

# Standardization Improves Postoperative Patient Handoff Experience for Junior Clinicians

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**T**ransfer of information is a crucial part of the care of all patients.<sup>1</sup> With critically ill patients, the clinical complexity makes efficient and safe handoff of care not only more important but also more challenging.<sup>2,3</sup> When the handoff further involves moving the patient from one location (eg, the operating room [OR]) to another (eg, the intensive care unit [ICU]), the process becomes highly complicated and error-prone, given the simultaneous change in environment and personnel.<sup>2,4</sup> The postoperative transfer of care of patients after cardiac surgery from the OR to the ICU exemplifies these challenges. Here, different groups of clinicians, potential delay of critical monitoring during transport and when giving report, and transfer of mechanical and pharmacological life support all contribute to the creation of a highly complex scenario with great potential for breakdown in communication and consequent loss of vital information.

Several official institutions and credentialing bodies have emphasized the need to develop standardized processes for handoff of care, especially for clinical trainees due to the hierarchy inherent in medical training.<sup>5</sup> Nonetheless, the vast majority of trainees do not receive formal training in handoff of patient care and consequently feel unprepared to perform these important tasks; they lack competency and psychological safety.<sup>5-7</sup> The concept of psychological safety defines an environment in which individuals feel safe to engage, actively contribute information, and ask questions.<sup>8,9</sup> Health care team effectiveness greatly depends on psychological safety, especially in environments with expertise diversity, status differences, and temporary memberships.<sup>8</sup> Furthermore, junior clinicians consider both task-related skills and system factors, such as structured processes, crucial for effective handoffs.<sup>5</sup> Communication breakdown during handoff of care is usually due to incomplete pret turnover preparations or lack of a standardized handoff process.<sup>3,10</sup>

Common communication problems that have potentially deleterious consequences include failure to report intraoperative problems and omission of crucial patient information, either of which could potentially lead to incorrect decision making during subsequent care. Barriers to effective communication often involve

## ABSTRACT

**OBJECTIVES:** Effective communication among health care providers is critically important for patient safety. Handoff of patient care from the operating room (OR) to the intensive care unit (ICU) is particularly prone to errors. The process is more complicated in an academic environment in which junior clinicians are being trained. Standardization of, and training in, transitions of care can be a crucial means to improve patient safety.

**STUDY DESIGN:** Pre- and postintervention surveys of health care providers.

**METHODS:** Based on a workflow analysis and qualitative needs assessments, we developed a 3-step protocol to standardize the handoff of care from the OR to the ICU for adult patients after cardiac surgery and to provide an effective learning environment. The process starts during surgery, continues when the patient leaves the OR, and concludes with the actual face-to-face transfer of care between providers, at the bedside, in the ICU. We conducted pre- and postimplementation surveys among physician trainees and nursing staff regarding their perception of the handoff process.

**RESULTS:** We surveyed 42 clinicians before and 33 after implementation of the handoff process. Prior to implementation, most clinicians expressed a need to improve the current process; this perceived need was significantly greater in health care professionals with 4 or fewer years of experience. Post implementation, clinicians saw a significant improvement in information provided, efficiency, relevance to patient care, and psychological safety, a concept in which participants feel accepted and respected in a group setting without fear of negative consequences or judgement.

**CONCLUSIONS:** Our workflow-oriented, standardized process for handoff of care from the OR to the ICU can improve perceived communication and psychological safety, especially for junior clinicians.

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the clinician's discomfort with participating (ie, lack of psychological safety) and insufficient or absent training in handoff of care. The latter aspect is especially crucial in academic institutions in which the need to train junior clinicians adds another layer of complexity to the overall problem.

Using a workflow perspective approach together with qualitative needs assessments, we have, therefore, developed a standardized handoff process that allows for effective transmission of crucial patient information and for a psychologically safe learning environment.

## MATERIALS AND METHODS

The Institutional Review Board of the Pennsylvania State University assigned a determination of “not human research” for this study. Therefore, no informed consent was required for this study.

### Interventions: Development and Implementation of “Time-out for Sign-out”

In 2014, at a single tertiary academic medical center, a group of cardiac anesthesiologists, intensivists, and senior ICU nursing staff came together to address shortcomings that had been previously identified with the existing handoff of care practice for adult patients after cardiac surgery.

In addition to analyzing the interactions during the handoff process at the bedside, we used a workflow perspective approach to carefully consider the essential steps leading to and following the handoff at the bedside upon arrival in the ICU. All parties involved identified their priorities and potential sources of failure. These items served as domains of interest for the perception survey that we developed later. We created a 3-step protocol with clearly defined action items and responsibilities. Each step in this protocol represented a critical phase in the entire workflow process and required specific actions.

In phase 1 (during surgery), the intention is to inform the ICU and the receiving registered nurse (RN) about the progress of surgery, allowing the ICU staff to plan for the patient's arrival and the required equipment (eg, the number of intravenous pumps and mediastinal drainage collection systems). Two phone calls from the OR RN to the ICU RN are made during this phase—the first at the time after the patient has been weaned from cardiopulmonary bypass and the second at the time of wound closure. The phone calls are limited to basic patient demographics, type of procedure, and number of active infusions and chest tubes, allowing classification of patients into 2 tiers for acuity of care—“stable” and “unstable”—to plan staffing and resource needs in the ICU.

In phase 2 (at conclusion of surgery and just prior to leaving the operating room), the aim is to prepare the ICU and receiving nurse of the patient's pending arrival. In a final phone call, the OR staff will notify the receiving nurse in the ICU that the patient is

## TAKEAWAY POINTS

The standardization of handoff of patients after cardiac surgery from the operating room (OR) to the intensive care unit (ICU) was significantly improved with a 3-step process named “time-out for sign-out.” During this process, updates are given to the ICU from the OR so the ICU providers can plan to be at bedside for transfer of care. This is further enhanced by standardization of signing out the patient from anesthesia and surgery teams to the ICU team. This was eventually adopted institution-wide for all ICUs.

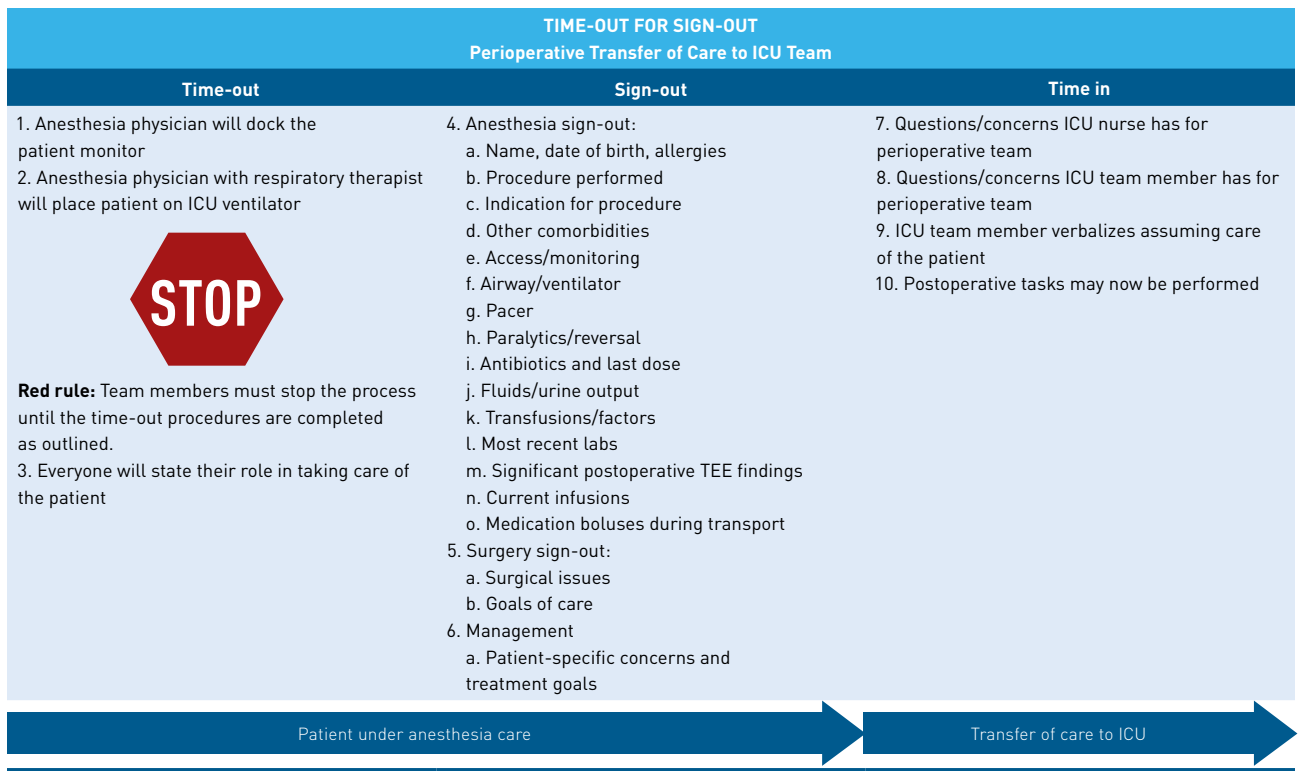
leaving the OR. This will then trigger the ICU team, including the receiving RN, respiratory therapist, and member of the intensive care team, to gather in the patient's room for the patient's imminent arrival. The anesthesia resident will also fill out the “time-out for sign-out” tool form (**eAppendix A** [eAppendices available at [ajmc.com](http://ajmc.com)]) containing all pieces of information necessary for the actual handoff.

In phase 3 (ICU arrival and sign-out), the process is completed. We have divided this phase into stages to promote and maintain a well-coordinated cascade of events: (1) The first stage begins when the patient arrives in the ICU. Ventilation is switched from the transport ventilator to ICU ventilator. The patient's vital signs monitor is docked into the docking station. Except for urgent interventions to preserve patient stability, no other task is performed for the remainder of the sign-out process. (2) The second stage represents the beginning of the actual sign-out process with the formal announcement of “time-out for sign-out” by the anesthesia resident. Conversations are limited to the ICU room and to 1 person at a time. All team members introduce themselves by stating their role. (3) The anesthesia resident, using the “time-out for sign-out” tool (**Figure 1**), presents all patient information, procedure and anesthesia details, and ongoing pharmacological and mechanical support. (4) ICU and anesthesia teams will review pump settings, lines and dressings, ventilator settings, and drains. A member of the surgery team will add further procedural details and postprocedure management concerns. (5) The sign-out process will conclude with the opportunity for any person in the room to ask questions. One unique aspect of this sign-out process is that the patient is under the care of the anesthesia attending/fellow (bottom of **Figure 1**) and any medical interventions will be performed by them while the anesthesia resident performs the sign-out. This is to allow the accepting ICU team to have complete focus on the sign-out process and on the information being given. Only once the ICU team's questions have been answered and the sign-out process ends does the transfer of care occur and the ICU team assume responsibility for the patient.

Prior to implementation, nursing and physician champions provided education to all team members through group discussions and paper handouts. Nursing and physician champions were also present for each “time-out for sign-out” during the first month after implementation to ensure completion of the process and provide feedback where necessary.

## METHODS

**FIGURE 1.** Time-out for Sign-out Process Flow Chart



ICU, intensive care unit; TEE, transesophageal echocardiography.

### Study Setting

The setting was a 30-bed ICU in a tertiary care, academic medical center with more than 600 open-heart surgeries per year, including implantation of ventricular assist devices and transplantations. All adult patients undergoing cardiac surgery were medically managed by dedicated cardiac anesthesiologists, cardiac intensivists, and cardiac surgeons. The nurse to patient ratio for all postoperative cardiac surgery patients was 1:1. All handoffs occurred in the patient's room in the ICU.

### Study Design

This was a prospective, interventional study to assess perception of handoff-of-care practice among bedside clinicians before and after implementation of a new, standardized process. On 2 occasions, all anesthesia residents and fellows with completed or ongoing cardiac anesthesia rotations ( $n = 41$ ; printed survey) and all members of the ICU nursing staff ( $n = 90$ ; survey via email) received perception surveys (eAppendix B). Surveys were sent 2 months prior to and 2 months after implementation of "time-out for sign-out." We used a self-selection sampling strategy.

In addition to respective clinical experience (years in practice) and role (RN or resident physician), we assessed both the old and the new handoff processes regarding the following: (1) the perceived need to improve the overall handoff-of-care process, (2) delivery of crucial patient information during the handoff (efficacy), (3) the level

of comfort to participate in the process (including psychological safety), (4) the relevance of the handoff process as part of patient care, and (5) the overall efficiency of the process.

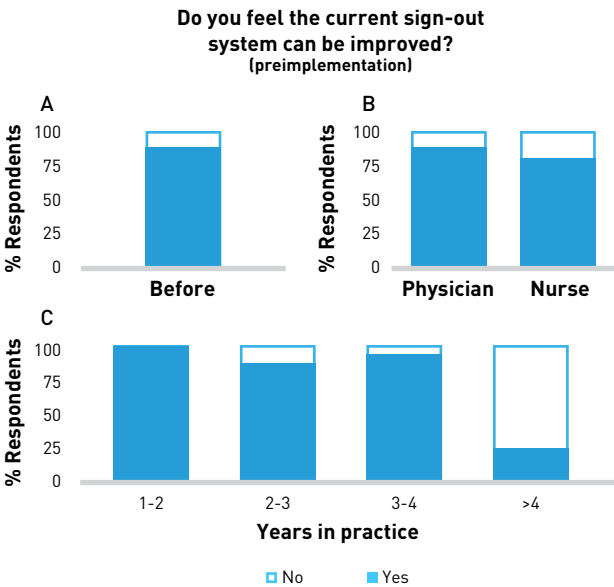
### Statistical Analysis

Data entry and analysis were performed by the authors of this paper. Questions and their respective responses were analyzed as logical (yes/no) and ordinal variables (Likert scale), respectively, using Fisher exact and Wilcoxon tests.  $P < .05$  was considered statistically significant. Results for Likert responses are presented numerically as median (interquartile range [IQR]) and graphically as diverging stacked bar chart and heat map.<sup>11</sup>

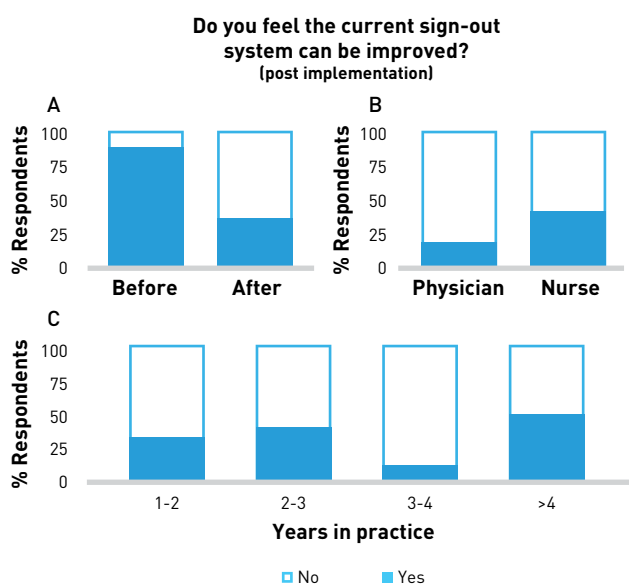
## RESULTS

The preimplementation survey was completed by 42 clinicians, corresponding to 23% of eligible nursing staff and 67% of eligible physician trainees. The vast majority of respondents (86%) expressed a need to improve the old handoff-of-care practice (Figure 2 [A]). There was no difference between physician trainees and nursing staff regarding the need to improve patient handoff (Figure 2 [B]). However, years of clinical experience emerged as a relevant factor in the perceived necessity to improve handoff practice (Figure 2 [C]). Whereas nearly all clinicians with 4 or fewer years of experience saw a need to improve handoff of care, the majority of clinicians

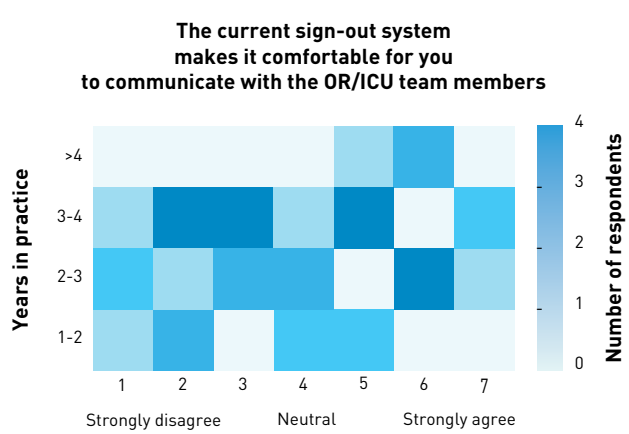
**FIGURE 2.** Desire for Sign-out Improvement: Preimplementation Survey



**FIGURE 4.** Desire for Sign-out Improvement: Postimplementation Survey



**FIGURE 3.** Level of Psychological Safety With Current Sign-out Process



ICU, intensive care unit; OR, operating room.

with more than 4 years of experience did not express a need for change. Moreover, there was a significant association between years of experience and agreement with the statement “The current sign-out makes it comfortable for you to communicate with the OR/ICU team members” ( $P = .031$ ) (Figure 3), reflecting the degree of psychological safety. The remaining domains of the survey did not show any significant associations with years of clinical experience. It can be perceived that those with 1 to 2 years of clinical experience did not feel comfortable with the nonstandardized format of sign-out because no one strongly agreed (Likert score 6 or 7) that

the nonstandardized sign-out made them feel comfortable. This is in stark contrast to clinicians with more than 4 years of experience, among whom all the responses were agreed/strongly agreed (Likert scores 5-7) that the old, nonstandardized sign-out was amenable to good communication.

Thirty-three clinicians, corresponding to 26% of eligible nursing staff and 24% of eligible physician trainees, completed a post-implementation survey. We have no way to know if these were the same or different individuals based on the anonymous nature of the survey. A significantly lower portion of all survey respondents (33%) felt that the new handoff-of-care process still required further improvement (Figure 4 [A]). The findings were similar for both nursing staff and physician trainees (Figure 4 [B]). Years of clinical experience did not significantly affect the perceived need for improvement anymore (Figure 4 [C]).

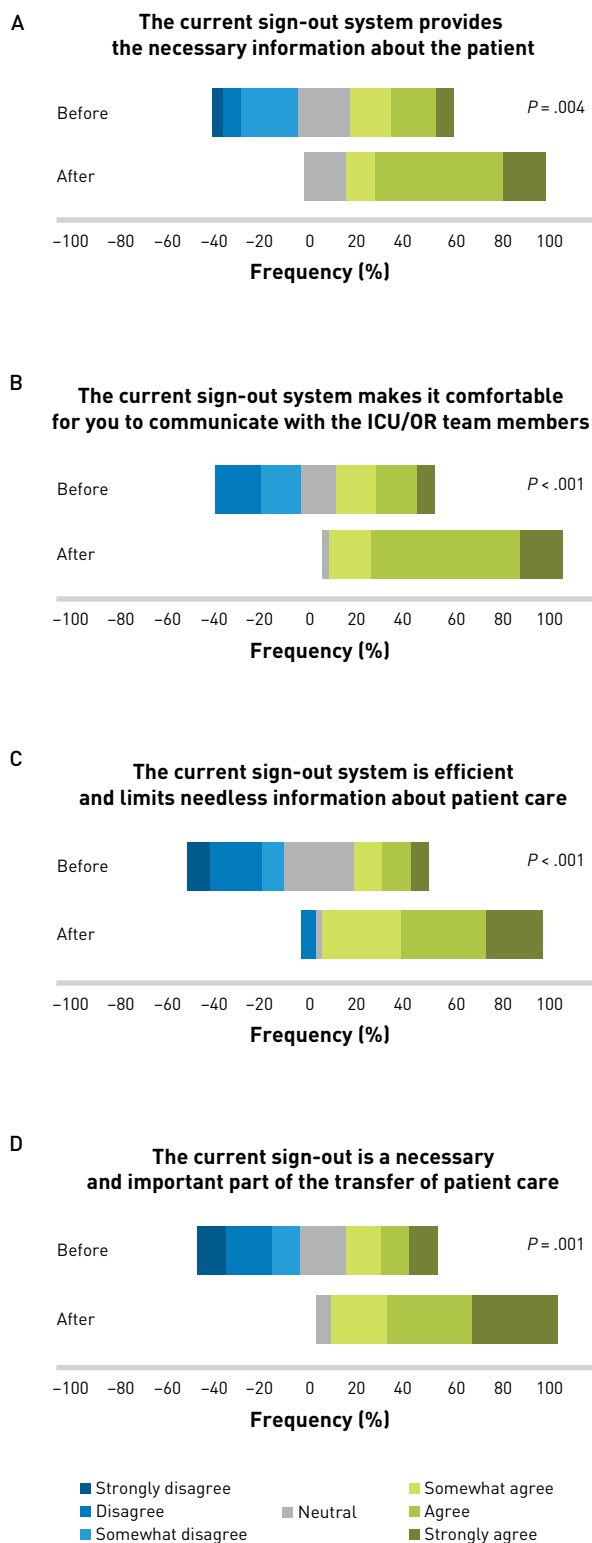
In addition to the perceived overall improvement after “time-out for sign-out” implementation, we also found a significant improvement in all 4 survey domains. Respondents showed significantly higher median (IQR) Likert scale ranks for perception regarding necessary information delivered (4 [3-6] vs 6 [5-6];  $P < .0001$ ) (Figure 5 [A]), comfort to participate (4 [2-5] vs 6 [6-6];  $P < .0001$ ) (Figure 5 [B]), process efficiency and needless information avoidance (4 [2-5] vs 6 [5-6];  $P < .0001$ ) (Figure 5 [C]), and necessity and relevance of the care handoff process (4 [2-5] vs 6 [5-7];  $P < .0001$ ) (Figure 5 [D]).

**DISCUSSION**

Handoff of patient care accountability and responsibility is a frequent event within a hospital setting. However, loss of vital information during handoff of care remains a leading cause of

## METHODS

**FIGURE 5.** Pre- and Post Comparisons of 4 Sign-out Domains



ICU, intensive care unit; OR, operating room.

communication breakdowns in today's health care.<sup>12,13</sup> Approximately 40% of communication errors occur during handoff of care and intrahospital transfers.<sup>14</sup>

Protocols for the handoff of care from the OR to the ICU after cardiac surgery have been described previously, improving communication and patient safety.<sup>15-21</sup> We show that the implementation of a structured, workflow-based handoff-of-care process from the OR to the ICU for patients after cardiac surgery improves the overall perception of the transfer of care for all clinicians involved. Our results further demonstrate that junior clinicians (ie, those with  $\leq 4$  years of clinical experience) are especially negatively affected by an ad hoc, unstructured handoff-of-care process. Moreover, junior clinicians feel psychologically unsafe to transfer care under such circumstances and clearly seek improvement in handoff-of-care processes.

Implementation of handoff protocols, as a specialized form of checklist for the transfer of care, has led to a decrease in technical errors and verbal omissions in various perioperative settings.<sup>15-21</sup> We have not observed any tendency on either the surgeon's or the anesthesiologist's part to limit details of intraoperative complications. In fact, our experience has been that the safe environment created by the structured sign-out has allowed all parties to openly discuss what occurred in the OR as it relates to postoperative care of these complex patients.

Limiting communication breakdowns requires a detailed examination of the entire handoff process. Here, one must not only focus on standardization using a handoff communication tool but also must take into account the overall context of effective communication as well as the steps leading to the actual handoff (ie, preturnover preparations).<sup>10</sup> Qualitative handoff communication studies using a workflow perspective have allowed us to acquire an extensive temporal and sequential analysis of the features and constraints surrounding our entire handoff process (preturnover, handoff, and postturnover phases).<sup>10</sup>

As part of the handoff process, we have developed body system-based communication templates that prompt clinicians to collect relevant, pertinent information (preturnover preparations)<sup>10</sup> and allow them to establish common ground with other team members. The body system format focuses on categorization of patient-care information by the different organ systems, including cardiovascular, neurologic, and pulmonary.<sup>22</sup> Because the organ system format is already taught in both medical and nursing school, it is a logical progression of the respective training. Body system-based handoff tools can result in improved interactions and communications.<sup>23</sup>

Our results further show that junior clinicians (eg, nurses, physicians, those in training) in particular seek a structured, well-defined handoff-of-care process in which they feel comfortable participating. A positive perception of the clinical environment is instrumental to reducing errors,<sup>24</sup> and after the implementation of "time-out for sign-out," junior clinicians felt they could appropriately participate in the handoff of care. Compared with the other perceived domains of our survey—efficacy, efficiency, and relevance—only

psychological safety showed a statistically significant association with the extent of clinical experience.

These findings emphasize important issues with respect to implementing and teaching handoff of care. First, a positive perception of the clinical environment is crucial to promote team effectiveness in general. In a busy, high-acuity clinical environment, health care personnel, in particular nursing staff, often hesitate to voice their concerns or recommendations; these are fundamental to efficient communication during interprofessional handoff of care.<sup>25,26</sup> Diminished psychological safety is also counterproductive to the quest to overcome hierarchical communications patterns, which frequently occur between junior and senior clinicians and are at least partially responsible for medical errors.<sup>27,28</sup>

Second, successful implementation and continuation of a new process, such as “time-out for sign-out,” requires ongoing learning at the team level. Team learning and, consequently, implementation of new processes are more successful in an environment that is perceived as psychologically safe.<sup>29,30</sup>

An environment without psychological safety also hampers individual learning. Junior clinicians depend on successful learning to acquire crucial clinical skills such as handoff of care. Junior clinicians need to learn to present and collect pivotal pieces of patient information without fear of reprimand. Junior clinicians consider handoff of care not simply a skills-based task but also a mastery of complex interactions between individuals.<sup>5</sup> Several governing and credentialing bodies have repeatedly stressed the importance of teaching handoff-of-care processes to junior clinicians.<sup>5</sup>

### Limitations

There are limitations to our preliminary investigation and to conclusions drawn from it. First, we present a single-center, single-unit study. We therefore have to consider that the success observed from the implementation of “time-out for sign-out” could be due to unique institutional/unit-specific features. Larger multicenter studies are needed to confirm our findings. Second, we do not have data with respect to if and how “time-out for sign-out” can be sustained over a longer period of time. We have attempted to minimize novelty biases by providing time (2 months) for adoption of and adaptation to the new handoff process. Finally, our response rates were on the lower end. Although internal survey response rates do tend to be higher than those for external surveys, our impression was that this was not an indicator of stakeholder commitment to the process. The staff commitment was evident at the bedside during patient care at all levels, from bedside RNs to advanced practice providers to physicians. The lower-than-ideal response rate may have been due to the acuity of care provided in the particular ICU where this project was conducted. Nurses are often dealing with critically ill patients with 1 or more mechanical circulatory support devices, which made filling out a survey less of a priority. We would have liked to resurvey those who still felt there was a need for improvement after implementation; however, due to the anonymous nature of the survey, longitudinal follow-up with respondents was not possible.

Due to clinical demands, we were unable to have a surgeon be a part of our team, but surgeons did collectively support our efforts.

## CONCLUSIONS

This process was so successful in our heart and vascular ICU that it was adopted by both the pediatric and neonatal ICUs and the surgical ICU with only minor revisions. Patient care findings such as echocardiographic findings or chest tube output were taken out because they were not relevant to that particular ICU. In conclusion, academic institutions in particular should implement structured handoff-of-care processes to allow junior clinicians to successfully learn this important skill while promoting patient safety. ■

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## REFERENCES

- Patterson ES, Wears RL. Patient handoffs: standardized and reliable measurement tools remain elusive. *Jt Comm J Qual Patient Saf*. 2010;36(2):52-61. doi:10.1016/s1553-7250(10)36011-9
- Moon TS, Gonzales MX, Woods AP, Fox PE. Improving the quality of the operating room to intensive care unit handover at an urban teaching hospital through a bundled intervention. *J Clin Anesth*. 2016;31:5-12. doi:10.1016/j.jclinane.2016.01.001
- Colvin MO, Eisen LA, Gong MN. Improving the patient handoff process in the intensive care unit: keys to reducing errors and improving outcomes. *Semin Respir Crit Care Med*. 2016;37(1):96-106. doi:10.1055/s-0035-1570351
- Lane-Fall MB, Beidas RS, Pascual JL, et al. Handoffs and transitions in critical care (HATRICC): protocol for a mixed methods study of operating room to intensive care unit handoffs. *BMC Surg*. 2014;14:96. doi:10.1186/1471-2482-14-96
- Cleland JA, Ross S, Miller SC, Patey R. “There is a chain of Chinese whispers...”: empirical data support the call to formally teach handover to prequalification doctors. *Qual Saf Health Care*. 2009;18(4):267-271. doi:10.1136/qshc.2008.029983
- Horwitz LJ, Moin T, Green ML. Development and implementation of an oral sign-out skills curriculum. *J Gen Intern Med*. 2007;22(10):1470-1474. doi:10.1007/s11606-007-0331-0
- Horwitz LJ, Krumholz HM, Green ML, Huot SJ. Transfers of patient care between house staff on internal medicine wards: a national survey. *Arch Intern Med*. 2006;166(11):1173-1177. doi:10.1001/archinte.166.11.1173
- Manthous C, Nembhard IM, Hollingshead AB. Building effective critical care teams. *Crit Care*. 2011;15(4):307. doi:10.1186/cc10255
- O’Leary DF. Exploring the importance of team psychological safety in the development of two interprofessional teams. *J Interprof Care*. 2016;30(1):29-34. doi:10.3109/13561820.2015.1072142
- Abraham J, Nguyen V, Almoosa KF, Patel B, Patel VL. Falling through the cracks: information breakdowns in critical care handoff communication. *AMIA Annu Symp Proc*. 2011;2011:28-37.
- Robbins NB, Heiberger RM. Plotting Likert and other rating scales. In: *JSM Proceedings Section on Survey Research Methods*. American Statistical Association; 2011:1058-1066.
- Collins SA, Mamykina L, Jordan D, et al. In search of common ground in handoff documentation in an intensive care unit. *J Biomed Inform*. 2012;45(2):307-315. doi:10.1016/j.jbi.2011.11.007
- Dayton E, Henriksen K. Communication failure: basic components, contributing factors, and the call for structure. *Jt Comm J Qual Patient Saf*. 2007;33(1):34-47. doi:10.1016/s1553-7250(07)33005-5
- Ong MS, Coiera E. A systematic review of failures in handoff communication during intrahospital transfers. *Jt Comm J Qual Patient Saf*. 2011;37(6):274-284. doi:10.1016/s1553-7250(11)37035-3
- Agarwal HS, Saville BR, Slayton JM, et al. Standardized postoperative handover process improves outcomes in the intensive care unit: a model for operational sustainability and improved team performance. *Crit Care Med*. 2012;40(7):2109-2115. doi:10.1097/CCM.0b013e3182514bab

## METHODS

16. Catchpole KR, de Leval MR, McEwan A, et al. Patient handover from surgery to intensive care: using Formula 1 pit-stop and aviation models to improve safety and quality. *Paediatr Anaesth*. 2007;17(5):470-478. doi:10.1111/j.1460-9592.2006.02239.x
17. Dixon JL, Stagg HW, Wehbe-Janek H, Jo C, Culp WC Jr, Shake JG. A standard handoff improves cardiac surgical patient transfer: operating room to intensive care unit. *J Healthc Qual*. 2015;37(1):22-32. doi:10.1097/01.JHQ.0000460123.91061.b3
18. Joy BF, Elliott E, Hardy C, Sullivan C, Backer CL, Kane JM. Standardized multidisciplinary protocol improves handover of cardiac surgery patients to the intensive care unit. *Pediatr Crit Care Med*. 2011;12(3):304-308. doi:10.1097/PCC.0b013e3181fe25a1
19. Petrovic MA, Aboumatar H, Baumgartner WA, et al. Pilot implementation of a perioperative protocol to guide operating room-to-intensive care unit patient handoffs. *J Cardiothorac Vasc Anesth*. 2012;26(1):11-16. doi:10.1053/j.jvca.2011.07.009
20. Petrovic MA, Martinez EA, Aboumatar H. Implementing a perioperative handoff tool to improve postprocedural patient transfers. *Jt Comm J Qual Patient Saf*. 2012;38(3):135-142. doi:10.1016/s1553-7250(12)38018-5
21. Segall N, Bonifacio AS, Schroeder RA, et al; Durham VA Patient Safety Center of Inquiry. Can we make postoperative patient handovers safer? a systematic review of the literature. *Anesth Analg*. 2012;115(1):102-115. doi:10.1213/ANE.0b013e318253af4b
22. Haynes AB, Weiser TG, Berry WR, et al; Safe Surgery Saves Lives Study Group. A surgical safety checklist to reduce morbidity and mortality in a global population. *N Engl J Med*. 2009;360(5):491-499. doi:10.1056/NEJMs0810119
23. Abraham J, Kannampallil TG, Almoosa KF, Patel B, Patel VL. Comparative evaluation of the content and structure of communication using two handoff tools: implications for patient safety. *J Crit Care*. 2014;29(2):311.e1-7. doi:10.1016/j.jcrc.2013.11.014
24. Chang Y, Mark B. Effects of learning climate and registered nurse staffing on medication errors. *J Nurs Adm*. 2011;41(7-8 suppl):S6-S13. doi:10.1097/NNA.0b013e318221c213
25. Deter J, Burris ER. Leadership behavior and employee voice: is the door really open? *Acad Manage J*. 2007;50(4):869-884. doi:10.5465/amj.2007.26279183
26. Siemsen E, Roth AV, Balasubramanian S, Anand G. The influence of psychological safety and confidence in knowledge on employee knowledge sharing. *Manuf Serv Oper Manag*. 2009;11(3):429-447. doi:10.1287/msom.1080.0233
27. Appelbaum NP, Dow A, Mazmanian PE, Jundt DK, Appelbaum EN. The effects of power, leadership and psychological safety on resident event reporting. *Med Educ*. 2016;50(3):343-350. doi:10.1111/medu.12947
28. Institute of Medicine. *Keeping Patients Safe: Transforming the Work Environment of Nurses*. The National Academies Press; 2004.
29. Nembhard IM, Tucker AL. Deliberate learning to improve performance in dynamic service settings: evidence from hospital intensive care units. *Organization Sci*. 2011;22(4):907-922. doi:10.1287/orsc.1100.0570
30. Tucker AL. An empirical study of system improvement by frontline employees in hospital units. *Manuf Serv Oper Manag*. 2007;9(4):492-505.

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# eAppendix A. "Time-out for Sign-out" Form

## Time Out for Sign Out : HVCCU SIGNOUT TOOL (not part of medical record)

### I. Intraoperative Report – Circulating OR RN to HVCCU RN- How-Telephone Verbal Report- When-Chest closure

Name: \_\_\_\_\_ Allergies: \_\_\_\_\_ Procedure: \_\_\_\_\_ Stable/ Unstable  
 Chest tubes \_\_\_\_\_ Pleurovac:  1  >1 unstable definition: >2 vasoactive infusions

### II. Anesthesia Sign-out –Transition in Patient Care- Team-based activity How/Where- In person face-to-face at patient's bedside. When- Upon patient's arrival in the HVCCU

Name: \_\_\_\_\_ Date of Birth: \_\_\_\_\_ Allergies: \_\_\_\_\_ Ht \_\_\_\_\_ cm Wt \_\_\_\_\_ kg  
 Procedure: \_\_\_\_\_ Indication for Procedure: \_\_\_\_\_  
 Relevant Comorbidities: \_\_\_\_\_

Access & Monitoring: PIVs \_\_\_\_\_ Aline \_\_\_\_\_ Central line \_\_\_\_\_ Swan \_\_\_\_\_

Airway & Ventilator: ETT size: \_\_\_\_\_ Ventilator settings: \_\_\_\_\_

Pacer Settings: \_\_\_\_\_ Underlying rhythm: \_\_\_\_\_

Sedatives: Fentanyl total: \_\_\_\_\_ mcg Midazolam total: \_\_\_\_\_ mg Other: \_\_\_\_\_

Paralytics: Last dose of \_\_\_\_\_ mg of \_\_\_\_\_ (drug) at \_\_\_\_\_ (time)  Reversed

Antibiotics: Vancomycin \_\_\_\_\_ mg at \_\_\_\_\_ (time) Last CO/CI: \_\_\_\_\_  
 Gentamicin \_\_\_\_\_ mg at \_\_\_\_\_ (time)  
 Cefazolin \_\_\_\_\_ mg at \_\_\_\_\_ (time) and \_\_\_\_\_ mg at \_\_\_\_\_ (time)

Fluids: Crystalloid: \_\_\_\_\_ mL Colloids: \_\_\_\_\_ mL Urine output for case: \_\_\_\_\_ mL  
 Foley bag emptied prior to leaving OR

Transfusion: \_\_\_\_\_ Units PRBCs \_\_\_\_\_ Units FFP \_\_\_\_\_ Units Cryoprecipitate \_\_\_\_\_ Doses Platelets  
 \_\_\_\_\_ Units Factor VII \_\_\_\_\_ Units Factor IX \_\_\_\_\_ Units Prothrombin Complex Concentrate  
 Tranexamic acid  Amicar

Most recent labs: pH pCO2 pO2 HCO3 BD Hb/HCT / Na K iCa Glu ACT  
 TEE Findings: \_\_\_\_\_

Current infusions: Epi \_\_\_\_\_ mcg/kg/min Nitroglycerin \_\_\_\_\_ mcg/min  
*\*identify any* Norepi \_\_\_\_\_ mcg/kg/min Nitroprusside \_\_\_\_\_ mcg/kg/min  
*non-standard* Vasopressin \_\_\_\_\_ Units/min Insulin \_\_\_\_\_ Units/hour  
*concentrations\** Dobutamine \_\_\_\_\_ mcg/kg/min Propofol \_\_\_\_\_ mcg/kg/min  
 Dopamine \_\_\_\_\_ mcg/kg/min \_\_\_\_\_ / /  
 Milrinone \_\_\_\_\_ mcg/kg/min \_\_\_\_\_ / /  
 Isoproterenol \_\_\_\_\_ mcg/kg/min \_\_\_\_\_ / /

Medication administration/changes during transport: \_\_\_\_\_

### III. Surgery Sign-Out

Surgical Issues: Clamp time: \_\_\_\_\_ (min) Pump time: \_\_\_\_\_ (min) Other: \_\_\_\_\_  
 Surgical goals of care: \_\_\_\_\_

### IV. Patient-specific Management Concerns/Treatment Goals

\_\_\_\_\_  
 \_\_\_\_\_



## eAppendix B. Perception Survey

1. What is your role on the team:

Nurse    Physician

2. How many years have you been in practice:

1-2      2-3      3-4      >4

3. Do you feel the current sign-out system can be improved?

Yes    No

4. For each of the following questions (A-D), please answer using the Likert scale below:

Strongly disagree				Neutral			Strongly agree
1	2	3	4	5	6	7	

a) The current sign-out system delivers the necessary information about the patient:

1    2    3    4    5    6    7

b) The current sign-out system makes it comfortable for you to communicate with the ICU/OR team members:

1    2    3    4    5    6    7

c) The current sign-out system is efficient and limits needless information about patient care:

1    2    3    4    5    6    7

d) The current sign-out is a necessary and important part of the transfer of patient care:

1    2    3    4    5    6    7