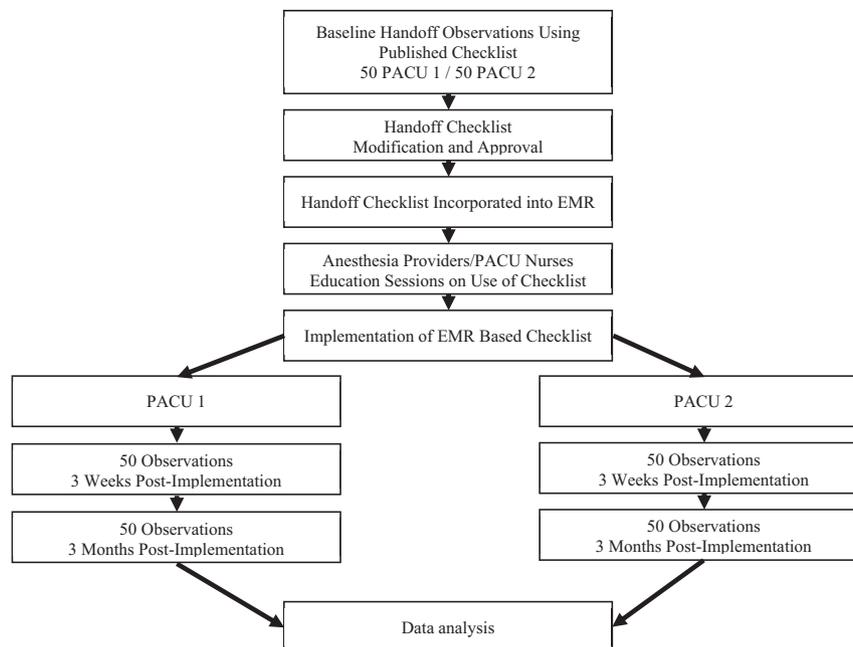


Figure 1. Flow diagram of the implementation procedures.

observed were performed by experienced anesthesia providers. Thirty individual PACU nurses were observed participating in handoffs during the observation periods. Forty anesthesia providers were observed providing 300 PACU handoff reports to 30 PACU 1 and PACU 2 nurses.

### Measures

The completeness and accuracy of information transfer during the handoffs were evaluated using a slightly modified version of a PACU handoff checklist published by Potestio et al.<sup>15</sup> This checklist was selected for its specific succinct design with notably fewer items than other handoff tools, which would presumably promote improved acceptability in practice.<sup>15</sup> Several items on the Potestio et al checklist were eliminated, including the time admitted to the PACU, the American Association of Anesthesiologists physical status number, and patient surgical positioning as they were not deemed applicable to the current clinical setting by the end user anesthesia providers and PACU nurses.<sup>15</sup> The final handoff checklist contained 20 patient-specific and procedural information items. In addition, the presence of “closed-loop communication” was assessed by determining if the anesthesia providers asked PACU nurses if they had any questions or concerns before leaving the patient in the PACU.<sup>15</sup> The final checklist contained a total of 21 total items (Table 1).

To verify the accuracy of the information being transferred during the PACU handoff, the checklist items were verified against information from each patient’s EMR. If the information was not accurate for any individual item on the checklist, then it was not counted as being transferred during the PACU report process. Through the use of a checklist format and patient record verification of information transfer, a continuous variable was created indicating the percentage (%) of the 21 items that were accurately addressed during each patient transfer.

The duration of the verbal report component of each handoff was measured in minutes and seconds using a stopwatch by the same observer. Before implementation of the EMR-based handoff checklist, time started when the anesthesia provider began speaking to the PACU nurse and ended when the anesthesia provider walked away from

the patient’s bed. After implementation of the handoff checklist and its availability as part of the patient’s EMR, anesthesia providers were required to review and complete the checklist before leaving the OR. However, PACU nurses were not required by hospital administrators and PACU nurse managers to review the checklist before the patient arrived in the PACU. During the period in which the handoff checklist document was incorporated into the EMR and tested by anesthesia providers and PACU nurses, it was determined that generation and review of the checklist required on average 1 minute each. Therefore, 2 minutes were added to the actual timed verbal handoff report interaction in the PACU for the completed OR checklist and a PACU nurse review to compensate for the additional EMR creation and review time. If the OR checklist was not reviewed by the PACU nurse then 1 minute was added to the timed verbal handoff.

**Table 1. Final 21 Item PACU EMR-Based Handoff Checklist**

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Patient Name
Allergies
Surgical procedure
Reason for surgery
Type of anesthesia (general anesthetic, total intravenous anesthetic, regional technique)
Surgical or anesthetic complications
Past medical history
Preoperative cognitive function
Preoperative activity level
Limb restriction
Preoperative vital signs
Intubation conditions (grade of view, quality of bag mask ventilation, bite block)
Lines/catheters
Fluids
Estimated blood loss
Urine output
Analgesia plan during case
Antiemetics administered
Medications due during PACU (antibiotics and so forth)
Other intraoperative medications (steroids, antihypertensives)
Do you have any questions or concerns?

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EMR, electronic medical record; PACU, postanesthesia care unit.

PACU nurses' satisfaction with the handoff process before and after implementation of the checklist was assessed using a condensed version of Caruso et al's PACU Nurse Satisfaction Questions (Table 2).<sup>3</sup> PACU nurses were asked to complete the iPad-based electronic survey following the anesthesia providers' verbal report. Most surveys were completed within 5 to 10 minutes after the PACU handoff. The survey contained eight questions and the responses were evaluated using a five-point Likert Scale ranging from "Strongly Disagree" to "Strongly Agree."<sup>3</sup> PACU nurses whose handoffs were observed at all three time points were asked to complete the satisfaction survey.

## Procedure

### Phase I: Preimplementation

This project was formally evaluated using an internal checklist and determined to be quality improvement and not human subject's research. Before incorporation of the modified checklist into the EMR, a total of 100 anesthesia providers to PACU nurse handoffs, 50 in PACU 1 and 50 in PACU 2, were observed, cross referenced with the EMR for accuracy, and assessed for the number of items accurately transferred. This process was performed by the same observer using the original Potestio et al published checklist.<sup>15</sup> The original published checklist was used without prior review or input from anesthesia providers and PACU nurses to avoid familiarity with the tool during the preimplementation period and prevent changes in the typical transfer behaviors at the institution. After baseline data collection, the tool was reviewed by most anesthesia providers and PACU nurses at the institution and slightly modi-

fied to best fit the institutional needs by consensus of the anesthesia provider and PACU nurse users. Items omitted from checklist are noted in the "Measures" section. The modified checklist was approved by the Chief Certified Registered Nurse Anesthetist, the Chief of the Department of Anesthesia, and the Nurse Manager of the PACU and incorporated into the EMR system (Table 1).

### Phase II: Implementation

After evaluation of the existing nonstandardized PACU handoff interactions using the handoff checklist, multiple education sessions were held to familiarize the anesthesia providers and PACU nurses with the approved modified checklist and how to access and complete or review it in the EMR. In addition, emails were sent to the anesthesia and PACU nursing staff providing supplemental education on how to use the checklist. Three volunteers from the anesthesia provider and PACU nurse pools were trained as checklist champions to answer staff questions regarding the tool. After a week of education sessions, the anesthesia providers began to use the standardized PACU handoff checklist to provide report to the PACU nurse during the handoff (Figure 1).

### Data Analysis

The percentage of each individual handoff checklist item that was addressed was calculated for PACU 1 and PACU 2 at preimplementation, 3 weeks postimplementation, and 3 months postimplementation to descriptively assess changes in the percentage of each item addressed over the course of the intervention. The mean percentage of the total number of items addressed over all the handoffs was also calculated for PACU 1 and PACU 2 at preimplementation,

**Table 2. Nurse's Satisfaction With the Handoff Process**

Survey Item	N	df	$\chi^2$ Value	P Value
The anesthesia provider report was satisfactory	287	8	4.98	.759
I heard the entire report	287	6	6.69	.350
I received information about potential problems	287	6	4.27	.640
I received information about with whom to follow-up	287	8	21.25	.007
Handoff start and end were clear	287	8	7.46	.488
I received anticipatory guidance	286	8	10.73	.217
I had a chance to ask questions	287	6	7.08	.314
Distractions interrupted the handoff	287	8	18.87	.016

3 weeks postimplementation, and 3 months postimplementation. One-way analysis of variance (ANOVA) tests were conducted separately for PACU 1 and PACU 2 to compare differences in the mean percentage of the total checklist items addressed at the three time points.

The duration of the handoff verbal report, to which 1 or 2 minutes were added based on elective PACU nurse review of the EMR handoff report created by the anesthesia provider postimplementation, was compared for PACU 1 and PACU 2 at the three time points using separate one-way ANOVAs.

The Likert Scale responses on the nurse satisfaction survey for each category were aggregated and compared between preimplementation and postimplementation using separate  $\chi^2$  tests for each item. IBM SPSS v.24 was used for statistical analysis with  $\alpha$  value set to  $< 0.05$ .

## Findings

### General

A total of 300 handoffs were observed for this project. There were 50 observations in PACU 1 and 50 in PACU 2 at each of three data collection time points (preimplementation, 3 weeks postimplementation, and 3 months postimplementation).

All but 1 of the 21 handoff checklist items were accurately addressed to a greater percentage at the 3 weeks and 3 months' time periods in the PACU 1 and PACU 2 compared with preimplementation baseline after standardization of the handoff process. The reporting of urine output in the PACU 1 decreased at the 3-month time period below baseline after a substantial improvement at 3 weeks. For the PACU 1, there continued to be improvement in addressing 7 of the 21 items (33.3%) at the 3 months compared with the 3 weeks assessment period. For the PACU 2, there was continued improvement in 16 of the 21 items (76.6%) at the 3 months compared with the 3 weeks assessment period (Table 3). Two of the 21 items, the patient's preoperative activity level, and intubation conditions (9.5%), were unchanged from 3 months to 3 weeks for the PACU 2. The remainder of the 21 items that were accurately addressed at the 3 months postimplementation time period decreased compared with the 3 weeks

**Table 3. List of the Items That Continued to Show Improvement in Being Addressed at the 3 months Compared to the 3 weeks' Time Periods for the PACU 1 and PACU 2**

PACU 1	PACU 2
Patient ID	Patient ID
Surgical or anesthetic complications	Allergies
Analgesia plan during case	Surgical procedure
Antiemetics administered	Reason for surgery
Medications due during PACU	Type of anesthesia
Other intraoperative medications	Surgical or anesthetic complications
Do you have any questions or concerns?	PMH
	Preoperative cognitive function
	Limb restriction
	Preoperative vitals
	Fluids
	Analgesia plan during case
	Antiemetics administered
	Medications due during PACU
	Other Intraoperative medications
	Do you have any questions or concerns?

PACU, postanesthesia care unit; PMH, past medical history.

postimplementation time period; however, they remained above the preimplementation baseline values in both PACU 1 and PACU 2.

### ***Specific Aim 3a: Collect and Compare Preimplementation and Postimplementation Data Regarding the Completeness and Accuracy of Patient Information Transfer During the Handoff***

For the PACU 1 data, Levene's test for homogeneity of variance was significant ( $P < .05$ ), thus the Welch adjusted  $F$  ratio was used to determine overall group differences. There were overall differences between groups, Welch's  $F(2, 89.68) = 91.33, P < .001$ . Post hoc tests revealed significant increases in the mean percentage of the total handoff checklist items addressed at 3 weeks and 3 months postimplementation as compared with preimplementation baseline. However, there was a significant decrease

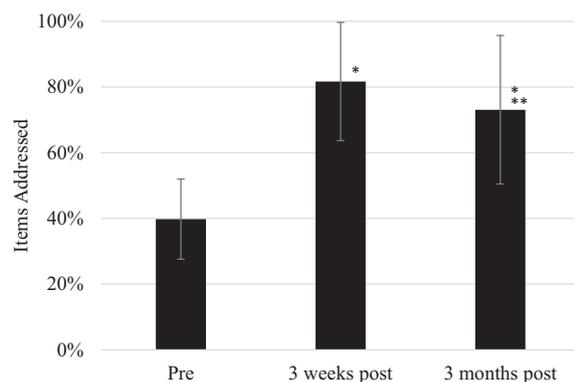


Figure 2. Comparison of the mean percentage of the total number of handoff checklist items addressed preimplementation and at 3 weeks and 3 months postimplementation of the standardized EMR-based checklist in the PACU 1. \*Significant increase compared with preimplementation baseline. \*\*Significant decrease compared with 3 weeks postimplementation. EMR, electronic medical record; PACU, postanesthesia care unit.

in the mean percentage of total checklist items addressed at 3 months compared with the 3 weeks postimplementation time period (Figure 2).

For PACU 2, the homogeneity of variance assumption was met (Levene's  $P = .846$ ). A one-way ANOVA revealed an overall difference between time points in the mean percentage of total items addressed,  $F(2, 147) = 5.88, P < .01$ . Post hoc least significance difference tests revealed significant increases in the mean percentage of the total handoff checklist items addressed at 3 weeks and 3 months postimplementation as compared with preimplementation baseline. There was no significant difference in the mean percentage of the total handoff checklist items addressed at 3 weeks compared with the 3 months postimplementation time periods ( $P = .344$ ) (Figure 3).

**Specific Aim 3b: Collect and Compare Preimplementation and Postimplementation Data Regarding the Duration of the Handoff Report During Patient Transfer**

**VERBAL HANDOFF REPORT TIME.** The mean times to provide the verbal PACU handoff report are displayed in Figure 4. For the PACU 1 data, the duration of the verbal report had an overall

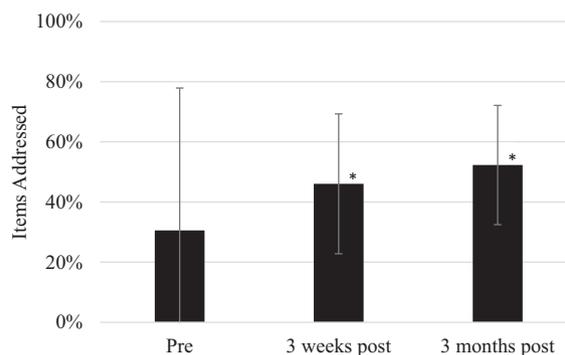


Figure 3. Comparison of the mean percentage of the total number of handoff checklist items addressed preimplementation and at 3 weeks and 3 months postimplementation of the standardized EMR-based checklist in the PACU 2. \*Significant increase compared with preimplementation baseline. EMR, electronic medical record; PACU, postanesthesia care unit.

significant difference between the time points,  $F(2, 147) = 4.62, P = .011$ . Post hoc tests revealed a significant decrease from preimplementation to 3 weeks postimplementation and from preimplementation to 3 months postimplementation. There was no significant difference between 3 weeks and 3 months postimplementation. For the PACU 2 data, the duration of the verbal report

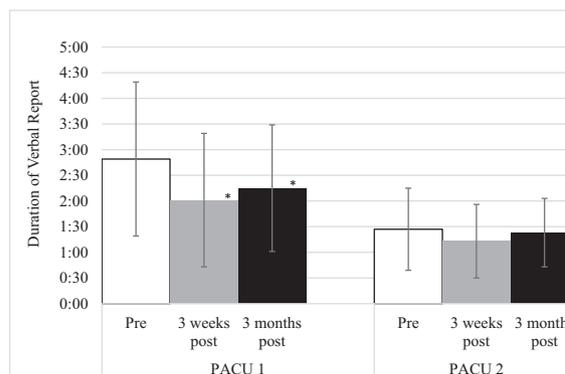


Figure 4. Comparison of the mean duration of verbal report preimplementation and postimplementation of the standardized EMR-based handoff checklist. The data for the 3 weeks and 3 months' time periods are for the verbal report component of the handoff and do not include the EMR generation and review time. Time is in minutes and seconds. \*Significant decrease compared with preimplementation baseline. EMR, electronic medical record.

was not significantly different among the three time points,  $F(2, 147) = 1.38, P = .256$ .

**EMR GENERATION AND REVIEW PLUS VERBAL REPORT TIME.** The mean times to generate and review the EMR report added to the verbal PACU handoff report are displayed in Figure 5. For the 3 weeks and 3 months postimplementation groups, 1 or 2 minutes were added to the measured verbal report time depending on whether the PACU nurse reviewed the EMR handoff report created by the anesthesia provider. For the PACU 1 data, there was an overall significant difference in the mean time to provide the EMR plus verbal report between the three time points,  $F(2, 147) = 3.36, P < .05$ . Post hoc tests revealed a significant increase in the mean EMR plus verbal report time 3 weeks postimplementation compared with preimplementation baseline verbal report time only. There were no other significant differences at any of the other time points for PACU 1. For the PACU 2 data, there were overall significant differences among the three time points,  $F(2, 147) = 9.51, P < .001$ . Post hoc tests revealed significant increases in the mean EMR plus verbal report time at the 3 weeks and 3 months postimplementation time periods as compared with preimplementation baseline verbal report time only. There was no significant difference between

3 weeks and 3 months postimplementation periods ( $P = .195$ ).

**Specific Aim 3c: Collect and Compare Preimplementation and Postimplementation Data Regarding the PACU Nurse Satisfaction With the Handoff Tool and Process**

Table 2 displays the  $\chi^2$  test results for each item on the nurse satisfaction survey. As shown, there were significant changes in responses for two items. When asked about receiving information about with whom to follow-up, there was a significant increase in responses of Strongly Agree from preimplementation ( $n = 41, 41\%$ ) to 3 weeks postimplementation ( $n = 49, 55.7\%$ ), and then again from 3 weeks postimplementation to 3 months postimplementation ( $n = 61, 61.6\%$ ). Regarding the occurrence of distractions interrupting the handoff, fewer participants reported Strongly Disagree preimplementation ( $n = 37, 37.0\%$ ) compared with 3 months postimplementation ( $n = 50, 50.5\%$ ).

## Discussion

### Implications for Practice

A greater percentage of complete accurate information was transferred between anesthesia providers and PACU nurses as a result of implementing a standard EMR-based PACU handoff tool. This was partly because of the capability to prepopulate the electronic handoff checklist with patient data already available in the EMR. This capability also minimized the time it took anesthesia providers to generate the checklist. In addition, the tool served as a visual reminder of the patient care information that should be transferred both on generation of the EMR by the anesthesia provider and review of the record by the PACU nurse. The improvement in information transfer was evident at both the 3 week and 3 month measurement intervals. The percentage of some of the checklist items that were accurately addressed continued to improve at 3 months compared with 3 weeks postimplementation; although overall the percentage of items accurately addressed decreased at 3 months for the PACU 1 group. Therefore, there was some evidence of the sustainability of this intervention in the institution in which it was implemented and the potential to positively impact patient safety during transfer of care from the OR

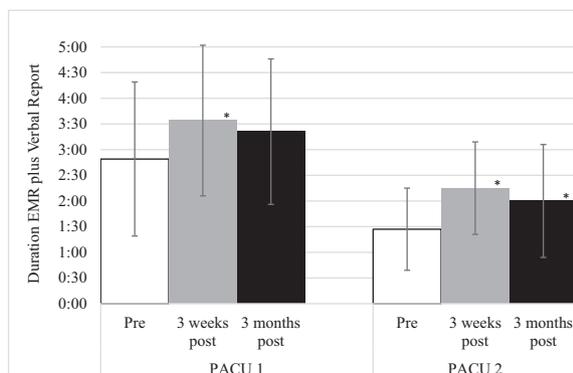


Figure 5. Comparison of the mean duration of EMR generation and review plus the verbal report preimplementation and postimplementation of the standardized EMR-based handoff checklist. The data for the 3 weeks and 3 months' time periods includes the time to complete and review the EMR checklist plus the verbal report time. Time is in minutes and seconds. \*Significant increase compared with preimplementation baseline. EMR, electronic medical record.

to the PACU. The fact that transfer of information for some of the checklist items remained unchanged and reporting of urine output decreased after implementation of the checklist suggests the impact of those PACU nurses who did not review the EMR transfer report and therefore required a full verbal report from an anesthesia provider who likely neglected to report on some elements of the transfer checklist.

As expected, the duration of the actual verbal handoff exchange at 3 weeks and 3 months was decreased from the preimplementation period as a product of the PACU nurses having the opportunity to review the items on the EMR handoff checklist before transfer of the patient from the OR to the PACU. Although the total handoff time (EMR generation and review plus verbal report time) increased significantly at 3 weeks and 3 months, in reality this increase amounted to less than 1 minute across the PACU 1 and PACU 2. This minimal increase would seem to be a reasonable tradeoff for the increase in degree of accurate information transferred and the potential to enhance patient safety. This slight increase in the total time to perform the transfer process appeared to go unnoticed and without comment from either the anesthesia providers or the PACU nurses.

The need to intervene in the anesthesia to PACU patient handoff process in this setting was partially driven by input from PACU nurses, who indicated a degree of concern with the current verbal process and adequate transmission of information they felt important to maximize patient care. In that regard, it was surprising that only two of the eight items on the PACU nurses' satisfaction survey were found to have significantly improved as a product of implementation of the EMR component of the handoff process. On the basis of the conversations between one of the authors and a number of the PACU nurses, it is likely that there was actually improved satisfaction with some of the other six items on the survey. However, there was apprehension on the part of the PACU nurses that they do not appear to be too critical of the existing transfer process. This may have resulted in an inflated degree of reported satisfaction with the existing process and therefore a lack of improvement by comparison after implementation of the EMR-based process. Indeed, after the successful and

sustained implementation of the EMR-based anesthesia to PACU handoff checklist, a similar process was initiated when patients were transferred from the PACU to an inpatient floor.

### **Barriers**

The most significant barrier to full implementation of this practice improvement was the fact that while the anesthesia providers were required to generate the electronic handoff checklists before leaving the OR, the PACU nurses receiving those patients were not required to review it. As a result not all the PACU nurses complied with the practice change. Several of the PACU nurses had adopted their own long-standing routine regarding how to prepare to receive a patient from the OR. Despite the PACU handoff checklist containing all the information they indicated was important to receive during a handoff, they did not review the electronic record before the patient's arrival. It is certainly conceivable that anesthesia providers would stop completing the electronic handoff checklist if the PACU nurses do not review it before the patient's arrival, resulting in an extended verbal exchange of patient information. In an attempt to increase review of the checklist by the PACU nurses, informal one-on-one re-education sessions were performed when the opportunity arose. Targeted personal education regarding the benefits of a standardized handoff process with noncompliant providers has been shown to increase compliance rates.<sup>12</sup> Although requiring PACU nursing staff to review the patient EMR transfer information was recommended to hospital administration and PACU nurse managers following the 3 weeks postimplementation data collection period, they decided not to make this a requirement. This may have been in deference to those veteran PACU nurses who had an established process for acquiring patient transfer information and preferred it to accessing the EMR data.

Equally challenging was embedding the checklist into the existing hospital-based EMR. This required many hours working with the institutions' information technology department and Epic system personnel to create and test the lines of code necessary to add a modifiable document to the EMR and make it available and transferable on demand to anesthesia providers and PACU nurses.

### Limitations

There were several limitations to this project that may have impacted the outcomes. First, there was no “control” condition, therefore the improvement in the total numbers of items addressed and their accuracy may simply be because of the presence of an observer or some other unknown external factor. Second, a within-subjects design was not used and the changes in responses to the survey items preimplementation and postimplementation of the EMR-based handoff checklist may be attributed to observing and surveying different providers. Finally, a convenience sample of nonrandomized providers was observed and this group may not be representative of the practices of all the anesthesia providers and PACU nurses at the institution. This limitation could be addressed by performing a randomized controlled trial.

### Conclusions

A standardized EMR-based anesthesia to PACU handoff checklist produced an increase in the quantity and accuracy of the information transferred during the PACU handoff, decreased the

duration of the verbal handoff interchange, and ultimately increased the PACU nurses' satisfaction with some components of the handoff process in the institution where it was implemented. Embedding the PACU handoff checklist in the EMR exploits the ability to prepopulate a number of items on the checklist, reducing the time required by the anesthesia provider to complete the tool to a minimum. In addition, the electronic PACU handoff checklist proved to be a sustainable and transferable intervention that continues to be used at the institution. Although it is an effective method to enhance transfer of information during the anesthesia to PACU handoff, a standardized EMR-based handoff checklist should not be considered a stagnant document and should be revisited at intervals to assess compliance with the existing process and product, and to determine its ongoing applicability and value to the institution. Finally, the performance of randomized controlled anesthesia to PACU handoff studies would be of value to determine the general efficacy of standardized electronic PACU handoff checklists, and more importantly, their ultimate effect on patient safety during this vulnerable period of patient care.

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