BRIEF REPORT

Focused Training for the Handover of Critical Patient Information During Simulated Pediatric Emergencies

Andrew J. Lautz, MD,[a] Kelly C. Martin, MD,[b,c] Akira Nishisaki, MD, MSCE,[b,c] Christopher P. Bonafide, MD, MSCE,[d,e] Roberta L. Hales, MHA, RRT-NPS, RN,[f] Elizabeth A. Hunt, MD, MPH, PhD,[g] Vinay M. Nadkarni, MD, MS,[b,c] Robert M. Sutton, MD, MSCE,[b,c] Donald L. Boyer, MD, MSEd[b,c]

ABSTRACT

OBJECTIVES: Miscommunication has been implicated as a leading cause of medical errors, and standardized handover programs have been associated with improved patient outcomes. However, the role of structured handovers in pediatric emergencies remains unclear. We sought to determine if training with an airway, breathing, circulation, situation, background, assessment, recommendation handover tool could improve the transmission of essential patient information during multidisciplinary simulations of critically ill children.

METHODS: We conducted a prospective, randomized, intervention study with first-year pediatric residents at a quaternary academic children's hospital. Baseline and second handovers were recorded for residents in the intervention group (n = 12) and residents in the control group (n = 8) during multidisciplinary simulations throughout the academic year. The intervention group received handover education after baseline handover observation and a cognitive aid before second handover observation. Audio-recorded handovers were scored by using a Delphi-developed assessment tool by a blinded rater.

RESULTS: There was no difference in baseline handover scores between groups (P = .69), but second handover scores were significantly higher in the intervention group (median 12.5 [interquartile range 12–13] versus median 7.5 [interquartile range 6–8] in the control group; $P < .01$). Trained residents were more likely to include a reason for the call ($P < .01$), focused history (P = .02), and summative assessment (P = .03). Neither timing of the second observation in the academic year nor duration between first and second observation were associated with the second handover scores (both $P > .5$).

CONCLUSIONS: Structured handover training and provision of a cognitive aid may improve the inclusion of essential patient information in the handover of simulated critically ill children.

[a]Department of Pediatrics, College of Medicine, University of Cincinnati and Division of Critical Care Medicine, Department of Pediatrics, Cincinnati Children's Hospital Medical Center, Cincinnati, Ohio; [b]Divisions of Critical Care Medicine and [d]General Pediatrics and [f]Center for Simulation, Advanced Education and Innovation, The Children's Hospital of Philadelphia, Philadelphia, Pennsylvania; [c]Departments of Anesthesiology and Critical Care Medicine and [e]Pediatrics, Perelman School of Medicine, University of Pennsylvania, Philadelphia, Pennsylvania; and [g]Department of Anesthesiology and Critical Care Medicine, The Johns Hopkins Hospital, The Johns Hopkins University School of Medicine, Baltimore, Maryland

www.hospitalpediatrics.org
DOI:https://doi.org/10.1542/hpeds.2017-0173

Address correspondence to Andrew J. Lautz, MD, Division of Critical Care Medicine, Department of Pediatrics, Cincinnati Children's Hospital Medical Center, 3333 Burnet Ave, Cincinnati, OH 45229. E-mail: andrew.lautz@cchmc.org

HOSPITAL PEDIATRICS (ISSN Numbers: Print, 2154-1663; Online, 2154-1671).

FINANCIAL DISCLOSURE: The authors have indicated they have no financial relationships relevant to this article to disclose.

FUNDING: No external funding.

POTENTIAL CONFLICT OF INTEREST: The authors have indicated they have no potential conflicts of interest to disclose.

Dr Lautz participated in study design and in data acquisition and analysis, wrote the first draft of this manuscript, and revised the manuscript; Dr Martin and Ms Hales participated in data acquisition and analysis, and reviewed and revised the manuscript; Drs Nishisaki, Bonafide, Nadkarni, Sutton, and Boyer participated in study design and in data acquisition and analysis, reviewed and revised the manuscript; Dr Hunt participated in study design and in data analysis, reviewed and revised the manuscript; and all authors approved the final manuscript as submitted.

Miscommunication has been identified as a leading cause of medical errors in sentinel patient events reported by the Joint Commission.[1] Omission of critical patient information may occur at multiple points in the transitions of patient care during hospitalization.[2–5] Furthermore, transitions in care by resident physicians have been associated with hospital mortality.[6] The improvement of patient handovers has become a priority in efforts to enhance patient safety.[1]

Standardized handover programs have been associated with decreases in medical errors and improvements in communication at pediatric institutions.[7] Structured postoperative handovers of pediatric cardiac surgery patients to the PICU have been associated with decreased loss of patient information and improvements in 24-hour patient outcomes.[8,9] However, little is known about the transmission of critical patient information to responders of the medical emergency team (MET) during pediatric emergencies.

The situation, background, assessment, recommendation (SBAR) framework has gained recognition as a structured handover tool for multidisciplinary health care professionals.[10–13] McCrory et al[14] proposed the use of airway, breathing, circulation-situation, background, assessment, recommendation ("ABC-SBAR"), a variation for the handover of patients who are critically ill during an emergency, and piloted this framework in simulated pediatric patients. Pediatric residents trained to use this ABC-SBAR tool were more likely to include clinically essential patient information in the handover of critically ill patients on the ward to the MET during simulated clinical vignettes.[14] However, the retention of this training over time and the generalizability of this handover tool to a variety of pediatric emergencies remain unclear.

In this prospective, randomized trial, we evaluated whether focused training of a structured ABC-SBAR handover tool could improve the transmission of clinically essential patient information during multidisciplinary simulations of critically ill children critically ill. We hypothesized that structured handover training would increase the inclusion of critical patient information in handovers by resident physicians during simulated pediatric emergencies.

METHODS

We performed a prospective, randomized, single-blinded trial. Our objective was to determine the efficacy of structured training for handovers using the ABC-SBAR tool during the management of simulated critically ill children by pediatric residents. All full-time, first-year pediatric residents at an urban, quaternary academic children's hospital in the 2013–2014 academic year were eligible for participation and were approached whenever a study team member was available on the day of a multidisciplinary mock code. The study protocol was exempted by the institutional review board as an educational intervention. All participants verbally consented to participation in this study.

While participating in mock codes over the course of the academic year based on their clinical schedules, first-year pediatric residents provided 2 handovers of the simulated patients to mock responders of the hospital MET, and these handovers were audio-recorded (see Supplemental Information for further details about the mock code curriculum). Participants were randomly assigned to an intervention group who received the handover training using the ABC-SBAR tool and to a control group who did not receive formal handover training. After providing the first handover, residents in the intervention group received focused feedback about their handover, as described in the Handover Training section below. When they again participated in another simulated scenario later in the year, second handovers were recorded. Participants in the control group again received no handover training, but residents in the intervention group were provided with a cognitive aid (visual representation of the structured handover) immediately before the second patient handover. This cognitive aid was not provided after the baseline handover to avoid exposure to the control group, resulting in unintentional, partial crossover.

Handover Structure

The ABC-SBAR handover format was the basis of the structured handover taught to the intervention group in this study.[14] Residents in the intervention group were asked to provide a reason for the call to the MET as an introduction, an assessment of the patient's ABC, a focused patient history, a discussion of the interventions already performed with any associated results, and a summative assessment of the situation (Table 1).

Handover Training

Five of the study authors, all attending physicians from the divisions of critical care medicine and general pediatrics, served as mock responders of the MET and provided feedback to first-year residents in the intervention group after the first handover was recorded. The ABC-SBAR handover format was described, and residents in the intervention group received feedback regarding missing components of their handover. They were then asked to repeat this handover, which was not recorded, using the structured handover format. The cognitive aid was provided to the intervention group after their second mock code, immediately before the second handover. This brief training format was devised by the study authors to fit within the context of the resident mock code curriculum and to permit individualized feedback. Feedback and recasting of the initial handover took <5 minutes.

TABLE 1 ABC-SBAR Handover Format as Depicted on Cognitive Aid

Mnemonic Component	Description
ABC	Assessment of airway, breathing, and circulation
Situation	Reason for call
Background	Focused patient history
Assessment and Recommendation	Discussion of interventions already performed and a summative assessment of situation

Handover Evaluation

All audio recordings were de-identified and reviewed by a single, senior pediatric critical care fellow who was blinded to group assignment. A modified Delphi process among the authors was used to identify the essential components in the handover of children who are critically ill. The authors also referenced the scoring tool used by McCrory et al[14] to develop an assessment tool. Inclusion of critical patient information was assessed on a 3-point Likert scale, yielding a maximum of 12 points for 6 items (Supplemental Table 3). This assessment also included scoring for the sequence of specific actions on a binary scale, providing up to 3 additional points for a total maximum of 15 points per handover. All data were recorded onto a standardized form by using the Web-based Research Electronic Data Capture system.[15]

Statistical Analysis

Cronbach's α was calculated to evaluate the internal consistency of the handover evaluation tool, using the variance of all 9 items. Cronbach's α for the summative handover evaluation tool was 0.78. Although Cronbach's α is a conservative reliability coefficient, the 9-item evaluation included 3 binary questions, which could have artificially inflated this value. When the 3 binary questions were removed from consideration, Cronbach's α was 0.62, which was considered acceptable for the small number of items in the assessment tool.

Handover scores are reported as medians with interquartile ranges (IQRs). The Wilcoxon rank-sum test was used to compare both the baseline and second handover scores between treatment groups, as well as to compare scores of individual handover components between groups. Because component scores are based on the partial or complete inclusion of that component, differences in component scores reflect differential inclusion of critical patient information in handovers. The Wilcoxon signed-rank test was used to compare baseline to second scores for each group. The Spearman's rank correlation was used to evaluate the correlation between second handover score and the duration between baseline handover and time of second handover assessment, and the correlation between second handover score and the timing of the second handover assessment. Statistical analysis was performed by using Stata Version 13.1 (StataCorp, College Station, TX). P values $<.05$ were considered statistically significant.

RESULTS

The first and second handover recordings were available for 12 residents in the intervention group and 8 residents in the control group, representing 42% of the entire residency class. There were an additional 5 residents in each group who had first handovers without going through second handovers because of their clinical schedules. These subjects were not included in the analysis. Twelve residents were female (6 in each group). All residents were postgraduate-year 1. The baseline and second handover assessments took place within median 8.5 (IQR 8–10) months and 11 (IQR 11–11.5) months of the beginning of the first year of residency training, respectively. The duration between baseline and second handover training was median 2 (IQR 1–3) months.

The scores of the second handovers in both groups are summarized in Table 2. There was no difference in first handover scores between the intervention group and the control group (median 7 [IQR 6–7.5] versus 6 [IQR 5.5–8.5], respectively; $P = .69$), but second handover scores were significantly higher in the intervention group (median 12.5 [IQR 12–13] versus 7.5 [IQR 6–8] in the control group; $P < .01$). Relative to the control group, residents in the intervention group were more likely to include the reason for the call ($P < .01$), a focused history ($P = .02$), and a summative assessment ($P = .03$) in their second handover.

In addition, there was significant improvement between first and second handover scores in the intervention group ($P < .01$), whereas there was no improvement in the control group ($P = .36$), Fig 1. There was no correlation between second handover score and time between handovers (Spearman's $\rho = -0.13$; $P = .58$) or time at second handover (Spearman's $\rho = -0.09$; $P = .71$).

DISCUSSION

In a prospective, randomized trial of handover training for first-year pediatric residents at a large, academic children's hospital, we found that structured handover education and a simple cognitive aid improved the inclusion of essential patient information in the handover of simulated critically ill children. With brief, focused handover feedback and a cognitive aid,

TABLE 2 Inclusion of Critical Patient Information in Second Handovers by Group

Variable	Intervention Group ($n = 12$)			Control Group ($n = 8$)			P^a
	No	Partial	Yes	No	Partial	Yes	
Reason for call	0 (0)	2 (17)	10 (83)	7 (88)	1 (12)	0 (0)	<.01
Airway and/or breathing	3 (25)	2 (17)	7 (58)	2 (25)	6 (75)	0 (0)	.58
Circulation	0 (0)	4 (33)	8 (67)	2 (25)	1 (12)	5 (63)	.08
Focused history	0 (0)	4 (33)	8 (67)	0 (0)	7 (88)	1 (12)	.02
Interventions performed	0 (0)	1 (8)	11 (92)	0 (0)	0 (0)	8 (100)	.41
Summative assessment	3 (25)	8 (67)	1 (8)	6 (75)	2 (25)	0 (0)	.03
Reason for call before history	0 (0)	—	12 (100)	7 (88)	—	1 (12)	<.01
ABC assessment before history	0 (0)	—	12 (100)	3 (37)	—	5 (63)	.02
History before summative assessment	1 (8)	—	11 (92)	0 (0)	—	8 (100)	.41
Total score 1, median (IQR)		7 (6–7.5)			6 (5.5–8.5)		.69[b]
Total score 2, median (IQR)		12.5 (12–13)			7.5 (6–8)		<.01[b]

All data presented as *n* (%) unless otherwise specified. —, not applicable

[a] Wilcoxon rank-sum test of component handover scores by group.

[b] Wilcoxon rank-sum test of total scores by group.

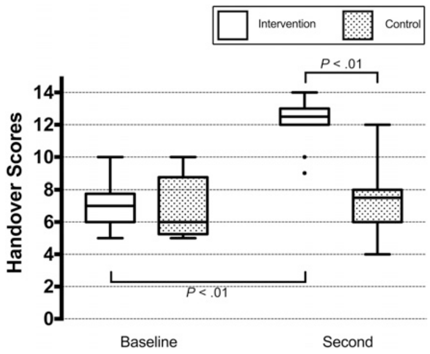

FIGURE 1 Baseline and second handover scores by group.

first-year pediatric residents were better able to synthesize and convey critical patient information from a variety of emergency scenarios to the members of the MET. Furthermore, there was no significant association between handover quality and time between handovers or length of previous clinical experience (before second handover). Taken together, we suggest that clinical experience and a standardized pediatric residency education curriculum were insufficient to improve handovers of critically ill children.

Our study further supports the use of the structured ABC-SBAR handover format and demonstrates the feasibility of a cognitive aid for this purpose. Similar to McCrory et al,[14] we found that residents who received handover feedback and a cognitive aid were significantly more likely to include a summative assessment during a handover after a mock code. In contrast, however, our study also revealed a higher likelihood of including a reason for the call and a focused history relative to residents who did not receive handover feedback or a cognitive aid. Interestingly, we did not find any differences in inclusion of an assessment of ABC, suggesting that at least in these mock emergencies residents were aware of and conveying critical information about the simulated patient's cardiopulmonary status.

This study has several limitations. Handovers were performed during in situ simulations of critically ill children but were not evaluated in actual patient care. However, the scenarios reflected a wide variety of pediatric emergencies, and residents synthesized patient information after care of the mock patients, similar to what would happen in actual pediatric codes. Second, in our study, we examined handovers occurring over the course of several months and did not evaluate skill retention (handover improvement) at longer time points. Because a reference card formed the basis of the cognitive aid, however, it is plausible that long-term implementation would be feasible and cost-effective. Third, our study cannot disentangle whether handover improvement in the intervention group was attributable to both the brief handover feedback and the cognitive aid or just to the provision of the cognitive aid before the handover. In an extension study, authors could evaluate for improvement solely with a cognitive aid. Fourth, although the recorded handovers were de-identified, evaluation bias through voice recognition is possible. However, none of the first-year residents had rotated through the PICU before or during this study; thus there was little opportunity for previous interaction between the critical care fellow who scored the handovers and the participants in this study. Finally, because our data reflect the experience of a single institution with a small number of participants, we recognize the need for larger study numbers and external validation of the ABC-SBAR handover assessment tool to assess the generalizability of this structured handover training.

CONCLUSIONS

Training of a structured handover format with brief feedback and a cognitive aid can improve the inclusion of essential patient information in the handover of simulated, critically ill children by pediatric residents. Future studies should investigate the durability of handover training, as well as the effectiveness in improving handovers during actual pediatric emergencies.

REFERENCES

1. The Joint Commission. Improving America's hospitals: the Joint Commission's annual report on quality and safety. 2007. Available at: www.jointcommission.org/assets/1/6/2007_Annual_Report.pdf. Accessed August 1, 2017
2. Fischer M, Hemphill RR, Rimler E, et al. Patient communication during handovers between emergency medicine and internal medicine residents. *J Grad Med Educ*. 2012;4(4):533–537
3. Piekarski F, Kaufmann J, Laschat M, Böhmer A, Engelhardt T, Wappler F. Quality of handover in a pediatric postanesthesia care unit. *Paediatr Anaesth*. 2015;25(7):746–752
4. Pickering BW, Hurley K, Marsh B. Identification of patient information corruption in the intensive care unit: using a scoring tool to direct quality improvements in handover. *Crit Care Med*. 2009;37(11):2905–2912
5. 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
6. Denson JL, McCarty M, Fang Y, Uppal A, Evans L. Increased mortality rates during resident handoff periods and the effect of ACGME duty hour regulations. *Am J Med*. 2015;128(9):994–1000
7. Starmer AJ, Spector ND, Srivastava R, et al; I-PASS Study Group. Changes in medical errors after implementation of a handoff program. *N Engl J Med*. 2014;371(19):1803–1812
8. 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
9. Breuer RK, Taicher B, Turner DA, Cheifetz IM, Rehder KJ. Standardizing postoperative PICU handovers improves handover metrics and patient outcomes. *Pediatr Crit Care Med*. 2015;16(3):256–263
10. Compton J, Copeland K, Flanders S, et al. Implementing SBAR across a large multihospital health system. *Jt Comm J Qual Patient Saf*. 2012;38(6):261–268
11. Randmaa M, Mårtensson G, Leo Swenne C, Engström M. SBAR improves communication and safety climate and

decreases incident reports due to communication errors in an anaesthetic clinic: a prospective intervention study. *BMJ Open*. 2014;4(1):e004268

12. Martin HA, Ciurzynski SM. Situation, background, assessment, and recommendation-guided huddles improve communication and teamwork in the emergency department. *J Emerg Nurs*. 2015;41(6):484–488

13. De Meester K, Verspuy M, Monsieurs KG, Van Bogaert P. SBAR improves nurse-physician communication and reduces unexpected death: a pre and post intervention study. *Resuscitation*. 2013;84(9): 1192–1196

14. McCrory MC, Aboumatar H, Custer JW, Yang CP, Hunt EA. "ABC-SBAR" training improves simulated critical patient hand-off by pediatric interns. *Pediatr Emerg Care*. 2012;28(6):538–543

15. Harris PA, Taylor R, Thielke R, Payne J, Gonzalez N, Conde JG. Research electronic data capture (REDCap)—a metadata-driven methodology and workflow process for providing translational research informatics support. *J Biomed Inform*. 2009;42(2): 377–381

Focused Training for the Handover of Critical Patient Information During Simulated Pediatric Emergencies

Andrew J. Lautz, Kelly C. Martin, Akira Nishisaki, Christopher P. Bonafide, Roberta L. Hales, Elizabeth A. Hunt, Vinay M. Nadkarni, Robert M. Sutton and Donald L. Boyer

Hospital Pediatrics 2018;8;227
DOI: 10.1542/hpeds.2017-0173 originally published online March 7, 2018;

HOSPITAL Pediatrics

Focused Training for the Handover of Critical Patient Information During Simulated Pediatric Emergencies

Andrew J. Lautz, Kelly C. Martin, Akira Nishisaki, Christopher P. Bonafide, Roberta L. Hales, Elizabeth A. Hunt, Vinay M. Nadkarni, Robert M. Sutton and Donald L. Boyer

Hospital Pediatrics 2018;8;227
DOI: 10.1542/hpeds.2017-0173 originally published online March 7, 2018;