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REVIEWS

Pediatric Hospital Discharge Interventions to Reduce Subsequent Utilization: A Systematic Review

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BACKGROUND: Reducing avoidable readmission and posthospitalization emergency department (ED) utilization has become a focus of quality-of-care measures and initiatives. For pediatric patients, no systematic efforts have assessed the evidence for interventions to reduce these events.

PURPOSE: We sought to synthesize existing evidence on pediatric discharge practices and interventions to reduce hospital readmission and posthospitalization ED utilization.

DATA SOURCES: PubMed and the Cumulative Index to Nursing and Allied Health Literature.

STUDY SELECTION: Studies available in English involving pediatric inpatient discharge interventions with at least 1 outcome of interest were included.

DATA EXTRACTION: We utilized a modified Cochrane Good Practice data extraction tool and assessed study quality with the Downs and Black tool.

DATA SYNTHESIS: Our search identified a total of 1296 studies, 14 of which met full inclusion criteria. All included studies examined multifaceted discharge interventions initiated in the inpatient setting. Overall, 2 studies demonstrated statistically significant reductions in both readmissions and subsequent ED visits, 4 studies demonstrated statistically significant reductions in either readmissions or ED visits, and 2 studies found statistically significant increases in subsequent utilization. Several studies were not sufficiently powered to detect changes in either subsequent utilization outcome measure.

CONCLUSIONS: Interventions that demonstrated reductions in subsequent utilization targeted children with specific chronic conditions, providing enhanced inpatient feedback and education reinforced with postdischarge support. Interventions seeking to reduce subsequent utilization should identify an individual or team to assume responsibility for the inpatient-to-outpatient transition and offer ongoing support to the family via telephone or home visitation following discharge. *Journal of Hospital Medicine* 2014;9:251–260. © 2013 Society of Hospital Medicine

The process of discharging a pediatric patient from an acute care facility is currently fraught with difficulties. More than 20% of parents report problems in the transition of care from the hospital to the home and ambulatory care setting.[1] Clinical providers likewise note communication challenges around the time of discharge,[2,3] especially when inpatient and outpatient providers are different, as with the hospitalist model.[4] Poor communication and problems in discharge transition and continuity of care often culminate in adverse events,[5,6] including return to emergency department (ED) care and hospital readmission.[7]

Thirty-day readmissions are common for certain pediatric conditions, such as oncologic diseases, transplantation, and sickle cell anemia and vary significantly across children's hospitals.[8] Discharge planning may decrease 30-day readmissions in hospitalized adults[9]; however, it is not clear that the same is true in children. Both the preventability of pediatric readmissions[10] and the extent to which readmissions reflect suboptimal care[11] are subjects of debate. Despite these uncertainties, collaborative efforts intended to decrease pediatric readmissions[12] and improve discharge transitions[13,14] are underway.

To inform these debates and efforts, we undertook a systematic review of the evidence of hospital-initiated interventions to reduce repeat utilization of the ED and hospital. Acknowledging that existing evidence for condition-specific discharge interventions in pediatrics might be limited, we sought to identify common elements of successful interventions across pediatric conditions.

METHODS

Search Strategy

With the assistance of a research librarian, we searched MEDLINE and CINAHL (Cumulative Index to Nursing and Allied Health Literature) from the inception of these databases through to March 28, 2012 (for search strategies, see the Supporting

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Information, Appendix, Part 1, in the online version of this article).

Study Selection

Two authors (K.A. and C.K.) independently reviewed abstracts identified by the initial search, as well as abstracts of references of included articles. Eligibility criteria for inclusion in full review included: (1) discharge-oriented process or intervention initiated in the inpatient setting, (2) study outcomes related to subsequent utilization including hospital readmission or emergency department visit after hospitalization, (3) child- or adolescent-focused or child-specific results presented separately, and (4) written or available in English. If abstract review did not sufficiently clarify whether all eligibility criteria were met, the article was included in the full review. Two authors (K.A. and C.K.) independently reviewed articles meeting criteria for full review to determine eligibility. Disagreements regarding inclusion in the final analysis were discussed with all 4 authors. We excluded studies in countries with low or lower-middle incomes,[15] as discharge interventions in these countries may not be broadly applicable.

Data Abstraction, Quality Assessment, and Data Synthesis

Two authors (K.A. and C.K.) independently abstracted data using a modified Cochrane Collaboration data collection form.[16] We independently scored the included studies using the Downs and Black checklist, which assesses the risk of bias and the quality of both randomized and nonrandomized studies.[17] This checklist yields a composite score of 0 to 28 points, excluding the item assessing power. As many studies either lacked power calculations or included power calculations based on outcomes not included in our review, we performed calculations to determine the sample size needed to detect a decrease in readmission or ED utilization by 20% from baseline or control rates. Due to the heterogeneous nature of included studies in terms of population, interventions, study design, and outcomes, meta-analysis was not performed.

RESULTS

Electronic search yielded a total of 1296 unique citations. Review of abstracts identified 40 studies for full article review. We identified 10 articles that met all inclusion criteria. Subsequent review of references of included articles identified 20 additional articles for full review, 7 of which met all inclusion criteria. However, 3 articles[18–20] assessed the impact of violence interventions primarily on preventing reinjury and recidivism and thus were excluded (see Supporting Information, Appendix, Part 2, in the online version of this article for findings of the 3 articles). In total, we included 14 articles in our review[21–34] (Figure 1).

Patient Populations and Intervention Timing and Components

Studies varied regarding the specific medical conditions they evaluated. Eight of the papers reported discharge interventions for children with asthma, 5 papers focused on discharge from the neonatal intensive care unit (NICU), and a final study discussed a discharge intervention for children with cancer (Table 1). Although our primary goal was to synthesize discharge interventions across pediatric conditions, we provide a summary of discharge interventions by condition (see Supporting Information, Appendix, Part 3, in the online version of this article).

Studies varied regarding the timing and nature of the intervention components. Eight discharge interventions included a major inpatient component, in addition to outpatient support or follow-up.[21,23–26,29,32,34] Two studies included an inpatient education component only.[22,27] The remainder were initiated during index hospitalization but focused primarily on home visitation, enhanced follow-up, and support after discharge (Figure 2).[28,30,31,33]

Outcome Assessment Methods

Readmission and subsequent ED utilization events were identified using multiple techniques. Some authors accessed claims records to capture all outcomes.[30,33] Others relied on chart review.[21,25–28,31,32] One study supplemented hospital records with outpatient records.[24] Some investigators used parental reports.[22,23,31] Two studies did not describe methods for identifying postdischarge events.[29,34]

Study Quality

The quality of the included studies varied (Table 2). Many of the studies had inadequate sample size to detect a difference in either readmission or ED visit subsequent to discharge. Eight studies found differences in either subsequent ED utilization, hospitalization, or both and were considered adequately powered for these specific outcomes.[21,23,25,26,28,30–32] In contrast, among studies with readmission as an outcome, 6 were not adequately powered to detect a difference in this particular outcome.[24,30–34] In these 6 studies, all except 1 study[30] had <10% of the sample size required to detect differences in readmission. Further, 2 studies that examined ED utilization were underpowered to detect differences between intervention and control groups.[24,26] We were unable to perform power calculations for 3 studies,[22,27,29] as the authors presented the number of events without clear denominators.

Excluding the assessment of statistical power, Downs and Black scores ranged from 10 to 23 (maximum 28 possible points) indicating varying quality.

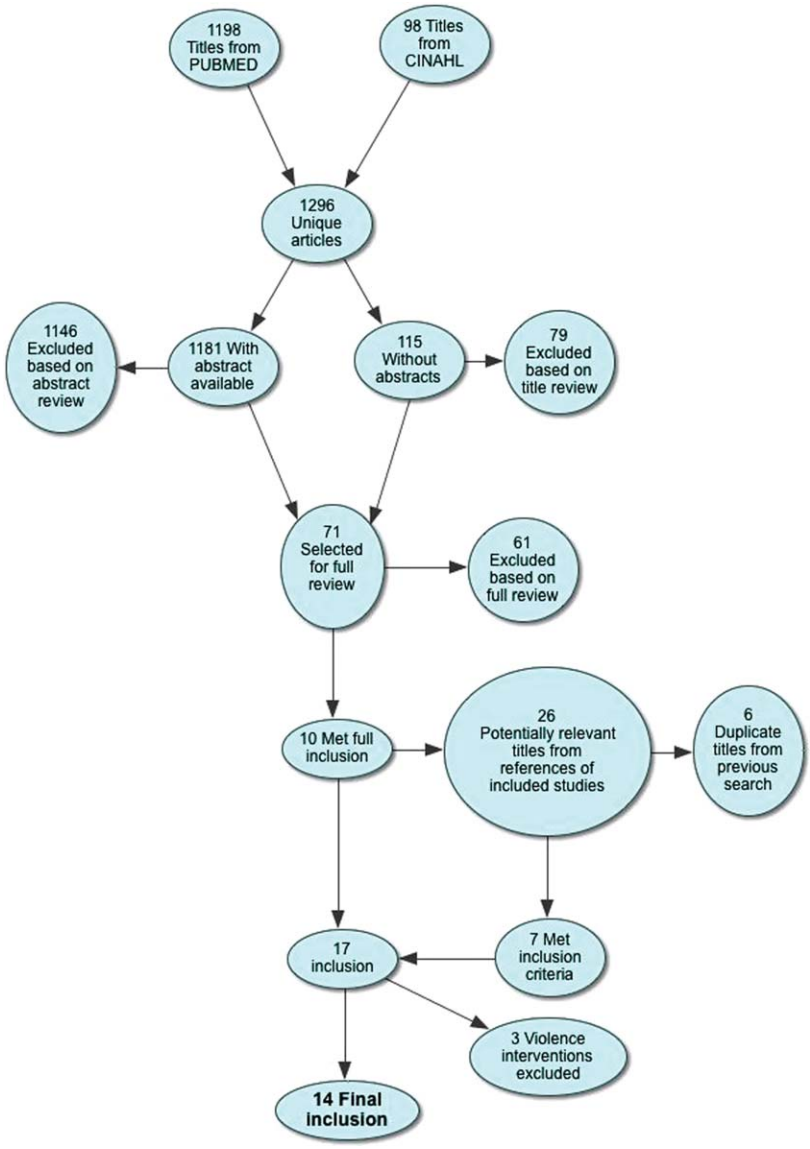

FIG. 1. Study inclusion. CINAHL, Cumulative Index to Nursing and Allied Health Literature.

As would be expected with discharge interventions, studies did not blind participants; 2 studies did, however, appropriately blind the outcome evaluators to intervention assignment.[22,30] Even though 10 out of the 14 studies were randomized controlled trials, randomization may not have been completely effective due to sample size being too small for effective randomization,[31] large numbers of excluded subjects after randomization,[30] and unclear randomization process.[34] Several studies had varying follow-up periods for patients within a given study. For example, 3 NICU studies assessed readmission at 1-year corrected age,[30,31,33] creating the analytic difficulty that the amount of time a given patient was at risk for readmission was dependent on when the patient was discharged, yet this was not accounted for in the analyses. Only 2 studies demonstrated low rates of loss to follow-up (<10%).[30,33] The remainder of the studies either had high incompletion/loss to follow-up rates (>10%)[22,24,31] or did not report rates.[21,23,25–29,32,34] Finally, 3 studies recruited patients from multiple sites,[24,31,33] and none adjusted for potential differences in effect based on enrollment site.

Findings Across Patient Populations Regarding Readmission

Of the 4 studies that demonstrated change in overall readmission,[23,25,26,28] all were asthma focused; 3 demonstrated a decrease in readmissions,[23,25,26] and 1 an increase in readmissions.[28] The 3 effective interventions included 1-on-1 inpatient education delivered by an asthma nurse, in addition to postdischarge follow-up support, either by telephone or clinic visit. Two of these interventions provided rescue oral steroids to some patients on discharge.[25,26] In contrast, a study from New Zealand evaluated a series of postdischarge

TABLE 1. Study Descriptions

Author, Year	Study Design	Age	Inclusion	Exclusion	Intervention	Control
Asthma						
Davis, 2011[21]	Retrospective matched case control	12 months–18 years	Admitted for asthma at a single hospital in California.		45 minutes of enhanced asthma education and phone call 3 weeks after discharge (n = 698)	Patients were matched on age and past utilization who received standard education/care (n = 698)
Espinoza-Palma, 2009[22]	RCT	5–15 years	Admitted for asthma at a single hospital in Chile.	Chronic lung disease or neurologic alteration.	Self-management education program with a postdischarge game to reinforce educational concepts (n = 42)	Standard education (n = 46)
Ng, 2006[23]	RCT	2–15 years	Admitted for asthma in a pediatric ward at a single hospital in China.	Admitted to PICU or non-Chinese speaking.	Evaluation by asthma nurse, animated asthma education booklet, 50-minute discharge teaching session, follow-up by phone at 1 week (n = 55)	Evaluation by asthma nurse by physician referral, a written asthma education booklet, 30-minute discharge teaching session (n = 45)
Stevens, 2002[24]	RCT	18 months–5 years	In ED or admitted with primary diagnosis of asthma/wheezing at 2 hospitals in the United Kingdom.	Admitted when no researcher available.	Enhanced asthma education and follow-up in a clinic 1 month after encounter (n = 101)	"Usual care" (n = 99)
Wesseldine, 1999[25]	RCT	2–16 years	Admitted for asthma at a single hospital in the United Kingdom.	Admitted when no researcher available.	20 minutes of enhanced asthma education including: guided self-management plan, booklet, asthma hotline contact, and sometimes oral steroids (n = 80)	Standard discharge that varied by provider (n = 80)
Madge, 1997[26]	RCT	2–14 years	Admitted for asthma at a single hospital in the United Kingdom.	Admitted on weekend.	45 minutes of enhanced asthma education with written asthma plan, a nurse follow-up visit 2–3 weeks postdischarge, telephone support, and a course of oral steroids (n = 96)	Standard education (did not include written asthma plan) (n = 105)
Taggart, 1991[27]	Pre-post	6–12 years	Admitted for asthma at single institution in Washington, DC with history of at least one ED visit in prior 6 months.	If resided outside of metro area.	Received written educational materials, adherence assistance, discussed "emotions of asthma," video education provided, and tailored nursing interactions (n = 40)	Enrolled patient's prior utilization
Mitchell, 1986[28]	RCT	>2 years	Admitted for asthma at single institution in New Zealand.	Having a previous "life-threatening" attack.	6 monthly postdischarge education sessions on lung anatomy/physiology, triggers and avoidance, asthma medication, advice on when and where to seek care (n = 94 children of European descent, n = 84 children of Polynesian descent)	Standard discharge (n = 106 children of European descent; n = 84 children of Polynesian descent)
Cancer						
Caliskan Yilmaz, 2009[29]	Quasiexperimental	<18 years	New oncologic diagnoses in hospital in Turkey.	Children who died during follow-up.	Frequent needs assessment, education, home visits, fever guidance, telephone consultation, and manual for home care; patients lived in Izmir (n = 25)	Routine hospital services without "formal education"; patients lived outside of Izmir (n = 24)
NICU						
Broyles, 2000[30]	RCT	Neonate	Infants with birth weight <1500 g with mechanical vent use in 48 hours of life, born at single NICU in Texas.	Infant death, infant adopted or moved out of enrollment county.	Specialized follow-up available 5 days a week for well or sick visits; access to medical advice via phone 24 hours a day, transportation to ED provided when needed; home visitation, parent education, and "foster grandmother" offered (n = 446)	Specialized follow-up available 2 mornings a week for well or sick visits; all other sick visits to be made through acute care clinic or ED (n = 441)
Finello, 1998[31]	RCT	Neonate	Infants with birth weight between 750 and1750 g; discharged from 2 NICUs in California.	Infants with "gross abnormalities."	Three separate intervention groups (n = 20 in each): (1) home health—home visits during the first 4 weeks after discharge, with physician consultation available at all times; (2) home visiting—health and development support, parental support, support with referral services for 2 years after discharge; (3) home health and home visiting arms combined	Standard discharge (n = 20).

TABLE 1. *Continued*

Author, Year	Study Design	Age	Inclusion	Exclusion	Intervention	Control
Kotagal, 1995[32]	Pre-post	Neonate	Infants discharged from a single NICU in Ohio.		Patients (n = 257) discharged after restructuring of discharge practices including: removal of discharge weight criteria, engagement of family prior to discharge, evaluation of home environment prior to discharge, and arrangement of home health visits and follow-up	Patients discharged before discharge restructuring (n = 483)
Casiro, 1993[33]	RCT	Neonate	Infants meeting discharge criteria from 1 of 2 NICUs in Canada.	Congenital anomalies, chronic neonatal illness, parent refusal, family complications, and death.	Early discharge based on prespecified criteria with 8 weeks of services including: assistance with infant care, sibling care and housekeeping; nurse availability via phone; follow-up phone calls and home visitation tailored to family need (n = 50)	Discharged at the discretion of their attending physicians; standard newborn public health referral for routine follow-up (n = 50)
Brooten, 1986[34]	RCT	Neonate	Infants born <1500 g at a single NICU in Pennsylvania.	Death, life-threatening congenital anomalies, grade 4 IVH, surgical history, O_2 requirement >10 weeks, family complications.	Early discharge based on prespecified criteria with weekly education prior to discharge, postdischarge follow-up phone call, and home nurse visitation; consistent nurse availability via phone (n = 39)	Standard discharge practices with a discharge weight minimum of 2.2 kg (n = 40)

NOTE: **Abbreviations:** ED, emergency department; IVH, intraventricular hemorrhage; NICU, neonatal intensive care unit; PICU, pediatric intensive care unit; RCT, randomized controlled trial.

visits using an existing public health nurse infrastructure and demonstrated an increase in readmission between 6 to 18 months after admission in European children.[28] An additional study focused on outpatient support after discharge from the NICU, and demonstrated a lower frequency of readmission to the intensive care unit without overall reduction of hospital readmission (Tables 1 and 2).[30]

Findings Across Patient Populations Regarding Subsequent ED Visits

Of all the discharge interventions, 6 demonstrated differences in return to the ED after discharge. Five studies described a decrease in ED visits after hospitalization,[23,25,30–32] and 1 showed an increase.[21] Three studies in the NICU population demonstrated decreased ED utilization through a combination of augmented family engagement during hospitalization and/or enhanced support after discharge. Two inpatient asthma education interventions with structured postdischarge follow-up decreased return visitation to the ED.[23,26] The intervention that worsened subsequent ED utilization (ie, increased ED visit hazard compared to matched controls) provided enhanced inpatient education to a nonrandom group of children hospitalized with asthma and provided a follow-up phone call 3 weeks after discharge (Tables 1 and 2).[21]

DISCUSSION

In this review, we synthesized evidence regarding pediatric hospital discharge-focused interventions intended to reduce subsequent utilization through decreased readmission and ED visits. Our review identified 14 studies clustered in 3 clinical areas: asthma, NICU care (chiefly prematurity), and cancer. Overall, 6 interventions demonstrated a reduction either in subsequent hospitalization or ED use. Four of the 6 positive interventions included both an enhanced inpatient education and engagement component as well as enhanced follow-up after discharge. Importantly, all of the interventions were multifaceted; thus, we could not ascertain which specific aspects of the interventions mediated the change. Many of the included studies had significant methodological limitations.

Current Conceptual Framework

There are a number of existing discharge transitional care frameworks from prior studies[35,36] and professional societies.[37] The Stepping Up to the Plate (SUTTP) alliance, a collaborative of 9 professional organizations, including the American Academy of Pediatrics, introduced 1 such framework in 2007. SUTTP sought to enhance care transitions by outlining principles of discharge transitional care including: (1) enhanced accountability, (2) creation of a central "coordination hub" charged with communicating expectations for care, (3) clear and direct communication of treatment plans and follow-up, (4) timely feedback/feed-forward

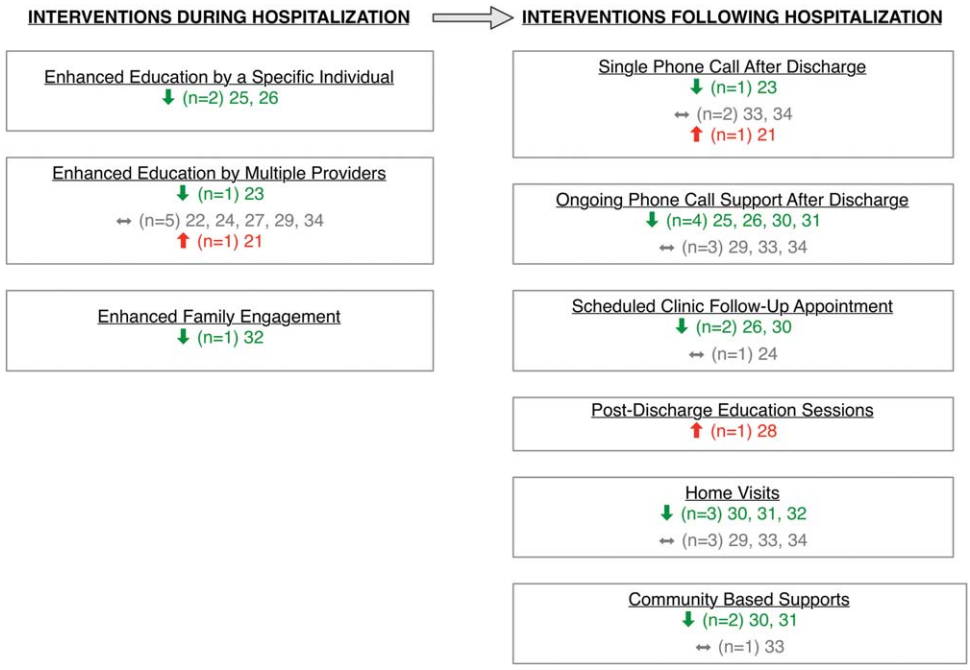

FIG. 2. Studies in green indicate improved/decreased subsequent utilization. Studies in gray indicate no change. Studies in red indicate worsened/increased subsequent utilization.

of relevant information, and (5) involvement of family member at every stage.[38] In the context of the SUTTP framework, we present 3 hypotheses based on our findings to guide future work.

Hypothesis: Appointing a Dedicated Individual or Coordinating Hub Reduces Subsequent Utilization

Ostensibly, each discharge intervention included in this review sought to enhance accountability of providers or their health systems for discharge transitional care. Two of the asthma interventions appointed a particular provider to coordinate the discharge transition and demonstrated reductions in readmission.[25,26] The successful NICU discharge interventions provided an integrated accountability structure across the health system, with a transition of accountability to an outpatient provider or central coordinating hub available to provide assistance and resources for an extended period following discharge.

By contrast, interventions with more than 1 individual intervener or without a centrally coordinated system for discharge transitional care tended not to demonstrate reduction in subsequent utilization.[21,24,27,28] In fact, the 1 asthma intervention that utilized a previously existing public health nurse infrastructure demonstrated an increase in readmission.[28] Future efforts to enhance transitional care might investigate directly the impact of accountability structure on subsequent utilization by varying the number of effector individuals or the organization to which they report (eg, hospital system vs public health department).

Hypothesis: Individualized Task Learning and Feedback Enhances Effectiveness

Studies varied with respect to the extent they incorporated the principles of enhanced communication of the treatment and follow-up plan and timely feedback/feed-forward of relevant information. Successful efforts, however, seemed to embrace these strategies. Each of the 3 interventions that demonstrated readmission reduction[23,25,26] developed an individualized treatment plan during hospitalization, with either a specific follow-up plan or resources for outpatient support. Two of these interventions assessed asthma inhaler technique prior to discharge, creating an inpatient audit and feedback loop allowing for assessment of competence prior to discharge. Audit and feedback has demonstrated promise modifying provider behavior[39] and is a plausible approach to enhancing patient and family self-care.

Hypothesis: Timing of Intervention Enhances Effectiveness

Discrete sentinel events such as inpatient admission, may serve as a "teachable moment"[40,41] or a "tipping point"[42] for some patients/families to initiate behavior change. Four of the 6 positive studies had a robust inpatient education component. By providing enhanced inpatient support, providers may be engaging the family at a timely opportunity to improve care. Both timing of the intervention (at admission vs discharge) and content (education- vs family-engagement focused) are likely important to their effect and should be further explored with prospective study.

TABLE 2. Study Quality and Findings

Author, Year	Study Design	D&B Score*	Adequately Powered (Yes/No)**	Timing of Outcome	Major Findings	Major Limitations
Asthma						
Davis, 2011[21]	Retrospective matched case control	14	Readmission: N/A; ED: yes	1 year	Patients with enhanced education had higher hazards of return to ED visit.	Intervention not randomized; only 29% of eligible children enrolled with unclear selection decisions due to lack of study personnel or caregiver presence in hospital; only 67% completed the intervention; 50% of patients were not "local"; follow-up was not well described.
Espinoza-Palma, 2009[22]	RCT	19	Readmission: †; ED:†	1 year	No difference between the intervention and control in hospitalizations or ED visits. ED visits and hospitalizations decreased in year after compared to the year prior for both intervention and control.	Pre-post analysis with similar effects in cases and controls, results may reflect regression to mean; follow-up was not well described, and 12.5% who were lost to follow-up were excluded from analysis; study was in Chile with different demographics than in the United States.
Ng, 2006[23]	RCT	20	Readmission: yes; ED: yes	3 months	Patients in the intervention group were less likely to be readmitted or visit the ED.	Recruitment/refusal was not well described; number lost to follow-up was not reported; study was in China with different demographics than the United States.
Stevens, 2002[24]	RCT	20	Readmission: no ED: no	1 year	No differences between intervention and control for any outcomes.	11% were lost to follow-up; number of patients who refused was not reported; analysis did not adjust for site of recruitment (ED vs inpatient); 30% of children did not have a prior diagnosis of asthma; study was in England with different demographics than in the United States.
Wesseldine, 1999[25]	RCT	20	Readmission: yes; ED: yes	6 months	Patients in intervention group less likely to be readmitted or visit ED.	Unclear if intervention group received oral steroids that might drive effect; number lost to follow-up was not reported; high miss rate for recruitment; study was in England with different demographics than the United States.
Madge, 1997 [26]	RCT	22	Readmission: yes; ED: no	2–14 months	Patients in intervention group were less likely to be readmitted compared to controls. No differences in repeat ED visits.	Unclear if education or oral steroids drove effect; number of patients who refused or were lost to follow-not reported; time to outcome (2–14 months) varied for different patients, which may introduce bias given the seasonality of asthma; study was in Scotland with different demographics than the United States.
Taggart, 1991[27]	Pre-post	12	Readmission:†; ED:†	15 months	Overall there was no change in ED or hospitalization utilization from pre to post. When limited to children with severe asthma, there was a decrease in ED utilization after the intervention compared to prior ED use.	Use of historical utilization as a comparison does not account for potential effects of regression to mean or improvement with age; over one-half of eligible patients were excluded due to lack of consent or inability to collect baseline data; inclusion criterion did not specify that prior utilization was necessarily for asthma exacerbation; number lost to follow-up was not reported.
Mitchell, 1986[28]	RCT	14	Readmission: yes‡; ED: N/A	6 months and 6–18 months	Increase in percentage of readmission between 6 and 18 months for children of European descent.	Unclear exclusion criterion; full compliance with intervention only 52%; number of patients lost to follow-up (outcome) was not reported; statistical analysis was not clearly described.
Cancer						
Caliskan Yilmaz, 2009[29]	Quasiexperimental	10	Readmission:†; ED: N/A	Not specified	For the first readmission to the hospital, more of the readmissions were planned in the intervention group compared to the control group. Number of readmissions was not assessed.	Intervention was not randomized; children who died were excluded (4%); planned vs unplanned distinction not validated; unclear cointerventions regarding chemotherapy administration; recruitment and follow-up was not well described; not all comparisons were described in methods.
NICU						
Broyles, 2000[30]	RCT	23	Readmission: no; ED: yes	At 1 year adjusted age	Overall hospitalization rates were similar but there were fewer admissions to the ICU. Intervention group had fewer ED visits. Total costs were less in intervention group.	10% refused to participate or consent was "not sought," and 12% were excluded after randomization; different periods of follow-up (outcomes observed at 1 year of life regardless of discharge timing); analysis did not adjust for site of recruitment (1 of 2 nurseries).

TABLE 2. *Continued*

Author, Year	Study Design	D&B Score*	Adequately Powered (Yes/No)**	Timing of Outcome	Major Findings	Major Limitations
Finello, 1998[31]	RCT	11	Readmission: no[§]; ED: yes	At 6 months adjusted age and between 6 and 12 months adjusted age	No changes in hospitalization rates.[§] The home health + home visit arm had fewer ED visits between 6 and 12 months of life. Intervention was reported as saving money by decreasing initial length of stay.	Inclusion and exclusion criteria, recruitment/refusal, outcomes, and analysis plan were not clearly described; sample size was too small for effective randomization; different periods of follow-up (outcomes observed at 1 year of life regardless of discharge timing); analysis did not adjust for site of recruitment; 15% of outcomes were missing.
Kotagal, 1995[32]	Pre-post	15	Readmission: no; ED: yes	14 days	Decreased number of ED visits in patients in intervention. No difference in readmission. Costs and length of stay were less in intervention.	Designed to decrease length of stay; pre-post nature of study allows for possibility of other changes to practices other than the intervention.
Casiro, 1993[33]	RCT	18	Readmission: no; ED: N/A	1 year of life	There were no differences in the readmissions or number of ambulatory care visits after discharge. Infants were discharged earlier in the intervention group, which resulted in cost savings.	Designed to decrease length of stay; 13% refused or were excluded due to "family complications"; and 8% were lost to follow-up; different periods of follow-up (outcomes observed at 1 year of life regardless of discharge timing); analysis did not adjust for site of recruitment (1 of 2 nurseries); 81% of infants were born to Caucasian women, which may limit generalizability.
Brooten, 1986[34]	RCT	15	Readmission: no; ED: N/A	14 days and 18 months	No difference in readmission. Significantly lower charges during initial hospitalization for intervention group.	Designed to decrease length of stay; unclear when randomization occurred and exclusions unclear; 12.5% were excluded due to refusal or "family issues"; follow-up not well described, and loss to follow-up was unknown.

NOTE: **Abbreviations:** D&B score, Downs and Black score; ED, emergency department; ICU, intensive care unit; N/A, not available; RCT, randomized controlled trial.

*Out of a possible 28 points.

**Adequate sample size to detect a decrease by 20% from the control rate, assuming equal sample size in both arms and power = 0.8. Studies that demonstrated a significant change in outcome are defined as having adequate power.

[†]Unable to calculate due to presentation of data.

[‡]Mitchell demonstrated change in admissions between 6 and 18 months for children of European descent, but the study was not powered to detect differences at <6 months or in children of Polynesian descent.

[§]Finello reports decrease in ED visits between 6 and 12 months for home health + home visit arm compared to other groups. They also report a decrease in the number of children with readmission >24 hours at <6 months postdischarge for this group compared to other groups. The intervention was not powered to detect differences at other time periods for ED visits or overall readmissions.

Persistent Literature Gaps

Follow-up with a primary care provider after discharge is another intervention that might decrease postdischarge utilization. We did not identify any studies that specifically examined primary care follow-up. However, 2 studies[43,44] that did not meet our inclusion criteria (because they included adults and did not stratify by age group in the analysis) examined any outpatient follow-up after discharge using state-specific Medicaid claims. One study found that outpatient follow-up after sickle cell hospitalization was associated with lower rates of readmission.[43] The other found no difference in readmission across multiple conditions.[44] One recent review of outpatient follow-up from the ED for asthma found that even when increases in follow-up were achieved, no reduction in the subsequent utilization was observed.[45]

Additional important questions remain underexplored. First, are condition-specific interventions superior to those that span conditions? All of the interventions that demonstrated reductions in readmission were condition-specific, yet no generic interventions met our inclusion criteria. Importantly, only 1 study[29] in our review examined discharge processes from 1 of the pediatric conditions with the most variation[8] in readmission. Further, no studies focused on children with complex medical conditions, who are known to be at increased risk of readmission,[46] indicating a sizable knowledge gap persists in understanding how to prevent readmissions in the most vulnerable pediatric populations.

Lastly, who are the most appropriate effector individuals for discharge-focused transitional care interventions? Demographically matched effector individuals have shown promise in improving care using community health workers.[47,48] The degree to which the identity of the intervener mediates subsequent ED and hospital utilization warrants further investigation.

Limitations of This Systematic Review

The studies included in this review assessed different outcomes at different intervals, precluding meta-analysis. With greater consistency in the collection of data on the quality of discharge processes and their subsequent outcomes, future studies may offer further clarity as to which discharge-oriented practices are more effective than others. Because we only identified literature in 3 pediatric conditions, generalizability beyond these conditions may be limited. The settings of the interventions also occurred in multiple countries; we excluded countries from low or low-middle incomes to facilitate generalizability. As many of the discharge processes contained multiple interventions, it is not possible to ascertain which, if any, singular action may decrease posthospitalization utilization. Additionally, some of the included interventions are older, and it is plausible that discharge processes have evolved with the expansion of the hospitalist model.

Methods of data collection influence the quality of results in the included studies. Most of the studies included in this review used either medical record review or parental self-report of utilization. Parental report may be sufficient for hospitalizations and ED utilization; however, it is subject to recall bias. Chart review likely underestimates the number of postdischarge events, depending on the individual institution's proportion of the market and the tendency of individuals to seek care at multiple institutions. Claims data may offer the most accurate assessments of ED and hospital utilization and cost, but can be more difficult to obtain and do not provide the same potential for granularity as parent report or medical records review.

Finally, subsequent ED visits, readmissions, and cost may not be the best measures of the quality of discharge transitional care. A number of tools have been developed to more specifically evaluate the quality of transitional care in adults,[49,50] including a validated instrument that consists of only 3 items,[50] which primarily assesses the extent to which patients are prepared for self-care upon discharge. For pediatric populations, validated tools assessing caregiver experience with discharge[51] and discharge readiness[52] are also available. These instruments may assist those interested in assessing process-related outcomes that specifically assess discharge transitional care elements and may mediate subsequent ED visits or hospitalizations.

CONCLUSION

Successful discharge interventions to reduce pediatric readmission and ED have some common features, including an individual or team with specialized knowledge of the condition that assumed responsibility for the inpatient-to-outpatient transition and offered ongoing support to the family following discharge. All studies included in our review examined multiple discharge interventions; however, many did not have enough participants to detect differences in the outcomes of interest. Future studies might adapt common features of effective interventions, which are consistent with professional societies' recommendations.

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