

# Closed-Loop Communication Improves Task Completion in Pediatric Trauma Resuscitation

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**BACKGROUND:** Pediatric trauma care requires effective and clear communication in a time-sensitive manner amongst a variety of disciplines. Programs such as Crew Resource Management in aviation have been developed to systematically prevent errors. Similarly, teamSTEPPS has been promoted in healthcare with a strong focus on communication. We aim to evaluate the ability of closed-loop communication to improve time-to-task completion in pediatric trauma activations.

**METHODS:** All pediatric trauma activations from January to September, 2016 at an American College of Surgeons verified level I pediatric trauma center were video recorded and included in the study. Two independent reviewers identified and classified all verbal orders issued by the trauma team leader for order audibility, directed responsibility, check-back, and time-to-task-completion. The impact of pre-notification and level of activation on time-to-task-completion was also evaluated. All analyses were performed using SAS® version 9.4(SAS Institute Inc., Cary, NC).

**RESULTS:** In total, 89 trauma activation videos were reviewed, with 387 verbal orders identified. Of those, 126 (32.6%) were directed, 372(96.1%) audible, and 101 (26.1%) closed-loop. On average each order required 3.85 minutes to be completed. There was a significant reduction in time-to-task-completion when closed-loop communication was utilized ( $p < 0.0001$ ). Orders with closed-loop communication were completed 3.6 times sooner as compared to orders with an open-loop [HR = 3.6 (95% CI: 2.5, 5.3)]. There was not a significant difference in time-to-task-completion with respect to pre-notification by emergency

service providers ( $p < 0.6100$ ). [HR = 1.1 (95% CI: 0.9, 1.3)]. There was also not a significant difference in time-to-task-completion with respect to level of trauma team activation ( $p < 0.2229$ ). [HR = 1.3 (95% CI: 0.8, 2.1)].

**CONCLUSION:** While closed-loop communication prevents medical errors, our study highlights the potential to increase the speed and efficiency with which tasks are completed in the setting of pediatric trauma resuscitation. Trauma drills and systems of communication that emphasize the use of closed-loop communication should be incorporated into the training of trauma team leaders.

**LEVEL OF EVIDENCE:** This is a prospective observational study with intervention level II evidence. (J Surg Ed **I:III-III**. © 2017 Association of Program Directors in Surgery. Published by Elsevier Inc. All rights reserved.)

**KEY WORDS:** pediatric trauma, trauma video review, closed-Loop communication, time to task completion, trauma team leader

**COMPETENCIES:** Interpersonal, Communication Skills

## BACKGROUND

In health care, effective teamwork and communication are central to patient safety.<sup>1</sup> In the 1990s, the Institute of Medicine highlighted the effect of poor communication on health care outcomes.<sup>2</sup> Poor outcomes involving preventable incidents are usually a result of multiple human factors, and not a mistake by a single person.<sup>3-6</sup> As expressed by Reason et al.<sup>7</sup> every step in a process has potential for failure. Often, these failures are because of poor communication. According to Control Risk Insurance Company over 30% of malpractice awarded suits, where a patient is injured or killed, have miscommunication to blame.<sup>8</sup> Gaps in communication have

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been identified during patient handoff between departments or within a department, in interdisciplinary teams where misunderstandings, language difficulties, misinterpretations, and hesitations to speak up have been reported.<sup>4,5,9-14</sup>

As a defense against communication breakdown, many standardized schemes of communication have been developed.<sup>15-18</sup> The aviation industry has developed team training concepts, such as Crew Resource Management, that systematically increase safety and prevent errors through improvement in effective communication.<sup>19-21</sup> This is achieved by standardizing terminology and procedures. The term closed-loop communication, originating from military radio transmissions, is a standard terminology used to describe a team's ability to deliver concise information (the call out), confirm reception of information (the check back), and acknowledge correct understanding of information (closing the loop).<sup>22</sup> During simulation training comparing communication patterns between flight crews, Browers et al. found that high-performing crews used more closed-loop communication as compared to low-performing crews.<sup>23</sup> This is not only evident in high-reliability fields such as aviation and the nuclear industry, but also translates into obstetrics, anesthesia, emergency medicine, and military health care.<sup>24-27</sup> Closed-loop communication has been used successfully by teams in medicine to maintain clear communication and decrease preventable errors.<sup>16</sup>

Clear communication in the midst of trauma resuscitation encompasses many fundamental aspects of team dynamics and collaboration oriented toward a common goal.<sup>12,28,29</sup> Pediatric trauma resuscitations may not always succeed in achieving this common goal with Burd et al. reporting over 337 errors in 39 pediatric trauma activations. In fact, 51% of the errors were never acknowledged or compensated for by the team.<sup>30</sup> The Department of Defense and the Agency of Healthcare Research and Quality developed Team Strategies and Tools to Enhance Performance and Patient Safety to improve the quality, safety, and efficacy of health care communication with significant emphasis on closed-loop communication.<sup>31</sup> Within the trauma community, the American College of Surgeons sets the standard for systematic care of the injured patient with the establishment of the Advanced Trauma Life Support program, but fails to include the importance of closed-loop communication. In this study, we evaluated the effect of closed-loop communication on the time required to complete a given task in pediatric trauma resuscitations. We hypothesize that closed-loop communication has the potential to improve the safety and efficiency of the care provided during pediatric trauma activations.

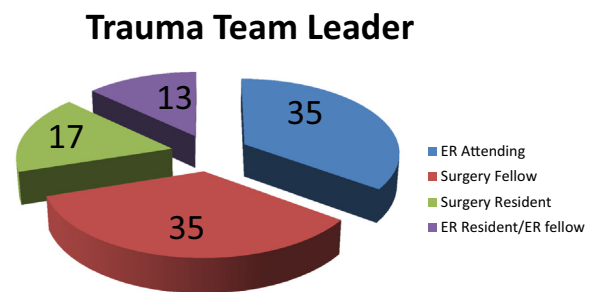
## METHODS

This study was approved by the Northwell Health Institutional Review Board. All trauma activations at Cohen

Children's Medical Center; an American College of Surgeons verified level 1 free-standing pediatric trauma center in the greater New York City area, from January to September 2016 were included in the study. All training activations were excluded from the study. TruVision Navigator 5.0 by Interlogix was used for trauma video review. Each trauma room is equipped with 3 high definition ceiling cameras and a microphone. Facility response guidelines direct responders to wear appropriate role identification stickers during trauma team activations. Trauma team leader sticker (bright pink in color) was used to properly identify the team leader for this study. In different activations, the team leader role may be filled by an attending pediatric surgeon or pediatric surgery fellow, surgical resident, emergency medicine attending, pediatric emergency medicine fellow, or emergency medicine resident. All verbalized orders articulated by the team leader were identified and evaluated for audibility, directed responsibility to a team member, and check-back by team member. Time from order call out to order completion was calculated. Closed-loop orders were defined as audible, directed to a team member, check-back by the team member, and acknowledgment by team leader. We recorded a description of task completed, the level of activation, and whether team members had prenotification from emergency medical services (EMS) personnel before the patient arrival.

## Statistical Methods

A separate Cox proportional hazards model for time-to-task-completion was carried out controlling for type of communication (open- or closed-loop), prenotification (yes or no), team leader type, and level of activation (I/II). For each model, the robust sandwich estimate of the covariance matrix was used to adjust for the correlation among multiple trauma events that occurred in a given day. A generalized linear mixed model for binary clustered data was used to model closed-loop (yes or no) separately as a function of prenotification (yes or no) and level of activation



**FIGURE 1.** Trauma team leader. The role of trauma team leader was filled by a variety of specialists. The pediatric surgery fellow and emergency room attending were most frequently the trauma team leader.

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