Improving Communication During Patient Handoff: Anesthesia to the Intensive Care Unit

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Abstract

Problem & Purpose: The omission of essential patient information during handoff report between health care providers is a cause of sentinel events, leading to medication errors and misdiagnoses. An acute care community hospital in Maryland lacked a systematic exchange of patient information from the operating room to the Intensive Care Unit, resulting in omission of patient information in 100% of handoffs. The inadequate communication jeopardized patient safety in the form of medication errors and delays in care. The purpose of this Doctor of Nursing Practice quality improvement project was to implement and evaluate the compliance of an evidence-based anesthesia to Intensive Care Unit handoff protocol, as well as to decrease information omissions during patient transfer. **Methods:** A site-specific assessment was performed to establish root causes and develop a feasible handoff protocol. A team of leadership and change champions were mobilized to identify barriers and facilitators before and during project implementation. Anesthesia and intensive care staff were educated on the protocol. Anesthesia providers gave bedside report using an evidence-based handoff tool. During handoff, a total of 25 items were communicated to the Intensive Care nurse. Surveys assessing the items communicated during handoff were collected and analyzed weekly for trends in both completion and number of information omissions. **Results:** Weeks one through four showed a 0% compliance in use of the handoff protocol, with an incline to a compliance rate of 90% in weeks four through 14. The average number of essential patient items communicated when the handoff tool was utilized was 98.5%. **Conclusion:** Preliminary findings suggest that incorporating the use of a handoff protocol is feasible at a small community hospital. Improving the exchange of essential patient information, such as past medical history, intraoperative course, and future plan of care, will encourage clarity and patient safety during the handoff process.

Keywords: Information omission, anesthesia handoff, Intensive Care Unit handoff, transfer protocol, handoff tool

Improving Communication During Patient Handoff: Anesthesia to the Intensive Care Unit

The omission of essential patient information during handoff report between health care providers is a major cause of sentinel patient events (The Joint Commission, 2017). In 2016, inadequate communication during patient handoff in United States hospitals resulted in over 30% of malpractice claims, and well over 1,700 patient deaths (The Joint Commission, 2017). Research shows that the use of a transfer of care protocol improves communication at handoff by increasing the amount of information shared during report and decreasing information omissions (Shah et al., 2016). Omission of patient information can lead to medication errors, misdiagnoses, and delay in care (Ong et al., 2011). Communication breakdown decreases satisfaction between healthcare staff and can create mistrust and strained working relationships (Methangkool et al., 2019). An acute care community hospital in Maryland lacked a systematic exchange of patient information from the operating room (OR) to the Intensive Care Unit (ICU). The handoff process varied with each ICU transfer and no handoff tool was utilized during report. The lack of standardization in handoff resulted in omission of patient information in 100% of patient handoffs between the OR and the ICU.

Nursing and anesthesia staff at this facility reported a high level of dissatisfaction with the handoff process. High amounts of critical patient information, such as past medical history or intraoperative medications given, was missed during report, resulting in medication errors and delays in patient care. Failing to act continued to affect the working environment of healthcare providers, but more importantly jeopardized patient safety. After an assessment of local context, the root cause most responsible for the omission of information during handoff was the absence of a formal transfer of care protocol between the OR and the ICU. The purpose of this Doctor of

Nursing Practice quality improvement project was to implement and evaluate the compliance of an evidence-based anesthesia to ICU handoff protocol.

The use of a handoff tool during report has been supported by the Joint Commission (2017) as a method to decrease patient sentinel events. A review of evidence was completed to determine if the use of a handoff tool from the OR to the ICU improved communication among healthcare providers. The evidence review included one level I study and six level III studies. These studies were assigned hierarchical levels based on the Johns Hopkins Nursing Evidence Based Practice Levels of Evidence Guidelines (Dang & Dearholt, 2018). See Appendix A for evidence review tables and Table 1 for an evidence synthesis.

Abraham et al. (2021) conducted a systematic review and meta-analysis which concluded that anesthesia to ICU handoffs using a handoff protocol or tool had fewer information omissions during handoff in both the adult and pediatric patient populations. Krimminger et al. (2018), Lane-Fall et al., (2020), and Mukhopadhyay et al. (2018) found that the initiation of a handoff protocol in addition to the use of a physical bedside reporting tool resulted in decreased information omissions during handoff. These three studies included the adult surgical population, as well as used a paper reporting tool during handoff.

Shah et al. (2016) was the only study that developed an electronic handoff tool in the electronic medical record and found the tool improved reporting of the anesthetic used, medications given, blood products given, and significant lab work during handoff. Yang et al. (2016) found the development of an operating room to ICU handoff protocol resulted in an increased exchange of anesthesia related items, surgery information, and care plan information. Overall, the above-mentioned studies support the use of a handoff protocol to improve information exchange and decrease information omissions during patient handoff in the surgical patient population.

The Knowledge to Action (KTA) framework was chosen to plan, implement, and evaluate this project. The KTA framework has two major elements. First, the knowledge creation cycle includes steps for knowledge inquiry, synthesis, and tools. Second, the action cycle has steps for implementation, project adjustment, and outcome evaluation (Graham et al., 2006). Knowledge creation was completed by assessing the site's culture, performing an evidence review, and choosing the evidence-based Situation, Background, Assessment, and Recommendations (SBAR) format for the handoff tool (Shahid & Thomas, 2018). The action cycle was initiated with the identification of the problem of information omission at this facility. Implementation began with staff education sessions and promoted with visual aids in the OR and ICU. See Figure 1 for the KTA framework. The intervention of a handoff protocol was anticipated to be successful as the KTA framework acknowledges that hospital environments are dynamic and complex, while taking the culture and local context into account with the goal of influencing behaviors of a group (ACCORDS Research, 2020).

Methods

Many contextual elements were considered when introducing the handoff protocol from the OR to the ICU. This healthcare facility did not have a protocol that supports thorough patient handoff, resulting in disorganized patient transfer. Communication between providers during patient transfer deteriorated since the Coronavirus Disease 2019 (COVID-19) pandemic. The pandemic had shifted the ICU into a more chaotic environment, as there were severe staffing shortages and a lack of patient beds. The team responsible for handoff included anesthesia providers, the ICU Registered Nurses (RN), the ICU medical staff (Intensivist, Physician

Assistant, or Nurse Practitioner), and the Respiratory Therapists (RT). Members of the OR and ICU team rarely worked together outside of the transfer process which led to hesitancy and a lack of comradery. See Figure 2 for more contextual elements.

Prior to project implementation, patient transfer was not completed in an organized way and report was not communicated in a systematic fashion. Often, the ICU nurse was not told pertinent information, such as equipment and drips needed, prior to the patient's arrival. Evaluating the barriers of the old handoff process was necessary to create improvement. To verify each transfer eligible was included in the new handoff process and in data collection, the chief Certified Registered Nurse Anesthetist (CRNA) and project sponsor tracked weekly ICU transfers and communicated this to the project lead every Monday.

The intervention of a handoff protocol was applied to all OR to ICU transfers. The paper handoff tool was not part of the patient's medical record but was used to guide verbal report and assisted in workflow. A laminated copy of the transfer protocol was displayed in every OR and throughout high trafficked areas in the ICU. This handoff protocol is seen in Appendix B. Bedside report was given using an evidence-based reporting tool, seen in Appendix C. To monitor the main outcome goal, the project lead assessed the number of OR to ICU transfers and collected completed Handoff Evaluation Surveys (HES), as displayed in Appendix D.

Many strategies were used to achieve the goal of no information omissions during handoff. The project lead attended the anesthesia mandatory staff meetings to complete both formal and information staff education at the inception of implementation. Educational emails were sent to ICU Nursing staff and a virtual teaching session was offered. Another effective implementation strategy was accountability. The commitment from leadership was apparent after both the Chief CRNA and Chief Anesthesiologist voiced support for the protocol during staff meetings. The ICU Nurse Manager also sent weekly emails to the ICU nursing staff formally endorsing the protocol and encouraging its use. Informal rounding with anesthesia providers who became early adopters of the protocol helped identify barriers and facilitators.

A modified handoff protocol (Lane-Fall et al., 2020) was developed and implemented at this healthcare facility. The handoff tool was adapted from The University of Washington Medical Center's Multidisciplinary OR to Surgical ICU Handoff Checklist (Shah et al., 2016) and followed the SBAR format (Shahid & Thomas, 2018). The SBAR handoff method was endorsed by The Joint Commission, Agency for Healthcare Research and Quality (AHRQ), and the Institute of Healthcare Improvement (IHI) as a reliable and valid tool (Shahid & Thomas, 2018).

Compliance to the new protocol during patient transfer was measured by the completion of the Handoff Evaluation Survey (HES). The HES was a simple yes/no survey evaluating if information outlined in the handoff tool was communicated in the transfer report. The HES, as seen in Appendix D, included 25 items that should be communicated during report. This dichotomous survey was a method to achieve quantitative data from the handoff report.

During the weekly site visits, the Clinical Site Representative or Sponsor would communicate how many ICU transfer happened the week prior and this was compared to the number of completed HES determined compliance to the protocol. The HES was then assessed for number of information omissions. The data on the HES was in the form of a 25-item dichotomous survey (yes or no choices). This data was then entered into the Research, Electronic, Data, Capture (REDCap) system for analysis.

Quantitative data was collected over 14 weeks to determine the compliance of the handoff protocol and tool, as well as to assess if information omission improved. Quantitative data was extracted from the HES. A completed survey determined if the protocol was followed. The amount of “no” boxes checked on the HES determine the occurrence of information omission. Descriptive statistics was entered into the REDCap software and run charts were employed for analysis.

Non-Human Subject’s Research determination from the Human Research Protections Office (HRPO) at the University of Maryland School of Nursing was obtained prior to project implementation, determining it did not involve human research. The specific site’s Internal Review Board committee also reviewed the quality improvement project, and it was determined to be non-human subjects research and was approved for implementation. Data was collected, accessed, and analyzed using REDCap software. REDCap is a secure application that requires a password and connection to the Virtual Private Network (VPN). Confidentiality measures were taken by de-identifying both patients and anesthesia providers through coding. All standard regulations by the Health Insurance Portability and Accountability Act (HIPAA) were strictly followed. Project outcomes were communicated to the site for discussion of the quality improvement effort.

Results

The main structure goal of this project was to have 100% of anesthesia providers and ICU nurses trained on the standardized patient transfer protocol. This main structure goal was successful. An educational email was sent to 100% of the ICU nursing staff. Over 50% of the anesthesia providers attended a formal education session, and those who did not were taught during informal sessions.

The main process goal was that 100% of the anesthesia and ICU nursing staff would utilize the new protocol during OR to ICU patient transfer. During the first weeks of implementation, this goal was not achieved due to initial low compliance. Appropriate adjustments to the project were made to overcome this barrier. Throughout the implementation period, compliance of the handoff protocol was high from the anesthesia staff. However, a major barrier in data collection was the non-compliance of the nursing staff in completing the HES. Even with weekly emails and daily reminders in shift huddle, the forms were not being completed by nursing staff with each ICU transfer. The responsibility of filling out the form was shifted to the anesthesia provider. This change was developed and officially enacted at the end of week five. For all transfers after this time, the HES was completed by the anesthesia provider and left in a folder in the anesthesia workroom.

Another major barrier was the low amount of OR to ICU transfers. There was an average of one OR to ICU transfer a week, so capturing compliance with these transfers was essential for project success. The run chart in Figure 3 reflects initial compliance of zero in weeks one through four, followed by a steady increase resulting 100% compliance in weeks seven through nine. During week six, there were two ICU transfers with only one completed HES, accounting for the 50% compliance rate. An improvement in compliance was noted when weekly email reminders were sent, followed by higher compliance when the responsibility of filling out the HES to the anesthesia provider. Weeks seven through eleven showed 100% compliance, followed by two weeks with no data due to no OR to ICU transfers.

The main outcome goal was that 100% of the information outlined by the transfer tool would be communicated by the anesthesia provider to the ICU staff during handoff, resulting in zero information omissions. When the handoff protocol was used, 98% of patient information was communicated. This reflects an extremely low amount of information omissions, close to achieving the outcome goal. The items that were not communicated have varied with each handoff. In one case, the urine output was not communication because the patient was oliguric. In another instance, the anesthesia provider did not communicate airway details because the provider did not think that information influenced the patient's plan of care as the patient was already intubated.

Figures 4 displays a run chart of the main outcome goal and shows a similar increase in items communicated when weekly reminder emails were initiated. There is a more consistent increase when the anesthesia providers began completing the HES. Even with these omissions, on average 98% of the items on the transfer tool were communicated during report. A run was noted in compliance and information communicated during weeks seven through 11 for both the process and outcome goals. These runs imply a change, and in this instance an improvement, as the implementation period continued. Weeks 12 and 13 represented no data as there were no ICU transfers. Week 14 had 100% compliance and 100% of information communicated during handoff report.

Discussion

This quality improvement project was a feasible option to improve information exchange between departments at this site. The project had no impact on financial cost for the institution as no additional staff or equipment were needed to complete the new handoff protocol. The cost of printing and lamination of the transfer protocol and handoff tool was minimal and funded by the project lead. The structure goal of staff education was easy to complete with support from leadership. Process and outcome goals were measurable and project barriers were resolvable with implementation adjustments.

When the transfer protocol and tool were used, an average of 98.5% of essential patient items were communicated in patient handoff, resulting in only 1.5% of information omissions.

These results show an improvement in information omissions prior to project implementation. The handoff protocol and tool improved information exchange at time of patient transfer from the OR to the ICU.

These results align with current literature that supports the use of a transfer protocol to information exchange. Krimminger et al. (2018), Lane-Fall et al., (2020), and Mukhopadhyay et al. (2018) found that the initiation of a handoff protocol in addition to the use of a physical bedside reporting paper tool resulted in decreased information omissions during handoff, just as demonstrated in this project. Yang et al. (2016) found the development of an operating room to ICU handoff protocol resulted in an increased exchange of anesthesia related items, surgery information, and care plan information. All three essential patient items were communicated more frequently with the use of the transfer protocol developed in this project.

Compliance to the handoff protocol was low during the first four weeks of project implementation due to hesitancy from ICU nursing staff. The initiation of weekly reminder emails and transferring the responsibility of completing the HES to the anesthesia providers helped increase compliance. This is shown during weeks seven through eleven, which had 100% compliance. Although efforts to improve compliance were successful, the beginning four weeks of no data significantly limited this project. Another limitation is the size of this project. This small community hospital only had a maximum of two OR to ICU transfers per week. This limited the amount of data to collect and had a significant impact on compliance averages if the transfer protocol was not used.

A main difference between anticipated and observed outcomes relates to the initial lack of compliance. After education at the site, both the anesthesia providers and ICU staff expressed positivity towards project goals. After initial implementation, however, ICU staff expressed hesitancy to fill out the HES due to their workflow when a patient arrives from the OR. This was not anticipated and required changes to the project design mid-implementation.

One factor that may have limited internal validity is the time at which the HES was completed. When it was the responsibility of the ICU nurse, the HES was filled at the time of report. When the HES was filled by the anesthesia provider, the tool was used as a prompt for verbal report, but the HES was often filled out after transfer was completed. This could have influenced the accuracy of the reported data. To minimize this factor, anesthesia providers were encouraged to fill out the HES immediately after verbal report.

Conclusion

The utilization of a handoff protocol and tool increases the quantity and quality of patient information communicated at time of patient transfer. Often, patients transferred to the ICU from the OR have a high level of acuity with complicated hospital courses. Streamlining the way providers at this institution communicate when transferring critically ill patients helps create an environment that emphasizes safety.

A site-specific root cause analysis revealed many reasons for information omissions at patient handoff, with three major categories being communication, staff, and teamwork. A major value of this quality improvement project is that it addresses these categories, encouraging staff to communicate in a clear, systematic fashion. Communicating essential items to the team that takes over patient care after the operating room helps with postoperative management, but also the overall plan of care.

Many actions have been taken to sustain the transfer protocol and transfer tool at the project site. Change champions agree to continue to use the protocol on future OR to ICU patient transfers. The transfer protocol and tool will be used in new hire orientation for anesthesia providers. Hard copies of the handoff protocols will continue to be displayed in each OR.

The success of this project opens the potential for initiating standardized patient transfer practices in other areas of the hospital. The Post-Anesthesia Care Unit and the Emergency Department are areas that rely on frequent verbal communication between multiple healthcare specialties to pass on essential patient information. At this institution, neither of these units have a patient transfer protocol or tool. These environments could benefit from a quality improvement project as implemented in the OR to ICU.

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Table 1

Evidence Review Synthesis

Category (Level Type)	Total Number of Sources/Level	Overall Quality Rating	Synthesis of Findings
Level 1 - Experimental study · Randomized Controlled Trial (RCT) · Systematic review of RCTs with or without meta-analysis	1 prospective blinded randomized control trial	A	Salzwedel et al. (2016) found that important patient information items, such as the patient's age, fluid status, and mental status preoperatively, were communicated during report 87.1% of the time with the use of a handoff checklist, as compared to 75.0% of the time without a handoff checklist. In conclusion, the use of a standard checklist for handover from the operating room (OR) to the Intensive Care Unit (ICU) increased both the quantity and quality of medical information transferred.
Level II · Quasi-experimental studies · Systematic review of a combination of RCTs and quasi-experimental studies, or quasi-experimental studies only, with or without meta-analysis			
Level III · Non-experimental study · Systematic review of a combination of RCTs, quasi-experimental, and non-experimental studies, or non-experimental studies only, with or without meta-analysis · Qualitative study or systematic review of qualitative studies with or without meta-synthesis	1 Systematic Review/Meta-analysis 5 pre and post intervention observational studies	B	Abraham et al. (2021) conducted a systematic review and meta-analysis which concluded that anesthesia to Intensive Care Unit (ICU) handoffs using a handoff protocol or tool had fewer information omissions during handoff in both the adult and pediatric patient populations. Krimminger et al. (2018), Lane-Fall et al., (2020), and Mukhopadhyay et al. (2018) found that the initiation of a handoff protocol in addition to the use of a physical bedside reporting tool resulted in decreased information omissions during handoff. These three studies were all in the adult surgical population, as well as used a paper reporting tool during handoff. Shah et al. (2016) was the only study that developed an electronic handoff tool in the electronic medical record, however found the tool also improved reporting of the anesthetic used, medications given, blood products given, and significant lab work during handoff. Yang et al. (2016) found the development of an operating room to ICU handoff protocol resulted in an increased exchange of anesthesia related items, surgery information, and care plan information. This was the only study to also include a "ventilator weaning plan" as part of the new handoff protocol. All six studies were completed in the years 2012-2016. Yang et al. (2016), Krimminger et al. (2018), and Mukhopadhyay et al. (2018) were completed over 4–8-month periods. Lane-Fall et al., (2020) and Shah et al. (2016) were conducted over a 14–16-month periods. Overall, the above-mentioned studies showed that the use of a handoff protocol and handoff tool improved information exchange and decreased information omissions during patient handoff.

Table 2

Measures, Goals, Data Collection Plan

Measures			
Project Goals	Measure Pre-Implementation	Measure During Implementation	Data Collection Plan
Structure Goal(s)			
1. 100% of anesthesia providers and Intensive Care Unit nurses will be trained on the standardized patient transfer protocol.	Number of healthcare providers at the project site that have knowledge of the handoff protocol.	Number of healthcare providers at the project site that have knowledge of the handoff protocol after attending a formal presentation by project lead.	Collection of sign-in sheets to assess attendance of information session.
2. Printed transfer tools will be available at the nurse's station in the ICU for use during OR to ICU transfer.	Existence of a formal physical handoff tool in the ICU.	Adapted Handoff Tool (with Handoff Evaluation Survey attached) available at the nurse's station in the ICU.	Weekly rounds in the ICU to restock supply of Handoff Tools to confirm availability.
Process Goal(s)			
1. The hand-off report protocol will be used 100% of the time by anesthesia and Intensive Care Unit staff transferring a patient from the operating room to the ICU.	**Numerator:** # of handoffs from the OR to the ICU that utilize a handoff protoc0l. **Denominator:** Total # of handoffs from OR to the ICU.	**Numerator:** # of handoffs from the OR to the ICU that utilize the evidence-based handoff protocol. **Denominator:** Total # of handoffs from OR to the ICU.	Weekly rounds in the ICU to collect completed Handoff Evaluation tools, chart audits to determine number of OR to ICU transfers.
Outcome Goal(s)			
1. 100% of information outlined by the transfer tool will be communicated by the anesthesia provider to the ICU staff during patient handoff, resulting in zero information omissions.	**Numerator:** # of critical information pieces passed on during handoff report. **Denominator:** Total # of information pieces determined "critical" by the receiving nurse.	**Numerator:** # of "yes" boxes checked on Handoff Evaluation Survey. **Denominator:** Total # of information subjects outlined on handoff tool.	Weekly rounds in the ICU to collect completed Handoff Evaluation tools, data analyzed for information omissions.

Table 3

Measurement Plan

Measure	***Measurement Plan***
100% of anesthesia providers and Intensive Care Unit nurses will be trained on the standardized patient transfer protocol.	• Fifteen-minute PowerPoint training presentation on new handoff protocol during anesthesia and ICU Nurse staff meetings • Sign-in sheet to determine training attendance
Printed transfer tools will be available at the nurse's station in the ICU for use during OR to ICU transfer.	• Dedicated file folder at nurse's station for ICU Registered Nurses to collect the handoff tool and Handoff Evaluation Survey • Weekly rounds to ensure copies of handoff tool are available for use
The hand-off protocol will be implemented 100% of the time by anesthesia and Intensive Care Unit staff transferring a patient from the operating room to the ICU.	• Laminated protocol (Appendix B) posted in every Operating Room and at the ICU Nurse's station as reminder of compliance • Monthly communication with staff to assess barriers/facilitators of new handoff protocol • Completion of Handoff Evaluation Survey signifies compliance to the protocol
100% of information outlined by the transfer tool will be communicated by the anesthesia provider to the ICU staff during patient handoff resulting in zero information omissions.	• Assessment of number of "yes" selections on Handoff Evaluation Survey indicates successful information exchange • Assessment of number of "no" selections on Handoff Evaluation Survey indicates information omission • Discussion with healthcare providers to receive feedback/satisfaction on handoff tool

Figure 1

Knowledge to Action Framework (Graham et al., 2006)

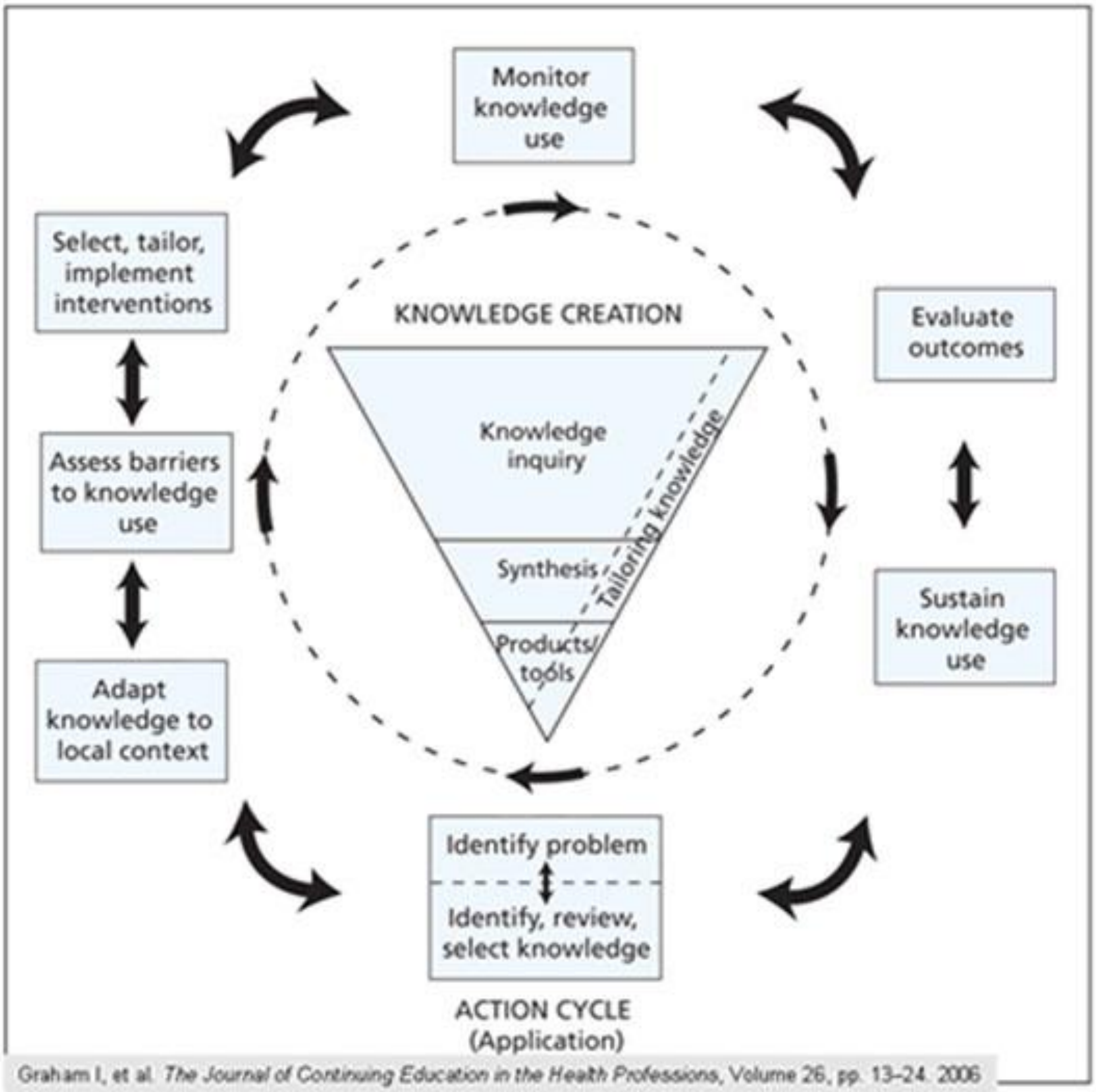


Figure 2

Fishbone Diagram: Information Omission Causes

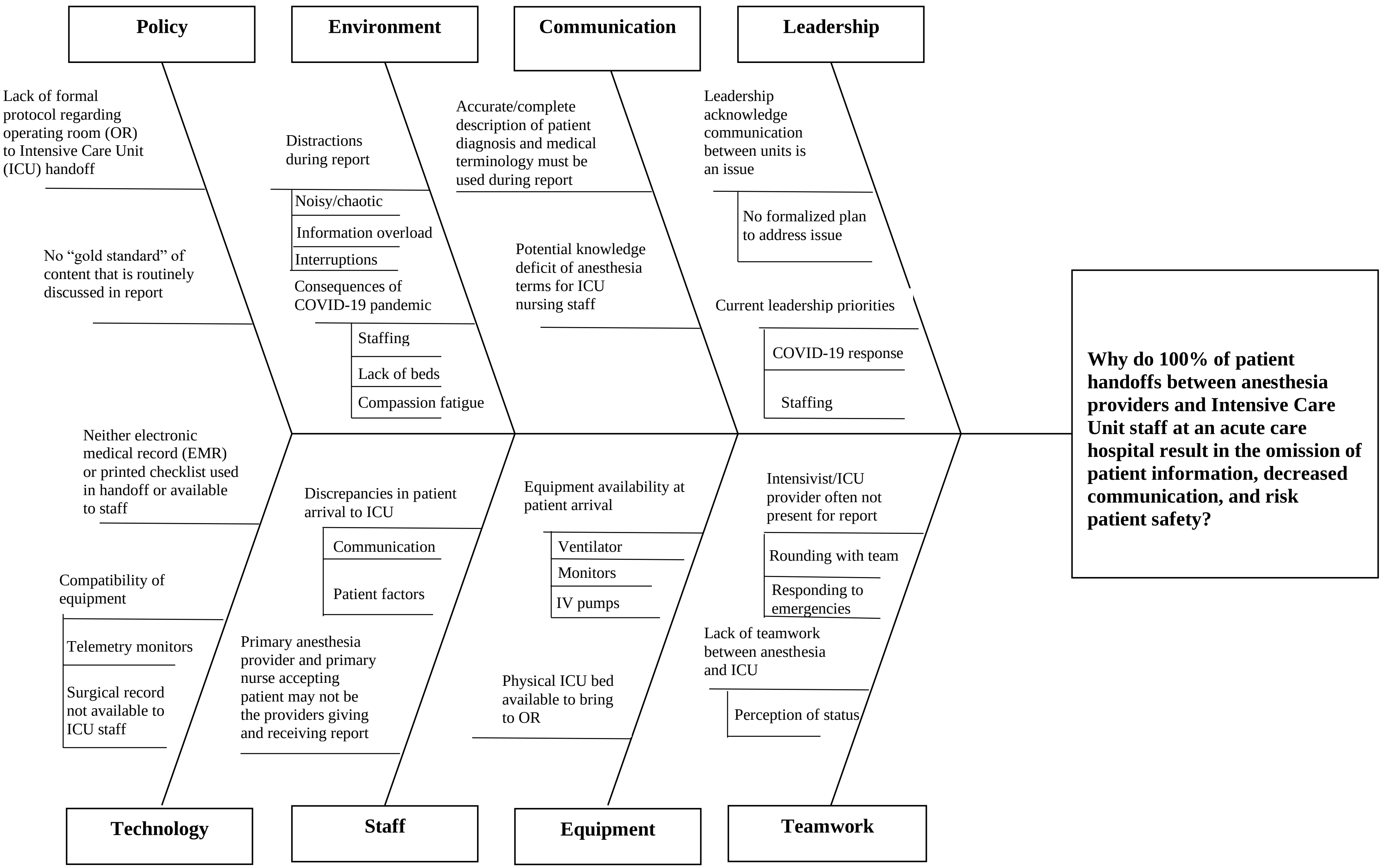


Figure 3

Run Chart: Operating Room to Intensive Care Unit Handoff Protocol Compliance

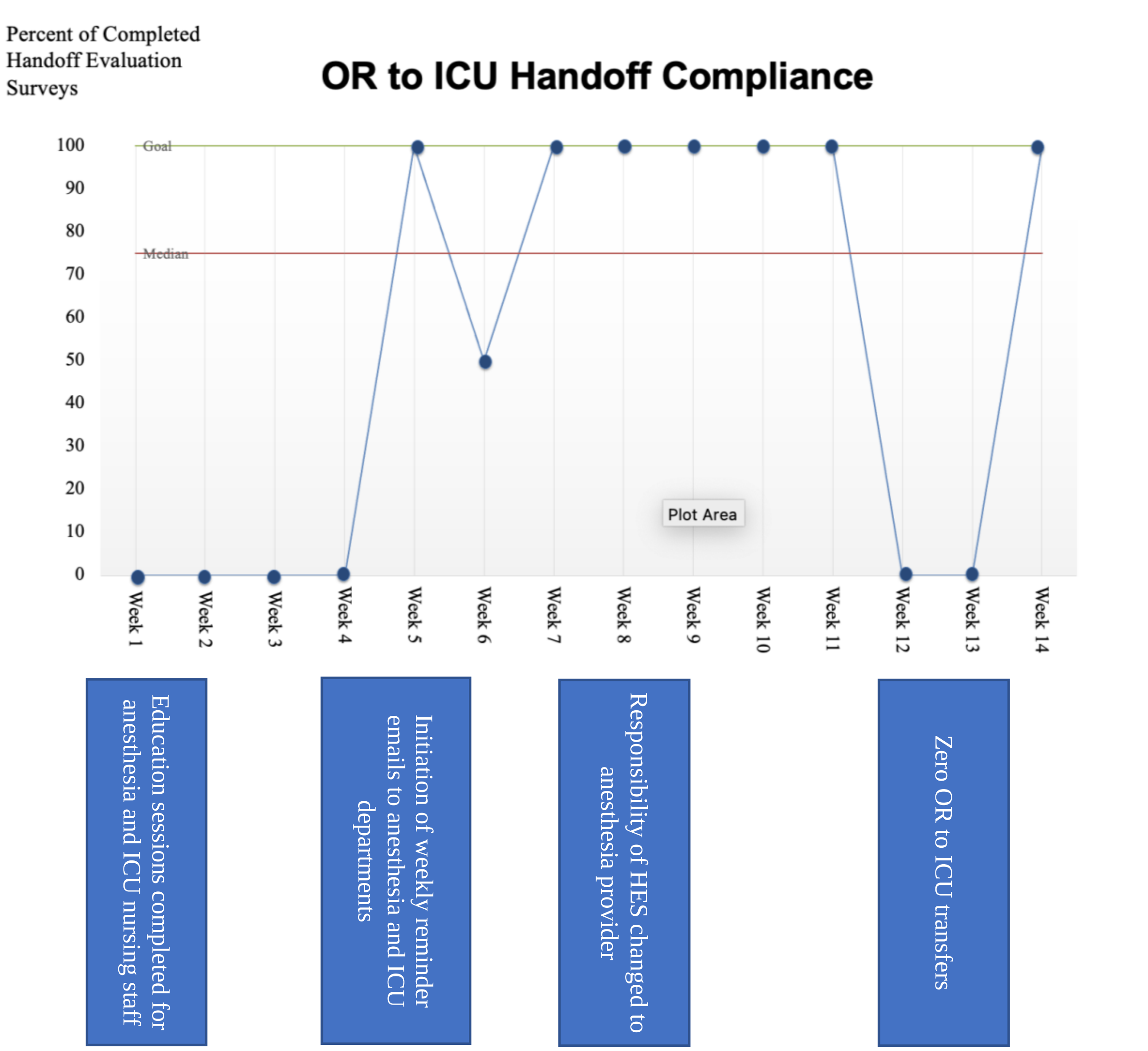
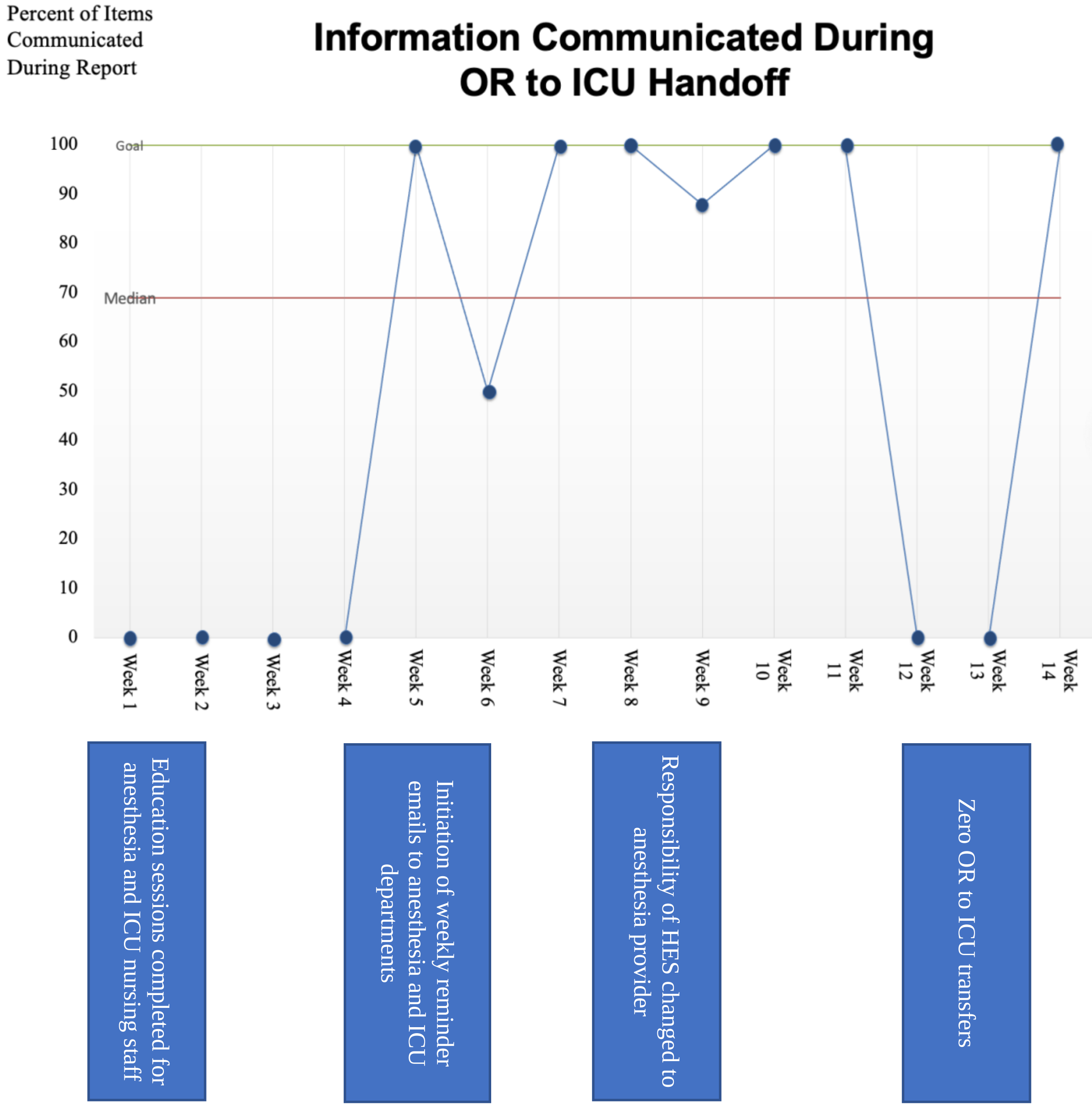


Figure 4

Run Chart: Information Communicated During OR to ICU Handoff



Appendix A

Evidence Review Table

<table>
<tr><td colspan="5">Citation: Abraham, J., Meng, A., Tripathy, S., Avidan, M. S., & Kannampallil, T. (2021). Systematic review and meta-analysis of interventions for operating room to Intensive Care Unit Handoffs. BMJ Quality & Safety, 30(6), 513–524. https://doi.org/10.1136/bmjqs-2020-012474</td><td>Level and Quality:
III B</td></tr>
<tr><td>Purpose/ Hypothesis</td><td>Research Design</td><td>Sample – Search for Studies included in SR</td><td>Intervention/ Procedures</td><td>Primary Outcome/ Measures</td><td>Results/Conclusions</td></tr>
<tr><td>The purpose of this systematic review was to determine the impact of structured handoff interventions on anesthesia to Intensive Care Unit (ICU) processes and patient outcomes.</td><td>Systematic Review and meta-analysis of Randomized Controlled Trials, quasi-experimental studies, and observationa l studies.</td><td>Search Strategy: A systematic search was conducted on these databases: MEDLINE, CINAHL, EMBASE, Scopus, and the Cochrane Central Register of Control Trials (CENTRAL) with the keywords: “surgery” “operating room” “handoffs” “handovers” “interventions” and “intensive care unit.” 1259 studies found and were evaluated for inclusion and exclusion criteria by two reviewers. After removing duplicates and screening abstracts, 58 were eligible for full-text review. Thirty-two articles identified as most relevant and included in the systematic review. All inclusion and exclusion criteria appropriately documented. Two disagreements noted between reviewers on study inclusion- was resolved by athird team member. Outcomes of studies were organized in a matrix to avoid reporting bias.
Eligible Studies: Studies in English that were published in peer-reviewed journals involving operating room (OR) to ICU handoff were considered,
Excluded: Retrospective studies, studies on postoperative handoff barriers/facilitators, studies that observed handoff from OR other settings, or shift-based handoffs. 539 duplicates removed; 662 studies removed for irrelevance; 31 studies removed for design flaws.
Included: Thirty-two studies totaling 4,571 patient handoffs. A mix of observational studies with control (28), observational studies without control (3) and Randomized Controlled Trials (1). Adult and pediatric patient populations both evaluated in the systematic review.
Power analysis: Not applicable to SR analysis.</td><td>Control: Varied among studies. Where applicable, the control was the usual care with unstructured verbal handoff between the OR and ICU.
Intervention: Included single component intervention (transfer checklist OR protocol) for 4 of the included studies, or multicomponent interventions (a transfer protocol AND a checklist) for 28 of the included studies.
Protocol: Not applicable to SR analysis.</td><td>Dependent Variable: Researchers chose articles with a primary measure of process-based outcomes: “technical errors,” “information omissions” or “information sharing scores.” The dependent variable was a measurement of quantitative communication between the OR and ICU.
Measurement: These process-based outcomes were measured by comparing the control group or pre-intervention group to the post-intervention group based on technical errors, information omission, or information items shared during handoff report.</td><td>Level of Measurement: Process-based outcomes were collected for meta-analysis. Random effects model and statistical heterogeneity assessed using Review Manager V.5. Studies that did not discuss similar outcomes or had missing data were evaluated separately.
Outcome Data Retrieval: Researchers found data using search strategy mentioned.
Analysis: Meta-analysis revealed that intervention groups had fewer technical errors (p=0.0007), fewer information omissions during handoff (p=0.003), and higher information sharing scores (p<0.000001) then control groups.
Conclusions: The use of a structured handoff protocol or checklist statistically decreases the number of information omissions and technical errors, increases information sharing scores during handoff.
SR Bias Risk: The risk of bias is low. Study selection based on Preferred Reporting Items for Systematic Reviews and Metanalysis (PRISMA) checklist.</td></tr>
</table>

Citation: Krimminger, D., Sona, C., Thomas-Horton, E., & Schallom, M. (2018). A multidisciplinary QI initiative to improve OR-ICU handovers. *The American journal of nursing, 118*(2), 48–59. https://doi.org/10.1097/01.NAJ.0000530248.45711.60					**Level and Quality:** III B
Purpose/ Hypothesis	**Research Design**	**Sample – Population, Size, Setting**	**Intervention/Procedures**	**Primary Outcome/ Measures**	**Results/Conclusions**
The primary purpose of this quality improvement initiative was to determine the influence that a standardized handover process had on information exchange between the operating room (OR) and the Intensive Care Unit (ICU).	A prospective pre-post intervention observational study.	**Sampling Technique:** Nonprobability convenience sampling. **# Eligible:** Eligibility for observation was determined by observer availability (conducted at random between 10am -7pm). A total of 38 handovers were observed. **Setting:** A 21-bed Cardiothoracic Intensive Care Unit (CTICU) in a large university-affiliated medical center. Observations were performed between August 2012-May 2013. **Excluded:** Handovers involving healthcare providers that declined to participate in the study (7% of staff members). **# Accepted:** 72 patient handovers of OR to ICU transfers. **# In pre-intervention:** 38 patient handovers from OR to CTICU. **# In post- intervention:** 38 patient handovers from OR to ICU. **Power analysis:** No power analysis discussed by researchers. **Group Homogeneity:** Patients were all surgical intensive care admissions. Healthcare providers participating in study included: CTICU nurses, ICU physicians, respiratory therapists, surgeons/fellows, and anesthesia providers. No characteristics or demographics of patients or healthcare participants provided.	**Pre-intervention:** Handover process prior to implementation of a new handover procedure. **Intervention:** Handover process after the implementation of the new handover procedure: (1) Following the Handover Report Template and (2) use of "The HandOver Report" or "THOR" as a physical report tool. **Intervention fidelity:** New handover procedure was developed by a multidisciplinary team of anesthesia providers, physicians, and ICU nurses. The new process went in this chronological order: (1) ICU room setup (2) Brief initial report from anesthesia to ICU on patient's arrival time and equipment needed (3) Handover of equipment (4) Printing of "The HandOver Report" or "THOR" with intraoperative data.	**Primary DV:** Sixteen items were scored by the observer for completion during handover. The main three dependent variables were: Number of handover process errors, number of information-sharing errors, and number of times report was interrupted. **Instrument, reliability, measurement procedure:** The handover observer was trained and assessed to determine interrater reliability. 100% agreement found determining the observer was reliable. To reduce bias, the observer was not involved in the development of the handover tool/protocol. The same trained observer participated in all pre and post-intervention observations.	**Statistical Results:** Comparison of pre and post implementation was conducted with a *t*-test for continuous variables and a chi-square for nominal variables. Statistical significance set at P= 0.05. After the quality improvement initiative, there was a decrease in interruptions during patient handover ($P<0.001$), fewer handoff process errors ($P<0.001$), and fewer information-sharing errors ($P<0.001$). **Clinical Significance:** The accurate exchange of patient information is imperative to patient safety and continuation of care, especially during transfer to the ICU where patients require a critical level of care. **Conclusions:** The researchers concluded that the development of a standardized handover process decreased handover errors, improved information sharing, and reduced potential patient harm.

Citation: Lane-Fall, M. B., Pascual, J. L., Peifer, H. G., Di Taranti, L. J., Collard, M. L., Jablonski, J., …Fleisher, L. A. (2020). A partially structured postoperative handoff protocol improves communication in 2 Mixed Surgical Intensive Care Units. *Annals of Surgery, 271*(3), 484-493. https://doi.org/10.1097/sla.0000000000003137					**Level and Quality:** III A
Purpose/ Hypothesis	**Research Design**	**Sample – Population, Size, Setting**	**Intervention/Procedures**	**Primary Outcome/Measures**	**Results/Conclusions**

The purpose of this study was to determine if the implementation of a standardized handoff process decreased information omissions during handoff report from the operating room (OR) to the Surgical Intensive Care Unit (SICU).	A pre-post intervention cohort study.	**Sampling Technique:** Nonprobability convenience sampling. **# Eligible:** All postoperative handoffs in the two SICUs were eligible, totaling 165 in-person observation of patient transfers. **Setting:** Two mixed SICUs in two separate academic hospitals in Philadelphia, Pennsylvania from July 2014- January 2016. **Excluded:** Handoffs that the study staff were not present for. Four handoffs were not recorded secondary to no communication between healthcare providers observed. **# Accepted:** 161 in-person observation of patient transfers. **# In pre-intervention:** 64 handoffs. **# In post- intervention:** 97 handoffs. **Power analysis:** 96 observations needed to have 95.7% power to detect a 33% decrease in information omission. This sample size was achieved. **Group Homogeneity:** Pre-post intervention group characteristics and homogeneity based on p values in Table 1. Group homogeneity achieved.	**Pre-intervention:** Handoff without formal structure. **Intervention:** Initiation of postoperative handoff protocol, including a physical handoff template. **Intervention fidelity:** Providers participated in the new handoff protocol, including the completion of the "handoff template" during face-to-face report. Observers were trained by study coordinators. Additional observers trained with experienced observers until their observations mimicked the trained observer. Observation data was entered into a database that was reviewed by research team. Missing data was not imputed. Handoff information was marked as discussed, not discussed, or unknown. One-month implementation period prior to the study to educate ICU staff on new handoff process and answer staff questions.	**Primary DV:** Number of information elements omitted during report. Thirteen main elements: past medical history, reason for ICU admission, allergies, airway, breathing/ventilation, hemodynamics, input, output, drains/lines, complications, post-surgical plan, family member information, surgical team contact information. **Instrument, reliability, measurement procedure:** The number of information omissions were collected from in-person observations of bedside handoffs by trained research staff. Observations were verified with audio recordings and reviewed after the handoff. Interrater reliability was calculated with Cohen's kappa. The measurement procedure was reliable.	**Statistical Results:** Nonparametric tests of means (Wilcoxon rank sum) used to compare information omission pre and post intervention. Handoff information omissions decreased 21.3% after handoff standardization (P=0.023). **Clinical Significance:** Information omission during handoff report in the ICU can lead to patient harm from medication errors, disruptions in plan of care, and delayed recognition of patient deterioration. **Conclusions:** The researchers concluded that standardizing the handoff process between the OR and the SICU significantly improved information exchange with a decrease in information omissions during patient handoff.

Citation: Mukhopadhyay, D., Wiggins-Dohlvik, K. C., MrDutt, M. M., Hamaker, J. S., Machen, G. L., Davis, M.L., … Shake, J. G. (2018). Implementation of a standardized handoff protocol for post-operative admissions to the Surgical Intensive Care Unit. *The American Journal of Surgery*, *215*(1), 28–36. https://doi.org/10.1016/j.amjsurg.2017.08.005					**Level and Quality:** III B
Purpose/ Hypothesis	**Research Design**	**Sample – Population, Size, Setting**	**Intervention/ Procedures**	**Primary Outcome/Measures**	**Results/Conclusions**
The purpose of this study was to determine if implementing a	A prospective pre-post intervention	**Sampling Technique:** Nonprobability convenience sampling. **# Eligible:** All post-operative handoffs in the SICU were eligible for observation, totaling 62 handoffs.	**Pre-intervention:** Handoff completed prior to implementation of the handoff protocol.	**Primary DV:** Communication of seven "significant" elements during the handoff process: (1) Presence of all team-members at initiation of handoff (2)	**Statistical Results:** Fisher exact test was used for categorical variables, unpaired two-tailed *t*-test was used for continuous variables with a

standardized patient transfer protocol between the operating room (OR) and Surgical Intensive Care Unit (SICU) resulted in improved communication during hand-off report.	observational study.	Population included patients who went to the OR under the thoracic, neurosurgery, trauma, acute care, vascular, orthopedics, plastics, urology, or oncology services. **Setting:** A 22 bed surgical ICU in a semi-rural non-profit tertiary academic center. Observations occurred from September 2013-May 2014. **Excluded:** No exclusion criteria provided. **# Accepted:** 62 in-person observation of patient transfers. **# In pre-intervention:** 31 handoffs. **# In post- intervention:** 31 handoffs. **Power analysis:** This study did not provide power analysis to detect optimal sample size. **Group Homogeneity:** The same nursing, surgical, and anesthesia staff was utilized in the pre and post intervention. A similar adult surgical patient population was used in the pre and post intervention. No table provided displaying group characteristics.	**Intervention:** Initiation of postoperative handoff protocol including a physical postoperative handoff checklist at the bedside. **Intervention fidelity:** Observers covered all shifts during the research period. Implementation of the protocol lasted six months. During this time healthcare staff attended mandatory education sessions about the new protocol. Researchers used a script during educational meetings to ensure the same training was delivered at each session. During handoff, the anesthesia provider would complete the "Postoperative Handoff Checklist for Anesthesiology." The surgeon completed the "Postoperative Handoff Checklist for Surgery." Both documents were given to the nurse at the conclusion of report.	Identification of patient and caregivers (3) Detailed surgical report (4) Detailed anesthesia report (5) Time to ventilator (6) Time to monitor set-up (7) Total handoff duration. **Instrument, reliability, measurement procedure:** Data from pre and post intervention handoffs were collected by trained observers. Elements 1 and 2 were entered as yes or no. Surgical data was based on procedure information and findings. Anesthesia data was based on pre-operative medication, lab work, airway issues, and hemodynamics. Elements 5-7 were timed by the research observer. The consistency in observation protocol created a reliable method.	statistical significance set at $p<0.05$. Improvement in the presence of physician providers during report was found ($p=0.0004$). The procedure performed was communicated more often in the post intervention ($p=0.0048$), as well as complications ($p<0.0001$), airway difficulties ($p<0.0001$), and vasopressor requirements ($p=0.0134$). Handoff duration did not significantly increase ($p=0.22$). **Clinical Significance:** Poor communication between healthcare providers can lead to sentinel patient events. **Conclusions:** Implementing a standardized patient transfer protocol reduced the number of information omissions and increased provider attendance and involvement during report between the OR and the SICU.

Citation: Salzwedel, C., Mai, V., Punke, M. A., Kluge, S., & Reuter, D. A. (2016). The effect of a checklist on the quality of patient handover from the operating room to the Intensive Care Unit: A randomized controlled trial. *Journal of Critical Care*, *32*, 170–174. https://doi.org/10.1016/j.jcrc.2015.12.016					**Level and Quality:** I A
Purpose/ Hypothesis	**Research Design**	**Sample – Population, Size, Setting**	**Intervention/Procedures**	**Primary Outcome/Measures**	**Results/Conclusions**
The purpose of this study was to investigate if the use of a handoff checklist for post-anesthesia to Intensive Care Unit (ICU) transfer led to	A prospective randomized control trial.	**Sampling Technique:** Randomized blinded sampling. **# Eligible:** All postoperative handoffs in the ICU were eligible, N= 136 handoffs. **Setting:** One high-volume academic medical center in Northern Europe from March 2013-July 2013.	**Control:** Anesthesia provider to ICU nurse/physician transfer without the use of a handoff checklist. **Intervention:** Anesthesia provider to ICU nurse/physician transfer with the use of a handoff checklist. **Intervention fidelity:** Attending anesthesiologist picked "red" or "important to be handed over" items	**Primary DV:** Number of "red" items, or items declared as "important to be handed over" included in the handoff report. **Instrument, reliability, measurement procedure:** Patient-specific "red" items were chosen by the	**Statistical Results:** A median of 87.1% of "red" items were handed over in the intervention group, while a medium of 75.0% of red items were handed over in the control group. Patient's age ($P=<.001$), fluid status ($P=0.006$), and mental status preoperatively

an increase in quantity of information items shared during report.		**Excluded:** Handoffs involving patients less than 18 years old, patients that were already known in the ICU, refusal of anesthesia provider to participate. Two excluded because of overlapping handovers. Eleven excluded for technical difficulties. **# Accepted:** 121 patient handovers. **# In control:** 61 handoffs. **# In intervention:** 60 handoffs. **Power analysis:** With a power of 80% and P <0.5, 116 patients had to participate (58 per group). Sample size was achieved. **Group Homogeneity:** Inclusion and exclusion criteria displayed in Table 1 represent group homogeneity.	specific to the patient. This attending did not participate in handoff but supervised the operating room. Patient randomly assigned control or intervention group via closed envelope. Once transferred to ICU, either physical report sheet (intervention) was handed to anesthesia provider giving report or not (control). Handover observed by researcher, and voice recorded to confirm findings later. Researcher did not interrupt during report. If same anesthesia provider participated multiple times, they would stay in the same original group to avoid knowing the handoff tool contents while in a control group. All data uploaded into research database.	attending anesthesiologist. Two researchers witnessed report and recorded number of red items transferred. All recordings of handoffs reviewed independently by each of the two researchers. Researchers were not informed of group designation while observing report. Designated “red” items compared with actual items transferred during report. Researchers were blinded to group allocation. Confirming findings with voice recording created a reliable method.	(P=0.011) were statistically handed over more often in the intervention group. **Clinical Significance:** Patient transfers can result in the omission of valuable information that can lead to dangerous medical errors. **Conclusions:** The researchers concluded that the use of a standard checklist for handover from the OR to the ICU increased both the quantity and quality of medical information transferred.

Citation: Shah, A. C., Oh, D. C., Xue, A. H., Lang, J. D., & Nair, B. G. (2016). An electronic handoff tool to facilitate transfer of care from anesthesia to nursing in Intensive Care Units. *Health Informatics Journal*, *25*(1), 3–16. https://doi.org/10.1177/1460458216681180	**Level and Quality:** III B

Purpose/ Hypothesis	Research Design	Sample – Population, Size, Setting	Intervention/Procedures	Primary Outcome/Measures	Results/Conclusions
The purpose of this study was to determine if the development and use of an electronic handoff tool (T2) between the operating room (OR) and Intensive Care Unit (ICU) would improve	A prospective pre-post intervention observational study.	**Sampling Technique:** Nonprobability convenience sampling. **# Eligible:** Patient transfers from the OR to the Cardiothoracic Intensive Care Unit (CTICU) and the Surgical Intensive Care Unit (SICU) when an independent observer was present. A total of 24 patient handovers were eligible. **Setting:** An academic medical center in Washington State from October 2012- December 2014.	**Pre-intervention:** Anesthesia provider to ICU team patient transfer without the use of the T2 electronic handoff tool. **Intervention:** Anesthesia provider to ICU team patient transfer with the use of the T2 electronic handoff tool. **Intervention fidelity:** The T2 transfer tool was developed using the Smart Anesthesia Manager (SAM) system. Initiating the T2 tool sent a text page to the resident informing them a patient is coming to the ICU. It also automatically sent a physical transfer sheet with patient information to print three copies	**Primary DV:** Number of “critical elements” communicated during handoff. **Instrument, reliability, measurement procedure:** The dependent variable was measured by 22 elements that were chosen as “critical” to safe patient handoff. These were organized into four categories: Key	**Statistical Results:** A 2-sample *t*-test/Mann-Whitney U test was used for continuous variables and Fisher’s exact test was used for categorical variables. A p-value of <0.05 reflected statistical significance. There was an increase in communication about anesthetic used (p=0.012), medications given (p=0.033), blood products given (0.004), and significant lab work (p=0.026) in the post-intervention group.

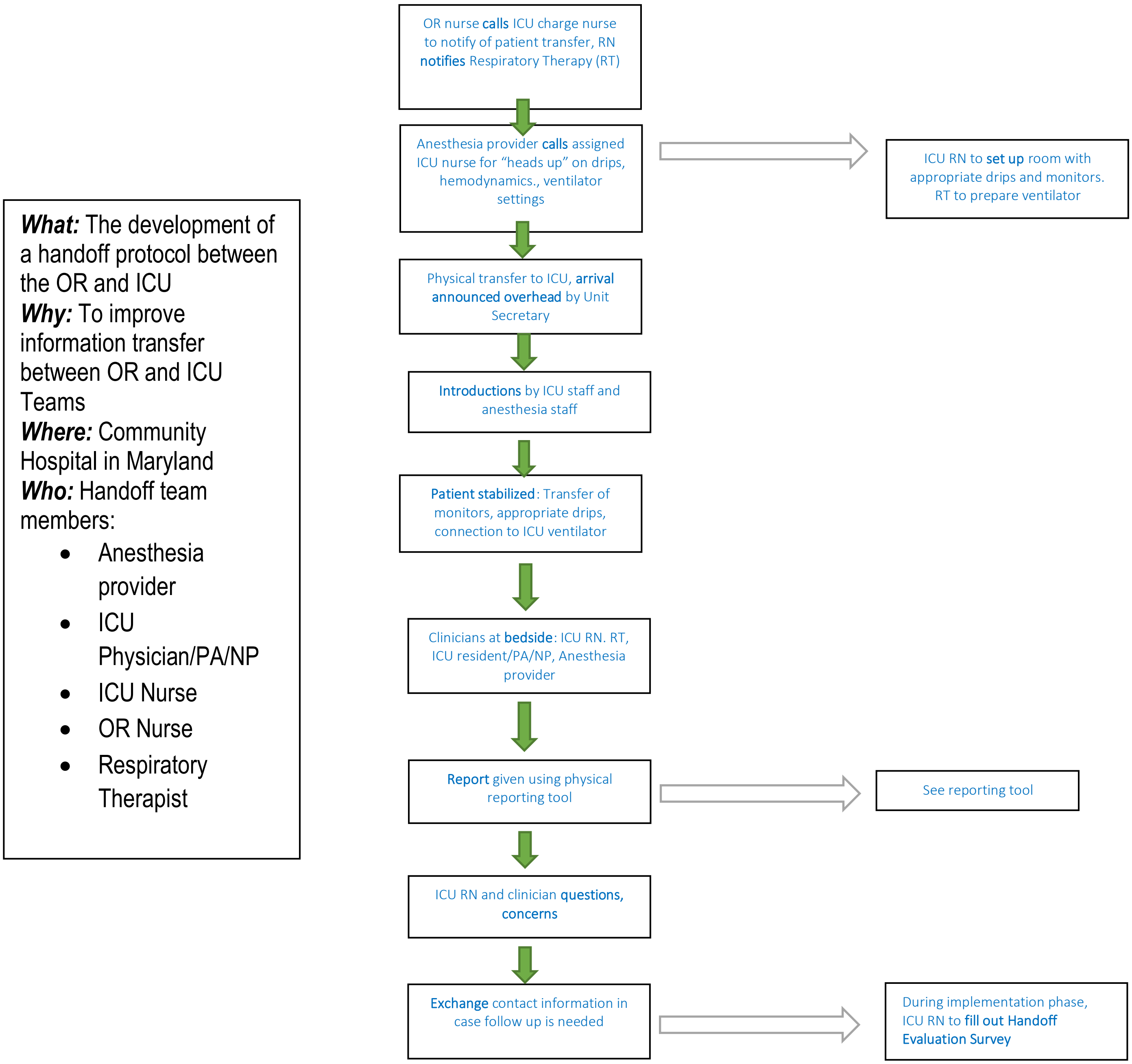
information exchange.		**Excluded:** Transfers that occurred when an independent observer was not present. **# Accepted:** 24 patient handovers. **# In control:** 12 handoffs. **# In intervention:** 12 handoffs. **Power analysis:** No power analysis provided by researchers. **Group Homogeneity:** Table 1 displayed patient demographics, characteristics of healthcare providers, and length of handoffs. Homogeneity among subjects represented.	from the ICU printer. These transfer sheets (along with a checklist) were used during bedside report by the ICU nurse, physician, and anesthesia team. A four-week education period was completed with the anesthesia staff and ICU team on the T2 tool. Education included presentations at staff meetings, grand rounds, and in-services. Once "live," the use of the T2 tool was observed by two medical students that were recruited independently from the researchers. These observers used a structured audit form to evaluate metrics discussed or missed during patient handoff.	elements, anesthesia course, patient status, and conclusions/ summary. The element was either discussed (marked yes), or not (marked no) during handoff. The same audit form with these 22 elements was used pre and post-intervention. No information on training provided to the observers. No inter-rater reliability data provided.	**Clinical Significance:** Using memory alone to recall important patient information can lead to an incomplete exchange of data. This can lead to sentinel events and serious medical errors. **Conclusions:** The use of a transfer tool avoided the need for patient information to be recalled from memory. The researchers concluded that the T2 electronic handoff tool encouraged team communication and decreased the risk of information omission during OR to ICU handoff.

Citation: Yang, J.-G. & Zhang, J. (2016). Improving the postoperative handover process in the Intensive Care Unit of a tertiary teaching hospital. *Journal of Clinical Nursing, 25*(7-8), 1062–1072. https://doi.org/10.1111/jocn.13115					**Level and Quality:** III A
Purpose/ Hypothesis	**Research Design**	**Sample – Population, Size, Setting**	**Intervention/ Procedures**	**Primary Outcome/Measures**	**Results/Conclusions**
The purpose of this study was to implement a post-operative handover protocol for patients transferred to the neurosurgical Intensive Care Unit (ICU) from the operating room (OR). The researchers hypothesized that this protocol would improve the postoperative	A prospective pre and post intervention observational study.	**Sampling Technique:** Convenience sampling was used for the healthcare provider population; purposive sampling was used for the patient population. **# Eligible:** Two categories of participants. 1) All nurses (*n= 77*), residents (*n= 20*), intensivists (*n= 10*), respiratory therapists (n= 2), surgeons (*n= 34*) and anesthesia providers (*n=13*) participated in this study. 2) Eligible patients were post neurosurgery, 18 years or older, still intubated/on the ventilator, and available during research hours. A total of 168 postoperative patient transfers were observed. **Setting:** A 40-bed ICU in a large tertiary teaching hospital in Central China. **Excluded:** Handovers that occurred after research hours (8 am-5pm). Patients that did not meet the eligible criteria. **# Accepted:** 168 total observations of OR to ICU patient transfers.	**Pre-intervention:** Handover completed prior to protocol implementation. Surgical team usually absent for bedside report. No handover tool used. **Intervention:** Handover completed after implementation of new protocol. **Intervention fidelity:** The new handover protocol included: (1) handover checklist (2) handover pathway (3) team performance (4) ventilator weaning plan. Education on the protocol given to healthcare providers (nurses, residents, respiratory	**Primary DV:** Number of key pieces of information exchanged during handover. Thirteen key information items organized as anesthesia information, surgery information, and care plan items. **Instrument, reliability, measurement procedure:** Testing of the internal consistency/reliability showed a Crombach's alpha of 0.937, confirming the	**Statistical Results:** Categorical variables analyzed using chi-square test, continuous variables assessed using two independent samples *t*-test. Statistical significance set at α= 0.05. Surgeon presence during bedside handover increased significantly (p= 0.007). Exchange of anesthesia related items increased from 75% reported to 93% reported. Surgery information exchanged increased from 42% to 83%. Care plan information exchanged at handover increased from 49% to 94%. **Clinical Significance:** Poor handover after surgery can result in serious consequences for the patient, including incorrect

handover process and patient outcomes. The intervention was assessed immediately after initiation, as well as three months later.		**# In pre-intervention:** 56 patient handovers. **# In post- intervention:** 56 patient handovers. **# In follow-up 3 months later:** 56 patient handovers. **Power analysis:** 102 patient handovers needed to meet 80% beta, 0.05 alpha, and medium effect size. Power analysis met. **Group Homogeneity:** Pre and post intervention patient groups homogeneous based on p values displayed in Table 2. No statistically significant differences among groups.	therapists, surgeons, and anesthesia providers) during scheduled meetings. Information on protocol displayed visually in office space. During implementation, team training and debriefings continued to ensure correct use of protocol.	reliability of this tool. No data provided on the training observers received or if the same observers were used pre and post intervention.	treatment, delays in diagnosis, medication errors, and increased hospital length of stay. **Conclusions:** The implementation of the handover protocol improved communication between the operating room and ICU.

Appendix B

Operating Room to ICU Transfer Protocol



Adapted from: Lane-Fall, M. B., Pascual, J. L., Peifer, H. G., Di Taranti, L. J., Collard, M. L., Jablonski, J.,Gutssche, J. T., Haplern, S. D., Barg, F. K., & Fleisher, L. A. (2020). A partiallystructured postoperative handoff protocol improves communication in 2 Mixed Surgical Intensive Care Units. *Annals of Surgery*, *271*(3), 484-493. https://doi.org/10.1097/sla.0000000000003137

Appendix C

Transfer Tool

Adapted from: SBAR tool by the Institute for Healthcare Improvement (2022), and The University of Washington Medical Center's Multidisciplinary OR to SICU/MICU Handoff Checklist (Shah et al., 2016)

Appendix D

Handoff Evaluation Survey

Was this item communicated during report?	YES	NO
Patient name		
Age		
Allergies		
Reason for surgery		
Medical conditions		
Home medications		
Surgical intervention		
Intraoperative course		
Estimated Blood Loss		
Tubes/Drains/Dressings		
Airway details		
Medications given		
Blood products given		
Fluids given		
Antibiotics		
Paralytic/Reversal		
Urine Output		
Recent lab work		
IV access		
Neuro status		
Hemodynamics		
Drips		
Oxygenation/Ventilation		
Plan of Care		
Questions/Concerns		