ABSTRACT

BACKGROUND: Interventions that facilitate early identification and management of hospitalized pediatric patients who are at risk for deterioration are associated with decreased mortality. In our large pediatric hospital with a history of success in decreasing unrecognized deterioration, patients at higher risk of deterioration are termed "watchers." Because communication errors often contribute to unrecognized deterioration, clear and timely communication of watcher status to all team members and contingency planning was desired.

OBJECTIVES: Increase the percentage of eligible watchers with a complete communication, teamwork, and planning bundle within 2 hours of identification from ≥8% to ≥80%.

METHODS: Watchers admitted to Hospital Medicine on 2 targeted units were eligible. Stakeholders were educated to facilitate ownership. Daily data analysis enabled real-time failure identification. Automated physician notification provided reminders for timely communication.

RESULTS: The percentage of watchers with a complete situation awareness bundle within 2 hours increased from ≥8% to ≥81% and was sustained for more than 2 years. There was no change in rates of rapid response team calls or ICU transfers on our intervention units, but these both increased throughout the hospital. Education facilitated modest improvement, with marked improvements and sustainment through use of technology.

CONCLUSIONS: A novel bundle that included contingency planning and communication expectations was created to improve situation awareness for watchers. Multidisciplinary engagement and use of automated technology facilitated by an electronic health record helped implement and sustain bundle adherence.

www.hospitalpediatrics.org
DOI: https://doi.org/10.1542/hpeds.2016-0170
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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: Dr Brady is supported by a Patient-Centered Outcomes Research Mentored Clinical Investigator Award from the Agency for Healthcare Research and Quality (award K08HS023827). The content is solely the responsibility of the authors and does not necessarily represent the official views of the funding organizations. The funding organizations had no role in the design, preparation, review, or approval of this paper; nor the decision to submit the manuscript for publication.

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

Drs Parker, Bolser, Brewington, and Brady and Ms Ballinger conceptualized and designed the study and drafted the initial manuscript; Dr Carroll, Ms Campanella, and Mr Davis-Sandfoss conducted the initial analyses and reviewed and revised the manuscript; Ms Tucker conceptualized and designed the study and critically reviewed the manuscript; and all authors approved the final manuscript as submitted.
Interventions facilitating early identification and management of hospitalized children at risk for deterioration, such as rapid response teams (RRT), are associated with decreased mortality and cardiopulmonary arrest rates.1–4 Over the previous 5 years, our institution has designed interventions to improve situation awareness (SA), defined as “the perception of elements in the environment within a volume of time and space, the comprehension of their meaning, and the projection of their status in the near future.”5–7 Previous interventions, including standardized safety huddles, proactive risk assessment, and tools to aid in robust contingency planning, led to a significant, sustained decrease in unrecognized clinical deterioration and serious safety events (SSEs) among inpatients.1

Root cause analyses of preventable adverse events often list communication errors as a leading contributor to mistakes.3 Despite encouraging advances to improve processes designed for better SA, we found that we were not reliably communicating and documenting plans on our highest acuity patients outside of the ICU, whom we call “watchers.” This term is broadly used across our institution; however, the process for determining watcher status and the actions following watcher determination were variable and unreliable on Hospital Medicine (HM) and non-HM units. Common communication challenges that occurred before our work included involvement of only some team members in the discussion of watcher determination and failure to establish a clear contingency plan and criteria for escalation of care. We believed that because the identification of high-risk status was insufficient to alter the trajectory of deterioration, a robust effector arm to communicate about, document, and ultimately mitigate patient risk was necessary. Our specific aim with this study was to increase the percentage of eligible watchers with a complete communication, teamwork, and planning bundle within 2 hours of watcher identification from 28% to 80%.

METHODS
Human Subjects Protection
Our project was undertaken in accordance with institutional review board policy on systems improvement work and did not require formal review.

Setting
In our large, academic medical center, care for HM patients occurs primarily in 2 units and is provided by teams of residents supervised predominately by pediatric hospitalists and rarely by community-based pediatricians. Our patients included those with medical complexity, neurologic impairment, and diseases like bronchiolitis with high rates of deterioration and need for ICU care. Reflective of the acuity of HM patients, the baseline rate of RRT calls and ICU transfers for HM units was ~150% of the baseline rate of RRT calls and ICU transfers for non-HM units in aggregate. Hospitalists are in house until midnight and on call 24 hours a day. Data for this quality improvement (QI) initiative were collected from November 5, 2012, to December 31, 2015. Two HM units comprise 11% of the institutional beds. RRT calls for deteriorating patients facilitate discussion between the floor and ICU teams to determine if transfer to a higher level of care is indicated.

Planning the Intervention
One HM attending physician and a clinical manager charge nurse co-led a multidisciplinary team that included another HM attending physician, a research assistant, a chief pediatric resident, HM unit bedside nurses, and 2 (Q) coaches. The team mapped the existing process of communication and planning for high-risk patients, characterized barriers to timely completion of the process, identified key drivers of watcher identification and documentation (Fig 1), and developed interventions to meet its aim.5 Process adherence was tracked on run charts. Eligible patients were younger than 18 years old and admitted to the HM service in 1 of 2 target nursing units. For our project, we considered a patient a watcher if he or she was identified as such in the electronic health record (EHR) or received an RRT call without previous watcher identification. Patients transferring to the ICU within 4 hours of admission to the floor were excluded because the priority for these rapid transfers was smooth transfer to the ICU and not mitigation planning or documentation on the floor, which was a primary target of the bundle we created.

To standardize communication and contingency planning, we created a bundle of expectations following designation of watcher status. The bundle initially consisted of the following 5 components, with all documentation components completed in the EHR: (1) identification of the patient as a watcher in the EHR by nursing staff; (2) documentation of physician awareness of watcher status; (3) documentation of respiratory therapist awareness of watcher status; (4) completion of a structured SA note by any physician on the care team, detailing the clinical concern and contingency planning; and (5) documentation within the SA note that the family was notified of the patient’s status change. A successful bundle required completion of all components within 2 hours of the patient being designated a watcher or within 4 hours for patients newly admitted to the floor because of the additional clinical evaluation required in those circumstances. Because of their frequent interaction with patients, bedside nurses typically were the first to notice a concern meriting potential watcher status. A broader goal of the bundle, not directly measured, was for a bedside evaluation to occur between the nurse, physician, and family to discuss watcher concerns, including appropriateness of watcher designation.

Improvement Activities
Education
Several interventions addressed the challenge of monthly changes in resident staffing. To improve ownership of this new process, our team presented to the entire resident group at a regularly scheduled meeting and discussed the global concepts of SA and the specific goals of the project. After this orientation, each HM team received a written and in-person summary that was included in previously
established, rotation-specific communication. A flyer summarizing key information was placed in resident workrooms. The project goals and interventions were also reviewed at divisional HM meetings, given the attending physicians’ involvement in discussions of watcher designation and contingency planning.

To spread knowledge of the new process to the nursing staff, we used a variety of educational methods, including a flyer posted in a high-traffic area summarizing the nursing responsibilities and just-in-time, face-to-face education during daily nursing shift huddles and monthly staff meetings.

**Process Integration**

To facilitate successful completion of the physician SA note, our team capitalized on the existing EHR to create a structured SA note template (Fig 2) that would allow the physician to quickly communicate the pertinent information.

We trialed multiple strategies to integrate our project into the workflow of the nursing staff. Because the charge nurses already held the responsibility for communication of SA concerns within the institutional safety huddles,13 we tested the modification of an existing SA concern checklist (Supplemental Fig 8). We added a check box for documentation of watcher designation in the EHR, which also served as a visible reminder of the project. In our EHR, customizable tabs on the nursing display provide streamlined shortcuts for charting responsibilities. We met with each nurse to ensure that the “SA Concerns” tab was displayed in their EHR view.

**Identification and Education**

We employed mitigation strategies for the first 18 months of the project. Resident physicians who did not successfully complete the physician portion of the SA bundle were approached within several days of the failure to elicit reasons for the barrier. Categorization of these reasons informed the modification of the education process. Residents who successfully completed the physician portion of the SA bundle were recognized in the weekly residency newsletter. A similar strategy of individually contacting nurses was employed. Biweekly run charts summarizing each resident team’s successful completion of the physician bundle measures were displayed in common residency spaces to provide feedback on the team’s performance.

**Automation of Communication**

To achieve a higher-reliability intervention, we partnered with the Information Services (IS) department to create a novel, automated paging system. IS had previously created a function that uses information from the EHR and monitors changes to patient status, such as new SA concerns, at 5-minute intervals. For our project, IS generated a program to retrieve data from this existing process and send an alert page to the resident and respiratory therapist when a patient was designated as a watcher. After verifying the reliability of the

![FIGURE 1 SA bundle key driver diagram.](image-url)
paging function, we eliminated notification of the physician and respiratory therapist from the tracked bundle measures.

**Methods of Evaluation**

Preintervention data were collected through manual review of the EHR for eligible patients from September 17, 2012, to November 4, 2012. Postintervention data were collected from November 5, 2012, to December 31, 2015. A research assistant received an automated e-mail as a part of internal hospital communication whenever an RRT call was activated on a patient in the HM service. Identification for data collection of watchers without an RRT call was initially manual, but with the implementation of automated paging, it was later incorporated in a system similar to the RRT notifications. Once an eligible patient was identified, the research assistant reviewed the EHR for completion of the bundle. The final 3 bundle measures were as follows: (1) identification of the patient as a watcher in the EHR by nursing staff, (2) completion of an SA note by any physician on the care team, detailing the clinical concern and contingency planning, and (3) documentation that the family was notified of the patient’s status change. A successful SA bundle required all 3 components. Qualitative data about staff impressions of the project impact were collected after the implementation of our interventions.

**Analysis**

The research assistant recorded data and used Microsoft Excel (Redmond, WA) to create run charts, which were updated biweekly to reflect the percentage of patients who received a complete SA bundle and each of the bundle components. For analysis of rates of RRT and ICU transfer for intervention units and hospitalwide comparisons, data from the 2 intervention units were pooled and run charts were updated monthly. Established rules for special cause variation were used to identify significant improvement.

**RESULTS**

We improved the percentage of completed bundles from 28% to 81% (Fig 3). During the initial interventions, there was significant weekly variability in adherence. Our first sustained improvement occurred alongside implementation of the automated resident paging notification. An increase in the median to 81% occurred after a modification to the SA note template to allow for documentation of an unsuccessful attempt to reach the family for notification of watcher status. Time criterion alone was a common mode of failure of a bundle measure. For example, after completion of the physician SA note reached 80%, 33% of the failures to complete the note were completed within 4 hours, 12% between 4 and 6 hours, 14% more than 6 hours after identification, and 41% were never completed. One contextual element for which we tracked data and designed interventions to support was the regular turnover of resident physicians. To evaluate the potential unintended impacts on RRT or ICU transfer frequency, we compared these data from our intervention units and hospital in aggregate. There was no change in the median percentage of RRT or ICU transfers for the HM units (Fig 4). Comparatively, the hospitalwide RRT rate increased from 1.4 to 1.8 per 10,000 patient days, and the ICU transfer rate increased.

**FIGURE 3** Run chart of adherence to the complete SA bundle within 2 hours of watcher designation over time. Performance on 2 target HM units is combined. Solid boxes denote time points of implemented interventions, whereas dashed boxes denote interventions that were discontinued. RN, registered nurse.
from 0.8 to 0.9 per 10 000 patient days (Fig 5). A potential unintended consequence was alert fatigue related to the automated paging of residents; however, this was not perceived by them to be a barrier. Improvements for individual components of the SA bundle are illustrated in Supplemental Figs 7–9.

Project feedback from the nursing staff was positive. One charge nurse commented, “The plan… is much more in depth, and with it being documented, there is no worry if a nurse misunderstood or passed on inaccurate information.” A bedside nurse said, “[Physicians] have a more thorough plan of care… and more precise criteria of what the next steps will be and when an [RRT] will be called.”

DISCUSSION

Using QI methods, we created and implemented an SA communication bundle for high-risk patients admitted to HM. We reached our goal of 80% bundle completion, as well as 80% completion of individual bundle measures, and have sustained our success for more than 2 years. We believe that early recognition of and clear communication about patients at high risk of deterioration may prevent SSEs and may facilitate team collaboration.

Our project built on previous work that developed a proactive system to standardize language on watchers. Because we wanted to make the process of watcher identification as robust as possible, we did not predetermine criteria for patients to receive the watcher designation. Nursing staff most commonly identified patients as potential watchers outside of rounds, which is not surprising given their frequency of interaction and reassessment intervals. To prioritize the input of the entire care team, and once a nurse identified a potential watcher, we designed watcher determination to be a collaborative decision made after a bedside assessment.11 Although not directly measured, the expectation from local culture and project-specific education was for the attending physician to be involved in mitigation planning regardless of the time of day. This approach was also facilitated by the multidisciplinary team members who served as liaisons to the frontline staff.

Leveraging the existing safety culture that has been associated with a reduction in the number and frequency of SSEs,12 we found that providers were receptive to the creation and implementation of our bundle. We tested many methods for education on the roles and ownership of the process. To provide education and feedback on performance, we communicated individually regarding each failure and recognized providers who were successfully completing the bundle. Despite numerous educational interventions, we were unable to reach our goal. Because lower-reliability interventions, including education alone, are typically unable to produce a level of reliable (80% to 90%) success,13-15 this was not surprising.

In striving toward a higher reliability intervention, we employed technology to provide innovative solutions. Because authors of previous studies have shown that structured communication is associated with improved outcomes,16,17 we created a standardized note template to integrate into the physician workflow, which also facilitated physicians’ ability to quickly communicate essential information. Note completion was challenging for several reasons, including the presence of multiple physicians on multiple HM teams, monthly turnover of resident teams, competing patient care demands related to volume or acuity, and time constraints. Support from IS enabled us to overcome this major barrier by the creation of an automated communication system using an electronically generated page when a patient was noted as a watcher in the EHR. This helped spread awareness of the project and reminded physicians of the time frame for note completion. We elicited feedback from the resident teams regarding alert fatigue, and we found none.

It is interesting to note that during the time frame when our units saw a stable rate of RRT calls and ICU transfers, hospitalwide rates increased for both. Institutional data have shown a consistent upward trend in RRT calls and ICU transfers over the past 6 years. Although we cannot definitively say that the HM unit trend is solely related to our work, this project was the only targeted, SA-related work done on the HM units.
during this time frame. Because our units previously saw a much higher rate of RRT calls and ICU transfers, we believe these data reflect a consequence of our work. It is possible that this framework of clear and timely communication facilitated patient care, leading to improved clinical outcomes, or that our intervention delineated criteria for escalation that helped avoid RRT calls and transfers. Qualitative feedback from nursing staff employed before and after the project’s implementation indicated that there was a perceived improvement in clarity of contingency planning for watchers. This positive impact on staff experience likely facilitated team cohesion, which is especially important for children at risk for deterioration.18

Our study has some limitations. First, our institution has a well-established culture that prioritizes both QI and patient safety, and as such, it has already implemented many measures resulting in positive outcomes. This environment primes such work for success; however, institutions with a higher rate of SSEs may see more significant, clinically relevant improvements in patient outcomes. Second, our project relied heavily on the EHR to assist in data collection for identification of eligible patients and successful completion of bundle measures. We believe that an automated system for inclusion of eligible patients is likely more effective than manual review, and implementation in a system without an EHR may mandate significant additional effort. Third, we considered an attempted family notification as a success, even if the family was unable to be reached. Through feedback, our team members noted that they were trying, at times repeatedly, to contact the family. We decided that this exemplified the behavior we wanted to incentivize, and that doing all that we could to contact families should drive how we think of success. Finally, we measured only documentation of the communication as reflected by signed notes, which may underestimate our actual success because busy providers may choose to prioritize patient care tasks over timely documentation. This assertion is supported by the higher success rate when not accounting for our 2-hour time criterion.

With any QI initiative, sustainability is an important consideration. Because we have successfully sustained our intervention through seasonal variation affecting patient acuity and through multiple new groups of residents, we believe this system is stable, and the expectation of communication regarding watchers has become part of the culture in our 2 intervention units. Ongoing interventions regarding education of frontline staff have shifted to established forums such as scheduled orientation times. Although not systematically implemented and tracked like in our intervention units, the use of the SA note and expectations of contingency planning have spread to other units within our institution through rotation of residents familiar with our process and expectations given at standardized safety huddles.1

CONCLUSIONS

We implemented and sustained a novel SA communication and contingency planning bundle for patients at the highest risk of deterioration. Strong contributors to our success included a collaborative approach to clinical assessments, a multidisciplinary representation of stakeholders, and capitalization on technological capabilities to facilitate the automation of key interventions. With the learning we have achieved through first implementing this bundle in HM units, our next steps include assessing opportunities to spread our work within our institution and beyond.

Acknowledgments

We would like to thank the following colleagues for their invaluable support for our project: Caitlin Clohessy, Patricia Feghali, Melissa Forton, James Frebis, Diane Herzog, Heather Jordan, Alyssa Mohr, Hadley Sauers-Ford, Ikaika Tadaki, Paul Yelton, and Janet Zahner.

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Implementation of a Communication Bundle for High-Risk Patients
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Hospital Pediatrics 2017;7;523
DOI: 10.1542/hpeds.2016-0170 originally published online August 29, 2017;

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