

# A Quality Improvement Intervention Bundle to Reduce 30-Day Pediatric Readmissions

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## Abstract

**Introduction:** Pediatric hospital readmissions can represent gaps in care quality between discharge and follow-up, including social factors not typically addressed by hospitals. This study aimed to reduce the 30-day pediatric readmission rate on 2 general pediatric services through an intervention to enhance care spanning the hospital stay, discharge, and follow-up process. **Methods:** A multidisciplinary team developed an intervention bundle based on a needs assessment and evidence-based models of transitional care. The intervention included pre-discharge planning with a transition coordinator, screening and intervention for adverse social determinants of health (SDH), medication reconciliation after discharge, communication with the primary care provider, access to a hospital-based transition clinic, and access to a 24-hour direct telephone line staffed by hospital attending pediatricians. These were implemented sequentially from October 2013 to February 2017. The primary outcome was the readmission rate within 30 days of index discharge. The length of stay was a balancing measure. **Results:** During the intervention, the included services discharged 4,853 children. The pre-implementation readmission rate of 10.3% declined to 7.4% and remained stable during a 4-month post-intervention observation period. Among 1,394 families screened for adverse SDH, 48% reported and received assistance with  $\geq 1$  concern. The length of stay increased from 4.10 days in 2013 to 4.30 days in 2017. **Conclusions:** An intervention bundle, including SDH, was associated with a sustained reduction in readmission rates to 2 general pediatric services. Transitional care that addresses multiple domains of family need during a child's health crisis can help reduce pediatric readmissions. (*Pediatr Qual Saf* 2020;2:e264; doi: 10.1097/pq9.000000000000264; Published online February 28, 2020.)

## INTRODUCTION

The ineffective transition from inpatient to outpatient care can lead to miscommunication between families and care providers, medication errors, and hospital readmission.<sup>1-3</sup> Nationally, between 7% and 11% of pediatric patients are readmitted within 30 days of discharge.<sup>4,5</sup> Reviews by



healthcare providers and families suggest 20%–30% of readmissions are preventable.<sup>6,7</sup>

Preventable readmissions are costly<sup>8,9</sup> and affect the quality of life for patients.<sup>10</sup> Readmissions likely represent a gap in care quality during the previous hospitalization, the transition period, the outpatient follow-up, or some combination of each.<sup>11,12</sup> A more coordinated system of care, including communication, education, and delivery of care in the right setting when needed, may mitigate the medical risk, morbidity, and cost of preventable readmissions.<sup>13</sup>

In 2012–2013, North Carolina Children's Hospital readmitted ~10% of children discharged from 2 general pediatrics services within 30 days. The objectives of this project included (1) improving the discharge process for children admitted to our general pediatrics services through a coordinated intervention spanning from the hospital stay through 30 days after discharge, and by doing so (2) reducing the readmission rate on those services by 30%.

## METHODS

### Context

North Carolina Children's Hospital is a non-freestanding, safety-net provider of quaternary care. The hospital has 2 general pediatric services, which together averaged

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1,600–1,800 discharges per year during this project period. The payer mix is ~60% Medicaid, 30% private insurance, and 10% military insurance (Tricare). Each general pediatric service includes an attending physician, pediatric residents, and a coordinator (nurse) who addresses family resource and care needs related to hospitalization, such as ordering medical equipment, scheduling follow-up visits, and transportation. Historically, the involvement of the medical team ended at a patient's discharge, leading to gaps in follow-through of medical and resource interventions put in place during hospitalization. These gaps may contribute to unplanned readmissions.

The project team included a physician lead, collaborating physicians, lawyer (and leader of a medical-legal partnership), nurses, and social workers. They developed an intervention bundle to transition patients actively back into their communities to reduce preventable readmissions. The Institutional Review Board reviewed this project and determined that it was a quality improvement initiative, not human subjects research, and therefore did not require review and approval.

### **Intervention**

The intervention mirrored components of the Institute for Healthcare Improvement Hospital STAAR initiative readmission intervention bundle.<sup>14</sup> A 2011 needs assessment helped to tailor a focus on social determinants of health (SDH).<sup>15</sup> Many families raising children with chronic health conditions were experiencing problems, such as food insecurity and poor housing conditions, that could affect a child's health and even readmissions.

This project's fishbone diagram highlights the potential causes of pediatric hospital readmissions, including adverse SDH (Fig. 1). Based on causes in the categories of Environment, People, Materials, Process, Equipment, and Management, the team developed primary and secondary drivers through review and discussion of discharge processes on the general pediatric services. Primary drivers included education and feedback for discharging physicians, addressing adverse SDH, enhanced follow-up care after discharge, and direct availability to families by phone following discharge (Fig. 2). Secondary drivers became components of the intervention. The resulting intervention included the following components:

1. Family education on discharge process and project resources;
2. Email notification of readmission to discharge attending physicians
3. Screening families for adverse SDH during a child's hospital stay;
4. Providing information on community resources and making direct referrals to a medical-legal partnership;
5. Medication reconciliation and assessment of adherence to the discharge plan in a follow-up call 1–3 days after discharge;

6. Scheduling a follow-up visit with the primary care provider or UNC Transition Clinic, and providing handover communication to the primary care provider when indicated;
7. 24-hour access for families by phone directly to an on-call attending physician for questions related to the hospitalization;

### **Family Education on the Discharge Process**

The transition coordinator met with families during a child's hospitalization to review the discharge planning process and inform them about follow-up calls and resources of the project available to them after discharge.

### **Education and Feedback for Discharging Clinical Teams**

Attending physicians and pediatric residents received emailed information and an in-person education session. Attending physicians work 1-week blocks; so, many unplanned readmissions occur after the discharging physician has rotated off service. Therefore, each week the physician lead for the project sent an email message about each readmission to the discharging physician to prompt reflection about potential contributing factors and to stimulate engagement with the intervention.

### **Addressing Adverse SDH**

The team lawyer developed a screening form for adverse SDH based on literature review and assessment of which needs program staff could influence (see Supplemental Digital Content 1 at <http://links.lww.com/PQ9/A170>). The team pilot-tested and revised the form in iterative cycles based on family feedback. The transition coordinator trialed screening methods in mini-PDSA cycles; ultimately, she found that families provided the richest, most actionable information through an in-person interview. She was able to provide resources in real-time, then follow-up with referrals as indicated by screening.

### **Enhanced Follow-up Care After Discharge**

Project staff initially made follow-up phone calls to families within 3 days after a child's discharge to follow-up on medical and social concerns. After the first year, the hospital's care management department began making these calls to all discharged patients. The project team could not track those calls. The project coordinator also attempted to contact families 30 days after discharge to assist with any problems remaining from the hospitalization, such as pending referrals. Clinicians on the project provided a hospital-based Transition Clinic to provide bridging care for children perceived at high risk, either because of medical complexity or an unresolved problem, such as weaning from sedating medications. Structured note templates for these visits included action-oriented follow-up steps to guide community-based providers. Transition clinic providers sent notes to primary care providers and made phone calls when needed to discuss complex issues.

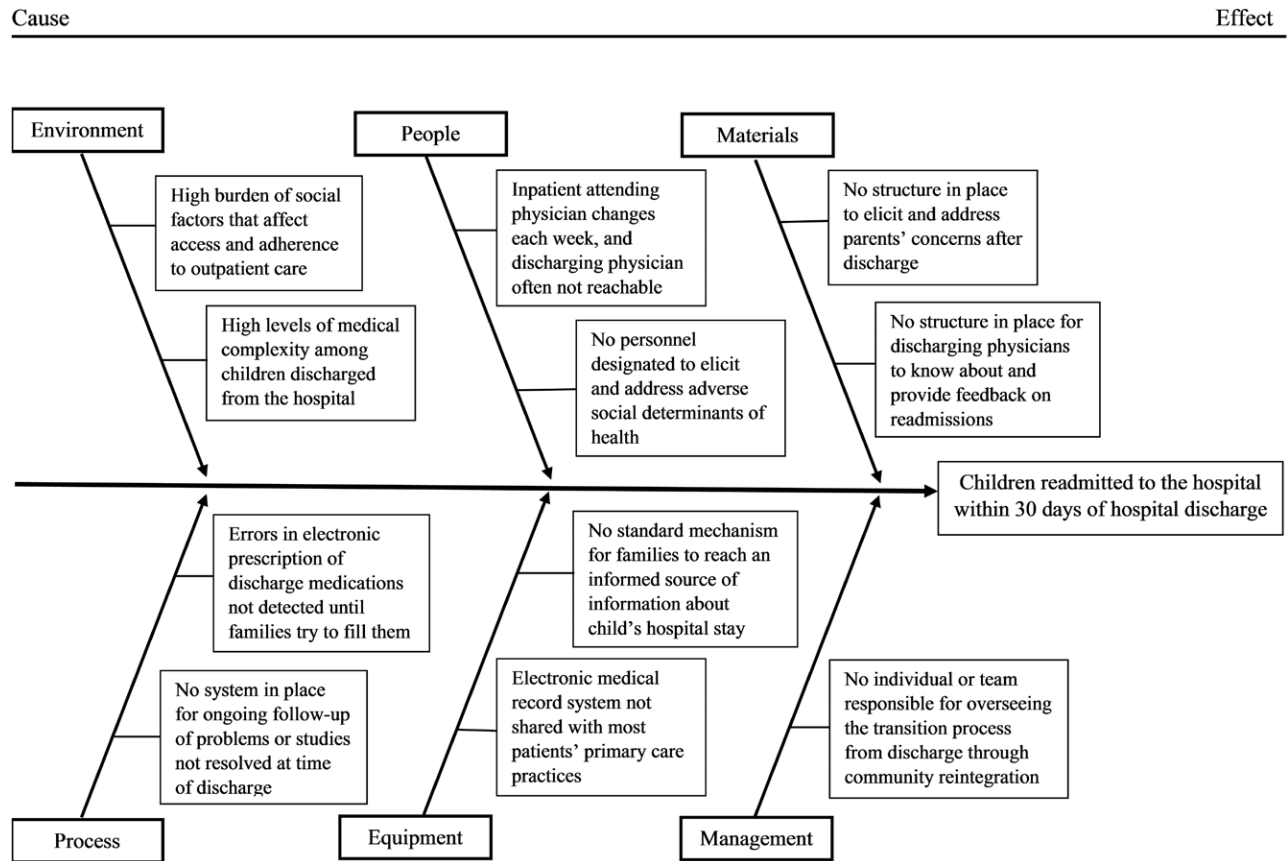


Fig. 1. Fishbone diagram for pediatric readmission reduction intervention bundle.

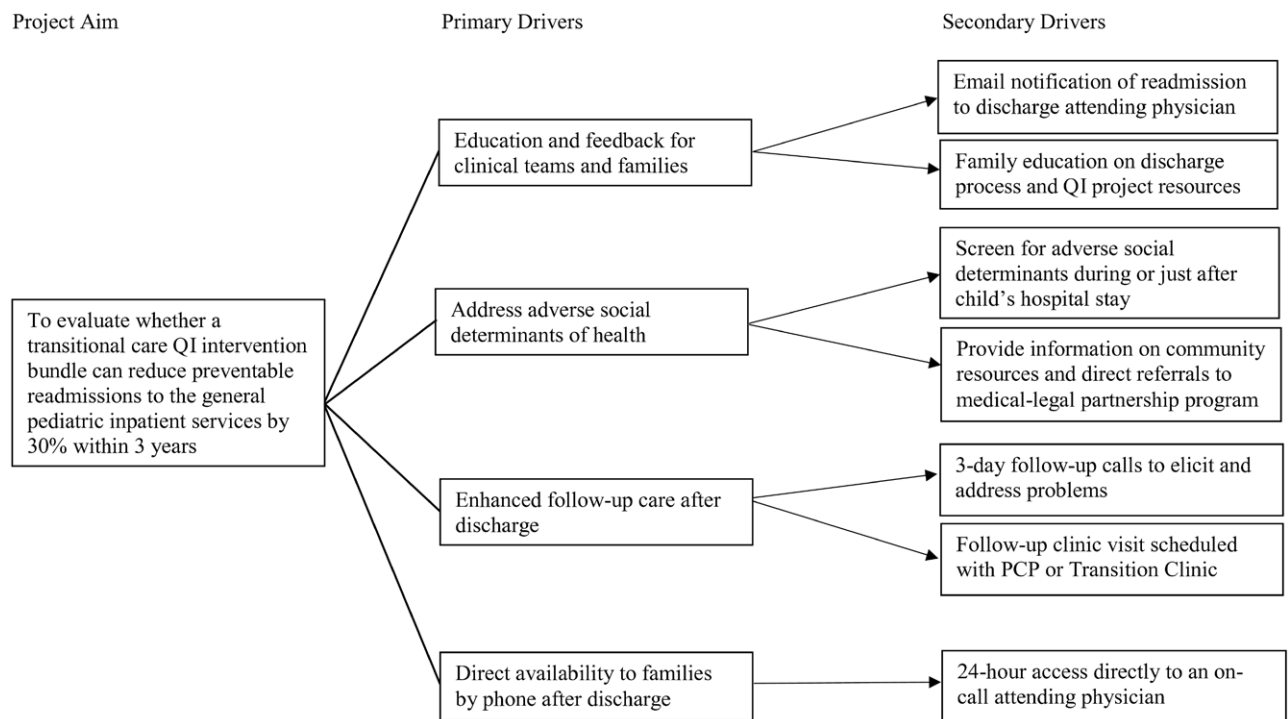


Fig. 2. Key driver diagram for pediatric readmission reduction intervention bundle.

### Direct Availability to Families by Phone

The team created a toll-free number, routed to the cellular phone of the on-call physician, for direct access to clinician support. The project coordinator provided this number to all families before their child's discharge. She counseled families that they could call anytime for help with prescriptions, medical concerns related to the hospitalization, or expedited connection back to a consulting subspecialty service. All patient discharge instructions included this number.

### Project Team

The team included a lawyer and director of the medical-legal partnership, who led the intervention process for adverse SDH; a physician lead/champion, who provided direction for the team, educated other physicians and residents about the project, and attended on the inpatient services; a physician project manager, who saw patients in the hospital-based Transition Clinic and sent follow-up emails about readmissions to discharging physicians; a care coordinator, who assisted with referrals; and a project/transition coordinator, who met families in the hospital, collected data on SDH and readmissions, and made follow-up calls to families to elicit concerns and provide assistance.

### Study of the Intervention Bundle

The team compared 2 time periods to evaluate the effect of the intervention on pediatric readmission rates: (1) a baseline phase of about 22 months (January 2012–October 2013); and (2) an intervention phase of 40 months (November 2013–February 2017). The project coordinator tracked readmission rates for an additional 4 months in a post-intervention period (March 2017–June 2017), during which she no longer met with families in the hospital or made follow-up calls. Components of the intervention began when feasible, then continued throughout the project (Table 1). Staffing limitations led to interruptions for several components. Specifically, the project coordinator could not meet families of children admitted and discharged on a weekend or holiday; she limited 3- and 30-day follow-up calls to 3 attempts; the time required for SDH screening meant that she could not meet all families.

### Measures

The primary outcome was the rate of readmissions to NC Children's Hospital within 30 days of discharge from the 2 general pediatric services. This rate equaled the number of readmissions within 30 days (numerator), divided by the total number of discharges each calendar month from the 2 general pediatric services (denominator), excluding nursery discharges. We excluded from the numerator 2 types of hospitalizations: (1) admission to the inpatient pediatric psychiatry unit on the same day as index medical discharge; and (2) admission for a planned surgical procedure within 30 days of index discharge. Planned surgical procedures were those described in the index discharge documentation.

Secondary outcomes were adverse SDH reported by families. As a balancing measure to assess whether the intervention might affect the index hospitalization, the team tracked hospital length of stay. The electronic health record (EHR) provided demographic information, with time-varying information (such as age) anchored to the date of discharge. A publicly available algorithm, the Pediatric Medical Complexity Algorithm, categorized patients by level of medical complexity according to diagnoses in their EHR problem list.<sup>16</sup>

Weekly EHR reports provided primary outcome data. At 6-month intervals, 2 team members reviewed medical records for all included discharges to assess the accuracy of EHR reports and verify calculated monthly readmission rates. During monthly project meetings, the team reviewed interim outcome reports, discussed contextual challenges to implementation of the intervention, and implemented process improvements. During the project, the hospital system implemented a system-wide readmission risk assessment and intervention focused on adults, but this did not include the children's hospital.

### Analysis

Monthly readmission rates were plotted in a statistical process control chart and analyzed as a time series outcome variable using Excel QI charts version 2013 (Process Improvement Products, Austin, Tex.). Control limits for the P chart were calculated for baseline and with each significant change in the time series. The resulting control chart was labeled with specific interventions to display any associated impact on readmission rates.

## RESULTS

During the 40-month intervention period, the general pediatric services discharged 4,853 children, roughly half of the hospital's pediatric discharges during that period. Half of the intervention patients (49.0%) were women; a majority (53.5%) were 0–5 years of age (Table 2). Racial and ethnic composition was 22.6% black, 47.2% white, and 15.0% Hispanic. Medicaid was the payer for 59.9% of discharges. Regarding medical complexity, 37.7% of children were PMCA 0 (no chronic condition), 20.9% PMCA 1 (non-complex chronic condition), and 41.4% PMCA 2 (complex chronic condition).

### Exposure to Intervention Bundle

Before discharge, nearly all families (99.2% of 4,853) received the toll-free number to reach the on-call physician and an introduction to the transition process (Table 3). The project coordinator conducted SDH screening with 1,394 (28.7%) families. After discharge, 531 families (10.9%) were reached for 3-day follow-up phone calls, until the project team stopped making these calls in July 2015. About 12% of families reached for follow-up reported using the on-call number, commonly for concerns related to discharge medications or to



**Table 1. QI Intervention Bundle Timeline**

Beginning Date	Ending Date	QI Intervention
October 2013	February 2017	Education and feedback for clinical teams; email notification of readmissions; family education on discharge process
January 2014	Ongoing	Scheduling follow-up appointments in the UNC Pediatric Transition Clinic
March 2014	Ongoing	24-hour access to attending physician for discharged families via 1-800 number
February 2015	February 2017	Predischarge visit to families from transition coordinator
March 2015	July 2015	Post-discharge calls within 3 days to identify problems
March 2015	February 2017	Systematic screening and intervention for adverse SDH
April 2015	February 2017	Calls 30-days after discharge to follow-up on identified problems and transition plan

**Table 2. Patient Demographic and Clinical Characteristics, n = 4,853**

Characteristic	Count	Percent
Female	2,379	49.0
Age		
0–5 years	2,635	53.5
6–11 years	923	18.7
12–17 years	1,106	22.4
≥18	267	5.4
Race		
Black	1,098	22.6
White	2,291	47.2
Other or Multiple	1,464	30.2
Ethnicity		
Hispanic	731	15.0
Not Hispanic	3,716	76.6
Unknown	406	8.4
Language		
English	4,205	86.6
Spanish	402	8.3
Other	246	5.1
Primary Payer		
Medicaid*	2,906	59.9
Private Insurance	1,499	30.9
Tricare	448	9.2
Medical complexity†		
PMCA 1	1,830	37.7
PMCA 2	1,014	20.9
PMCA 3	2,009	41.4

\*Includes a small number of patients with Medicare who had kidney failure and were being treated with dialysis.

†Pediatric Medical Complexity Algorithm, version 1.

symptoms related to the reason for hospitalization. The project coordinator reached 1,375 (28.3%) families for 30-day follow-up calls. In those calls, >80% of families reported their child had had a follow-up visit with a doctor. Overall, 386 (8.0%) of discharged children had follow-up visits in the hospital-based Transition Clinic.

### Adverse SDH

Of 1,394 families who completed SDH screening, 48.0% reported at least 1 problem. Most commonly reported were problems accessing disability benefits (33.5%), uninsured adults in the household (14.9%), problems getting appropriate school services for a child (12.3%), problems with transportation for medical appointments (11.1%), household food insecurity (8.5%), and telephone insecurity (7.7%). Other problems included housing insecurity (4.4%), unsafe housing conditions (3.7%), children without health insurance (2.5%), and concerns about family safety (1.4%). Families reporting adverse SDH received information about community resources and direct referrals to our medical-legal partnership.

**Table 3. Proportion of Patients Who Received Components of the Intervention Bundle**

Intervention Overall n = 4,853	n	%
Before discharge		
Provide on-call number and discuss transition process	4,812	99.2
Screen for and address SDH issues	1,394	28.7
After Discharge		
3-day calls*	531	10.9
30-day calls	1,375	28.3
Follow-up in hospital transition clinic	387	8.0

\*Hospital staff took over responsibility for 3-day calls to all discharged patients in July 2015, so these were only made and counted by the project team from March to July 2015.

### Readmissions Over Time

From a baseline readmission rate of 10.3%, the rate declined by 28% to 7.4% during the implementation of the intervention and remained stable through the post-intervention period (Fig. 3). The notable decline in readmission rates happened after the initial bundle was implemented: families began receiving the 1-800 number for the on-call physician; discharging attending physicians began receiving email feedback about readmissions, and the project coordinator began making follow-up calls to families 3 days after discharge. No additional, significant changes were observed in the mean readmission rate after later components of the intervention began. However, as previously noted, the percentage of patients/families who received later components of the intervention was relatively low.

Patients categorized as PMCA 3 (complex chronic disease) experienced a disproportionately high share of readmissions during the project (41.4% of index discharges, but 70.8% of 30-day readmissions). The length of stay increased slightly from baseline (4.10 days in 2013) to post-intervention (4.30 days in 2017).

## DISCUSSION

This multi-component quality improvement project aimed to reduce 30-day pediatric hospital readmissions by addressing inter-related medical, social, and logistical problems. During the intervention, the 30-day readmission rate declined from 10.3% to 7.4%. Based on an average of 164 discharges per month in 2016, this represents 4 to 5 readmissions prevented each month. However, the average length of stay increased slightly. Two strengths of this intervention are its implementation at large-scale in

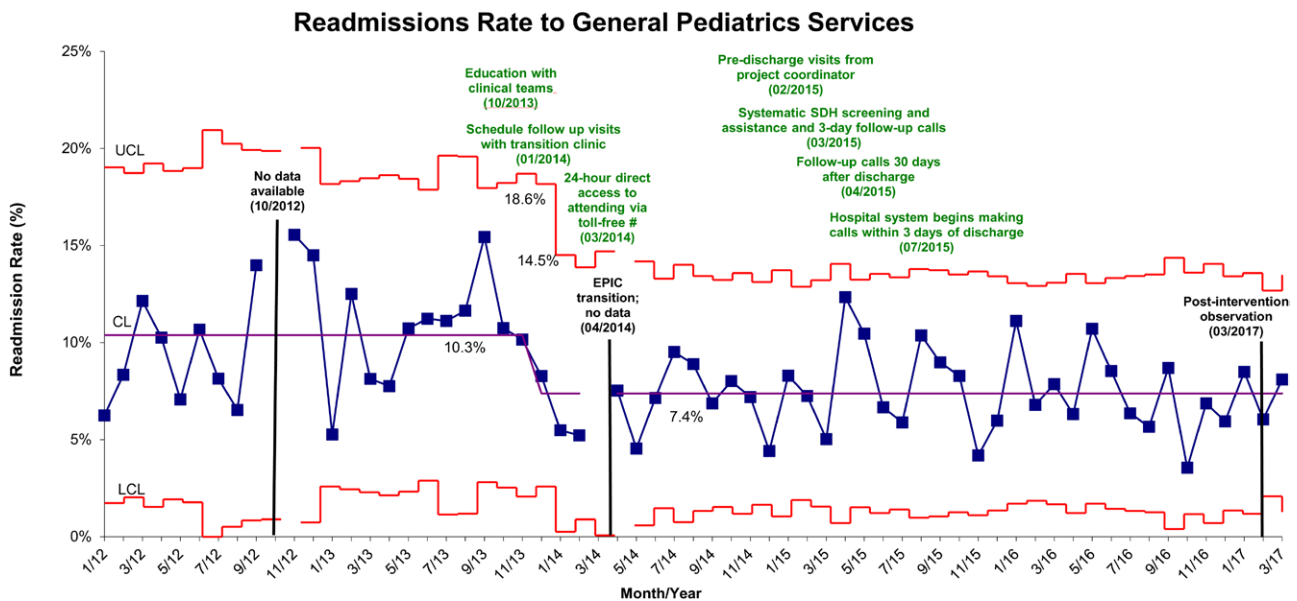


Fig. 3. Statistical process control chart of readmissions over time.

a real-world context and the incorporation of social and logistical interventions with traditional medical ones.

This project’s interventions helped make pediatric discharge a transitional process rather than an event. In particular, 3 initial strategies in the intervention bundle—preparing families for the weeks after discharge, proactive outreach to families after discharge to review the discharge plan, and making attending physicians available by phone to families—coincided with a notable reduction in readmissions. Although these are resource-intensive interventions, they create a continuum of care that guides community reentry and de-escalates care gradually rather than abruptly at discharge. Such investments may not be feasible for all institutions, but the principle of de-escalation rather than abrupt discontinuation is widely generalizable and can be adapted to institutional priorities and resources.

Screening for adverse SDH identified more problems than expected. Of 1,394 families screened, 48% reported at least 1 issue that could affect the health and wellbeing of the child. The transition coordinator provided referrals for all reported issues. However, changes in the average 30-day readmission rate over time were not observed in association with systematic SDH screening and intervention. This finding may be because the screening rate was low (28.7%) or because the time needed to realize health-services-related benefits of mitigating adverse SDH was longer than the 30-day window observed for hospital readmissions. The lack of an observed relationship between addressing adverse SDH and a change in the 30-day readmission rate should not suggest that this particular intervention was ineffective or unimportant. A growing body of evidence highlights the strong relationship between adverse SDH and hospitalization for children,<sup>17,18</sup> and community-level interventions have reduced use of the hospital and emergency room for children with asthma.<sup>19</sup>

Recent publications on pediatric readmissions have focused on their potential preventability<sup>7,20–22</sup> or their feasibility and appropriateness as a quality measure.<sup>23,24</sup> Reviews have found that incorporating multiple components to improve family preparation for discharge, bridge the hospital-to-home transition, and offer ongoing support after discharge were characteristics of interventions that successfully reduced pediatric hospital readmissions.<sup>25–27</sup> This project incorporated those features, which likely contributed to its effectiveness. Experts in pediatric hospital care have begun to develop standards for pediatric discharge<sup>13</sup> and to include population-level adverse SDH in assessments of hospital admission performance.<sup>28</sup>

Several lessons from this project are worth highlighting. First, medical and social problems are interrelated. For example, a rural family who lacks reliable transportation cannot take a child for important follow-up care. Even with excellent outpatient care available, hospital readmission may occur for that child. Effective assessment of children’s medical problems requires attention to social problems. Second, children with both medical and social problems may be at higher risk for readmissions. This transitional intervention targeted the general population of hospitalized children and did not differentiate for those higher-risk groups. Tiering the intervention for high-risk subgroups may be an important future step. Third, hospitalizations offer critical opportunities to address SDH. Many hospitalized patients face adverse SDH that negatively affect health outcomes and likely impact their use of health services. In this project, as the number of reported adverse SDH increased, the chance of 30-day readmission also increased (data not shown). Fourth, community practices play an important role in transitional care. The majority of follow-up visits reported by families took place in community practices. Future efforts

need to facilitate an ongoing exchange of information between community providers and hospital providers to maximize the effectiveness of transitional care.

### Limitations

Some limitations may affect this project's generalizability to other settings and the precision of the findings. First, measuring readmissions at the population level of hospitalized children means that the team could not ascertain reasons for individual readmissions. The case-mix of patients and reasons for hospitalization may differ from those in other institutions in undetectable ways. However, the population-level approach is also a strength. Including all discharged children and providers on the general pediatric services in this project has led to buy-in and sustainment in the institution. Second, implementation in a real-world context is resource-intensive and limited the ability to implement all intervention components for the duration of the project. In particular, staff capacity limited rates of completed, 3-day follow-up calls (10.9%), and screening for and addressing adverse SDH (28.7%). It may be that low rates of completion obscure any potential effect of these components on readmission rates. Future efforts should include dedicated staff for these time-intensive functions and can be adapted to align with institutional priorities. Third, since components of the intervention were not all implemented for the full duration of the project, it is not possible to ascertain the effects of individual components apart from the whole. Finally, other factors we could not account for could have affected readmission rates. For example, heightened attention to readmissions by policymakers and payers could have led clinicians to invest additional effort to prevent them.

### Conclusions

A multi-component intervention bundle that enhances families' discharge preparation and actively bridges the hospital-to-home transition is associated with decreased readmissions to a children's hospital. Such efforts are time-intensive and will need dedicated staffing to sustain. The next steps could include standardizing an intervention bundle for adaptation and testing across diverse settings.

### DISCLOSURE

The authors have no financial interest to declare in relation to the content of this article.

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