Postdischarge Nurse Home Visits and Reuse: The Hospital to Home Outcomes (H2O) Trial

Katherine A. Auger, MD, MSc,[a,b,c] Jeffrey M. Simmons, MD, MSc,[a,b,c] Heather L. Tubbs-Cooley, PhD, RN,[d,e] Heidi J. Sucharew, PhD,[c,f] Angela M. Statile, MD, MEd,[a,c] Rita H. Pickler, PhD, RN,[e] Hadley S. Sauers-Ford, MPH,[g] Jennifer M. Gold, MSN, RN,[d] Jane C. Khoury, PhD,[c,f] Andrew F. Beck, MD, MPH,[a,c,h] Susan Wade-Murphy, MSN, RN,[d] Pierce Kuhnell, MS,[f] Samir S. Shah, MD, MSCE,[a,b,c] on behalf of the H2O Trial study group

abstract

BACKGROUND: Hospital discharge is stressful for children and families. Poor transitional care is linked to unplanned health care reuse. We evaluated the effects of a pediatric transition intervention, specifically a single nurse home visit, on postdischarge outcomes in a randomized controlled trial.

METHODS: We randomly assigned 1500 children hospitalized on hospital medicine, neurology services, or neurosurgery services to receive either a single postdischarge nurse-led home visit or no visit. We excluded children discharged with skilled home nursing services. Primary outcomes included 30-day unplanned, urgent health care reuse (composite measure of unplanned readmission, emergency department, or urgent care visit). Secondary outcomes, measured at 14 days, included postdischarge parental coping, number of days until parent-reported return to normal routine, and number of "red flags" or clinical warning signs a parent or caregiver could recall.

RESULTS: The 30-day reuse rate was 17.8% in the intervention group and 14.0% in the control group. In the intention-to-treat analysis, children randomly assigned to the intervention group had higher odds of 30-day health care use (odds ratio: 1.33; 95% confidence interval: 1.003–1.76). In the per protocol analysis, there were no differences in 30-day health care use (odds ratio: 1.14; confidence interval: 0.84–1.55). Postdischarge coping scores and number of days until returning to a normal routine were similar between groups. Parents in the intervention group recalled more red flags at 14 days (mean: 1.9 vs 1.6; $P < .01$).

CONCLUSIONS: Children randomly assigned to the intervention had higher rates of 30-day postdischarge unplanned health care reuse. Parents in the intervention group recalled more clinical warning signs 2 weeks after discharge.

Divisions of [a]Hospital Medicine, [f]Biostatistics and Epidemiology, and [h]General Pediatrics, [d]Department of Patient Services, and [b]James M. Anderson Center for Health System Excellence, Cincinnati Children's Hospital Medical Center, Cincinnati, Ohio; [c]Department of Pediatrics, University of Cincinnati College of Medicine, Cincinnati, Ohio; [e]The Ohio State University, Columbus, Ohio; and [g]Department of Pediatrics, University of California Davis Health, Sacramento, California

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WHAT'S KNOWN ON THIS SUBJECT: Postdischarge nurse visits reduce reuse rates for adults. In pediatrics, home visits are used in both acute and chronic conditions to support child health and well-being. The use of a postdischarge nurse visit after standard pediatric discharge is unknown.

WHAT THIS STUDY ADDS: Children randomly assigned to receive a single postdischarge nurse visit had higher rates of 30-day reuse compared with children randomly assigned to standard discharge. Parents in the intervention arm recalled more red flag clinical warning signs 2 weeks after discharge.

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Poor hospital discharge transitions burden patients, families, and the health care system. Families may experience stress, uncertainty about new diagnoses and treatments, and adverse postdischarge outcomes, including readmissions.[1,2] Up to 30% of pediatric readmissions are potentially preventable, often driven by lack of support by the discharging hospital.[3] With health care policies increasingly penalizing readmissions, there is growing interest to do more to support patients during the transition home.[4]

Nurse home visits are used to effectively bridge adults from inpatient to outpatient settings; they can be used to reduce cost and improve self-management skills.[5–9] Some adult interventions, including the Care Transitions Intervention in which a nurse transition coach was used, can be used to significantly reduce postdischarge reuse.[10] In pediatrics, nurse home visits are used in a variety of settings from managing acute or chronic illness to supporting overall child health and well-being.[11] Certain populations, including children with chronic conditions and neonates, benefit from enhanced transitions.[12–16] Authors of a systematic review of interventions used to assist transitions for families of premature infants concluded that nurse home visits were integral to a smooth hospital-to-home transition.[17] Yet, evidence regarding the effectiveness of general pediatric transition nurse visits is less clear. Such visits may improve standard pediatric discharges by reinforcing teaching and reassuring parents[1]; however, no studies have been focused on this population. Thus, we sought to determine the postdischarge effects of a single, nurse-led home visit on transition success as measured by postdischarge health care reuse, parent coping, and disease understanding.

METHODS

Trial Design, Participants, and Setting

We conducted a 2-arm randomized controlled trial. Children (<18 years of age) hospitalized on the hospital medicine or neurosciences services (neurology or neurosurgery) at the freestanding, tertiary-care Cincinnati Children's Hospital Medical Center (CCHMC) between February 2015 and April 2016 were eligible. We excluded children not discharged from the hospital (eg, admission for suicidal ideation necessitating psychiatric hospitalization), living outside of the home care service area (ie, >55 miles from CCHMC and/or outside OH because of nurse licensing), requiring postdischarge skilled nursing services (eg, central line care), or without an English-speaking parent or caregiver (hereafter referred to as parent). We focused on pediatric hospitalizations with "standard discharges" (ie, children discharged from the hospital and not requiring skilled nursing care outside the hospital), because these discharges are prevalent in both academic and community settings. See the Supplemental Information for additional information.

Intervention

Before trial initiation, we piloted a transitional postdischarge nurse visit for children hospitalized on 2 units serving general hospital medicine and neurosciences patients. We solicited parents' impressions of postdischarge needs by using focus groups[1,2] and modified the program to ensure the visit met family and care team goals.[18,19] During the trial, CCHMC home care nurses met with the family before discharge to schedule the visit and create a visit plan on the basis of the child's diagnosis. A different home care field nurse visited the home postdischarge to assess the child using a standardized and condition-specific approach. During the visit, families were provided with a list of clinical "red flags" or warning signs, which, when present, would indicate the need to seek further medical care at either a primary care office or emergency department (ED).[20] The red flag list, standardized on the basis of condition, typically included between 6 and 10 warning signs. The list was also texted to the families in the intervention group after the visit. Nurses with any clinical concerns during the visit contacted the discharging inpatient attending or primary care provider. When appropriate, the nurse provided reassurance of the child's overall recovery. Visits occurred within 96 hours of discharge.[21]

Control

Children in the control arm received routine discharge care including the following: recommendations for outpatient follow-up, written documentation regarding prescribed medications, delivery of prescribed medications to the hospital bedside, and communication from hospitalist to the primary care provider.

Outcomes

Our primary outcome was a composite measure of unplanned 30-day acute health care reuse (unplanned readmission, ED, or urgent care visit). Unplanned readmissions were identified by using a validated definition[22]; data were obtained from hospital administrative data because CCHMC is the only admitting pediatric facility within the study area. We supplemented CCHMC data with an administrative data set used to capture most regional inpatient and/or ED facilities.[23]

Secondary outcomes consisted of additional use and patient- and family-centered outcomes. All parents received a postdischarge phone call between postdischarge days 14 and 23 to collect parent-reported outcomes. For utilization outcomes, we assessed 30-day ED revisit rates and 30-day unplanned readmission rates, separately. We also measured 14-day use on the basis of a combination of administrative data and parent report of use. If either the parent reported use (unplanned outpatient visit, urgent care, ED, or unplanned readmission) or the administrative data revealed relevant use (urgent care, ED, or unplanned readmission) then the 14-day use was considered positive. Because parents often completed the call beyond 14 days, the "14-day" use outcome may include events that occurred beyond 14 days postdischarge. For patient- and family-centered outcomes, measures were chosen on the basis of focus group findings.[1,2] Specifically, we assessed coping, measured by the validated Post-Discharge Coping Difficulty Scale (PDCDS).[24,25] We asked parents to recall the number of days it took to "return to 'normal' routine," including return to work and school (range of 0–14 days or not yet back to normal). We also assessed knowledge by asking parents to recall "any red flags or warning signs" to indicate the "child's condition was getting worse."

Sample Size

We enrolled 1500 children to ensure adequate sample size on the basis of the primary outcome to detect a 0.07 rate change from a control reuse rate of 0.2. See the Supplemental Information for more information.

Recruitment and Randomization

The CCHMC Institutional Review Board approved the study. We approached participants for enrollment near discharge by using established methods for discharge prediction.[19,26] Research assistants used computer-generated lists of randomly selected, potentially eligible children to approach each morning.[21]

Once a parent consented and completed the baseline survey, enrolled participants were randomly assigned 1-to-1 to intervention or control groups by using a permuted block randomization approach. We stratified by neighborhood poverty and medical complexity using a web-based randomization tool. Neighborhood characteristics may reflect differential access to health care services of relevance to our outcomes.[2,27] In addition, neighborhood poverty is associated with individual financial characteristics[28] as well as acute health service use.[29] We used the census definition of "poverty areas," or census tracts where ≥20% of the population lives below the federal poverty level.[30] Medical complexity was determined by the patient's hospitalization service and was as follows: "non-complex" patients were hospitalized on the hospital medicine general services, whereas "complex" patients were hospitalized on the neurosciences services or the hospital medicine complex care service, which cares for children with technology dependency or significant neurologic impairment.[31] If the child was randomly assigned to the intervention group, the intervention nurse team was notified to schedule the nurse visit.

Blinding

Participants were informed of their treatment assignment at the time of randomization so those in the intervention arm could schedule their nurse visit. Although hospital physicians and bedside nurses were not informed of randomization assignment, it is possible that they were told by parents or witnessed home care staff in the rooms of patients in the intervention group. Research assistants blinded to treatment assignment conducted the 14-day follow-up phone survey.

Analyses

For all outcomes, we performed an intention-to-treat (ITT) analysis, including everyone randomly assigned except for withdrawn participants, and a per protocol (PP) analysis, including randomly assigned participants without a major protocol violation. We defined major protocol violations as not meeting eligibility criteria after being randomly assigned, not completing the 14-day phone call within the allotted time window, and, for participants in the intervention group, not completing the nurse visit within 96 hours of discharge.

We analyzed reuse using logistic regression. We also plotted time-to-reuse for both the ITT and PP populations. For parent coping (PDCDS), we used a general linear model. For return to normalcy, we used a censored Poisson model with a bound set at 15 days for those parents who had not returned to normal at the 14-day call. For recall of red flags, we used a Poisson model; because different conditions had different numbers of red flags, we included the number of potential correct answers for the child's specific condition as a covariate. All models included the variables neighborhood poverty and medical complexity.

RESULTS

Overall, 2777 children were approached; of those, 1500 (54%: 751 intervention; 749 control) were enrolled and randomly assigned (Fig 1). We withdrew 2 subjects in the intervention group (1 because of invalid consent and 1 requested withdrawal). Age, sex, and admitting services were similar among those enrolled and those who refused or were not enrolled.[21] For enrolled children, the most common primary discharge diagnosis category[32] for the index hospitalization was respiratory diseases (35% overall), followed by neurologic diseases (14%) and gastrointestinal diseases (9%) (Supplemental Table 4). The median age was 2 years, median length of stay was 2 days, approximately half of participants had public insurance, and most (84%) were hospitalized on the general hospital medicine services. Demographic characteristics were similar between intervention and control groups (Table 1).

Intervention

The intervention was completed within 96 hours of discharge in 651 out of 749 (87%) families (Supplemental Table 5). Primary reasons for incomplete visits included families declining participation and inability to contact family to schedule. In 12% of intervention nurse visits ($n = 79$), the nurses referred the patient for additional care; in 4 visits (<1%), children were referred directly to the ED.

Follow-up

Reuse data were obtained for all enrolled participants. Most (1423 out of 1498; 95%) completed the 14-day follow-up call within the allotted time window (Supplemental Table 5).

ITT Analysis

We included 749 children in both the intervention and control groups.

Primary Outcome

The 30-day unplanned reuse rate was 17.8% in the intervention group and 14.0% in the control group. Children randomly assigned to the intervention group had higher odds of 30-day reuse (odds ratio [OR]: 1.33; 95% confidence interval [CI]: 1.003–1.76) (Table 2). In the time-to-reuse plot, separation between intervention and control curves is noted in the first few days after discharge (Fig 2A).

Secondary Outcomes

Children randomly assigned to the intervention group had higher 30-day rates of both unplanned readmission (7.7% versus 5.5%) and ED use (10% versus 7.2%); however, these differences were not statistically significant (Table 2). Coping (PDCDS) scores and the number of days until return to normalcy were similar in the intervention and control groups. Parents in the intervention group recalled significantly more red flags than those in the control group (mean: 1.9 vs 1.6 red flags; $P < .01$) (Table 3).

PP Analysis

We included 628 children in the intervention group and 692 children in the control group. Child-level reasons for exclusions (totals from intervention and control arms combined) included ineligible after being randomly assigned ($n = 51$), failure to complete the follow-up phone call ($n = 68$), and failure to complete the intervention ($n = 59$) (Fig 1). There were no comparable control exclusions for the 59 intervention children excluded because of intervention nonadherence. These 59 children were predominantly black (62%) and publicly insured (79%) with many parents rating their primary care access as suboptimal (29%) (Table 1). Protocol-level exclusions are displayed in Supplemental Table 5.

Primary Outcome

Differences in the primary outcome of 30-day health care reuse were not significant (OR: 1.14; CI: 0.84–1.55) (Table 2); there was no separation between the intervention and control groups on the time-to-event plot (Fig 2B).

Secondary Outcomes

Analyses of secondary outcomes in the PP population were similar to those of the ITT population (Tables 2 and 3).

DISCUSSION

Children randomly assigned to a single home nurse visit after standard pediatric discharge after an acute care hospitalization had higher rates of 30-day unplanned acute health care reuse compared with those in the standard discharge arm. However, this difference was not observed in analyses in which the population was restricted to those who received the intervention and completed follow-up (PP analysis). Postdischarge coping and parent-reported time to return to normal routine were similar between intervention and control groups. Parents in the intervention group demonstrated greater knowledge of clinical red flags or warning signs to seek additional care.

Our findings of increased reuse in children randomly assigned to receive the intervention, although in the opposite direction of our hypothesis, are not unprecedented. A small randomized controlled trial of phone calls after pediatric ED use revealed an increase in revisits among children randomly assigned to the call.[34] Several potential mechanisms may explain increased reuse. First, in children hospitalized for asthma, higher parent asthma knowledge was associated with increased health care reuse; although, that analysis had limited ability to control for asthma severity.[35] In our intervention, parents received and understood warning signs as revealed by the higher recall of red flags in the intervention group. With increased knowledge, parents may be more inclined to act upon concerning clinical signs by seeking additional evaluation. Second, intervention participants may have experienced enhanced access to urgent health care settings. During the visit, nurses often made phone calls to the discharging hospitalist to clarify discharge instructions or medication orders or to seek assistance

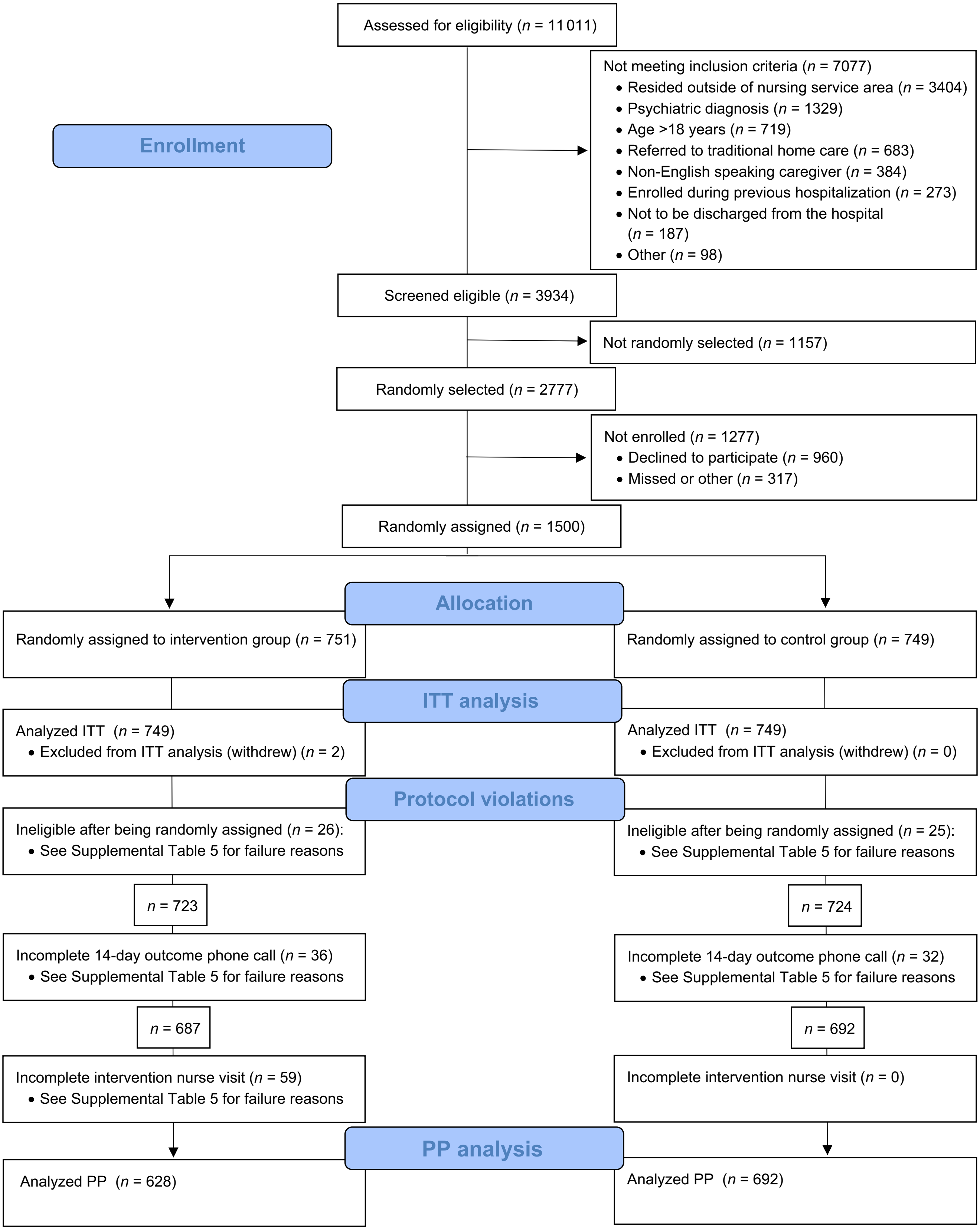

FIGURE 1

H2O Trial CONSORT flow diagram. CONSORT, Consolidated Standards of Reporting Trials.

TABLE 1 Population Characteristics

Characteristics		ITT Population		PP Population		Population Excluded Only Because of Intervention, n = 59
		Intervention, n = 749	Control, n = 749	Intervention, n = 628	Control, n = 692	
Age, y		2.1 (0.5–8.2)	1.9 (0.4–6.9)	2.1 (0.5–8.4)	2.0 (0.4–6.9)	2.8 (0.8–7.8)
Female sex		47.7	48.6	47.6	48.0	49.2
Length of stay, d		2 (1–3)	2 (1–3)	2 (1–3)	2 (1–3)	2 (1–2)
Race	White	61.2	61.5	65.0	62.3	31.0
	Black	29.6	28.3	26.0	28.3	62.1
	Other	9.2	10.1	9.0	9.3	6.9
Ethnicity	Hispanic or Latino	4.6	4.2	4.9	3.7	3.5
Insurance	Private	42.4	43.6	45.6	44.7	17.2
	Public	56.5	54.7	53.9	53.6	79.3
	Self-pay or other	1.1	1.7	0.5	1.7	3.5
Reported primary care access (P3C score)	Less than almost always adequate access (<75)	16.0	17.9	13.8	17.7	28.8
	Almost always adequate access (75–99)	42.4	42.0	44.0	41.6	33.9
	Perfect access (100)	41.7	40.1	42.2	40.7	37.3
Neighborhood poverty	<20%	69.6	69.4	71.7	69.7	50.9
	≥20%	30.4	30.6	28.3	30.4	49.2
Admitting service	General hospital medicine	84.1	84.0	83.0	83.4	91.5
	Neurology or neurosurgery	15.9	16.0	17.0	16.6	8.5
Complex chronic conditions[a]	0	79.3	79.7	80.3	80.8	81.4
	1	15.0	16.7	14.3	15.6	15.3
	2	4.1	2.1	3.8	1.9	1.7
	3–4	1.6	1.5	1.6	1.6	1.7

Data shown as median (interquartile range) or percentage. P3C, Parents Perception of Primary Care scale.

[a] Number of complex chronic condition categories[33] based on discharge diagnoses.

TABLE 2 Primary and Secondary Use Outcomes

Outcome	Intervention Rate Number (%)	Control Rate Number (%)	OR (95% CI)
ITT analyses	n = 749	n = 749	—
30-d health care reuse[a]	133 (17.8)	105 (14.0)	1.33 (1.003–1.76)[b]
30-d unplanned readmissions	58 (7.7)	41 (5.5)	1.45 (0.96–2.19)
30-d ED use	75 (10.0)	54 (7.2)	1.44 (0.997–2.08)
14-d health care reuse including outpatient clinic visits[c]	132 (17.6)	110 (14.7)	1.24 (0.94–1.64)
PP analyses	n = 628	n = 692	—
30-d health care reuse[a]	98 (15.6)	96 (13.9)	1.14 (0.84–1.55)
30-d unplanned readmissions	37 (5.9)	37 (5.3)	1.11 (0.69–1.77)
30-d ED use	57 (9.1)	49 (7.1)	1.30 (0.87–1.94)
14-d health care reuse including outpatient clinic visits[c]	93 (14.8)	103 (14.9)	0.99 (0.73–1.34)

[a] Primary outcome includes unplanned readmission, ED, and urgent care use.

[b] $P < .05$.

[c] Includes parent report of unplanned readmission, ED, urgent care use, and unscheduled outpatient appointments or administrative data indicating unplanned readmission, ED, and urgent care use.

in patient assessment. Nurses potentially facilitated additional ED visits rather than primary care visits. Third, families were not blinded to the intervention; parents may have perceived that their child needed additional evaluation because they were randomly assigned to the intervention. Finally, in contrast to transition-related interventions in adults,[10,36] nurses delivering the intervention had not assessed the child before discharge. Many children would, not unexpectedly, still have physical abnormalities associated with their illness. Without the context provided by a predischarge assessment, nurses may have referred a child for further evaluation on the basis of current ill appearance, even if symptoms had stabilized or improved since discharge.

In parent focus groups, which informed the development of this intervention, families expressed a desire to understand clinical warning signs after discharge.[1] In analyses of our secondary outcomes, the nurse visit increased parent knowledge of their child's condition as evidenced by the increase in average number of red flags parents in the intervention group recalled after discharge. Parents in both intervention and control groups received education from nurses and physicians about their child's condition while in the

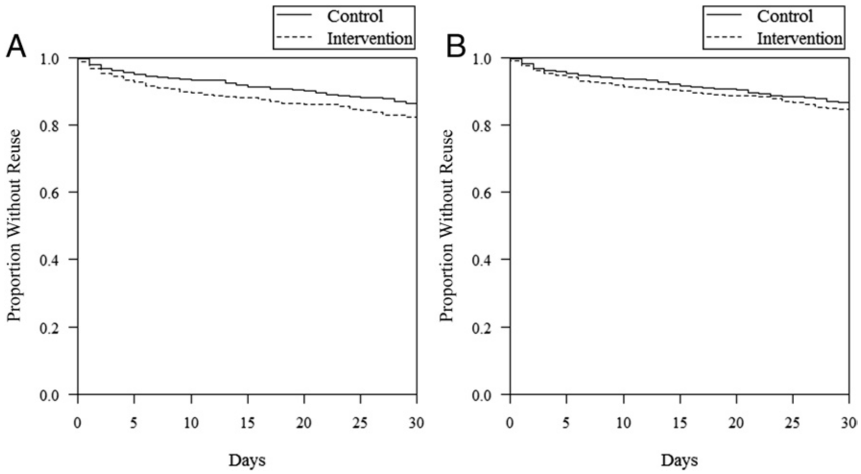

FIGURE 2
Time-to-Reuse. A, ITT population. B, PP population.

hospital. Red flag information was reinforced during the nurse visit for patients in the intervention group. Although the absolute difference in the average number of red flags recalled was small between the groups, 91% of parents in the intervention group recalled any (>0) red flags compared with 85% of parents in the control group; 39% of parents in the intervention group recalled ≥3 red flags compared with 27% of parents in the control group. Thus, these statistically significant differences (in both the ITT and PP analyses) likely reflect clinically relevant differences in knowledge.

ITT analyses are the gold standard for randomized controlled trials.[37] The PP population has multiple nonrandom exclusions. In our trial, similar numbers of participants in the intervention and control arms were excluded for being ineligible after being assigned randomly and failing to complete the 14-day outcome phone call (Fig 1). However, 59 children in the intervention arm were excluded solely because of intervention nonadherence. Although this number accounts for just 8% of all children randomly assigned to receive the intervention, those excluded were not random and are as follows: many were black, publicly insured, lived in high poverty areas, and had suboptimal primary care access. Minority children, children with public insurance, and/or children living in poor neighborhoods all experience higher readmission rates.[38–41]

In the PP analysis, there is no exclusion in the control group that matches the nonadherence exclusion from the intervention group. Many of the reuse events excluded from the PP population intervention arm occurred in children who experienced reuse in the first 4 days after discharge. Some of these early reuse events occurred because the child was readmitted to the hospital and, thus, could not receive the planned nurse visit. Other potential explanations for larger numbers of early reuse exclusions in the intervention arm include the following: children who returned to the ED or urgent care shortly after discharge may have declined the nurse visit because they had already been reassessed or the process of scheduling the nurse visit (with calls from nurses reminding families that their child should receive additional care) may have prompted some to seek evaluation in the ED rather than have a nurse visit their home. Thus, significant differences observed in the ITT but not the PP analyses are in part due to the higher number of intervention event exclusions occurring soon after discharge, the time period in which our intervention occurred.

TABLE 3 Secondary Patient- and Family-Centered Outcomes

Outcome	Intervention Least Square Means (CI)	Control Least Square Means (CI)	*P*
ITT analyses	n = 722[a]	n = 723[a]	—
PDCDS[b,c]	20.4 (19.1–21.8)	21.2 (19.8–22.5)	.32
Days until normalcy[d]	4.2 (3.9–4.4)	4.1 (3.8–4.4)	.82
No. red flags recalled[e]	1.9 (1.8–2.0)	1.6 (1.5–1.7)	<.01[f]
PP analyses	n = 628	n = 692	—
PDCDS[b,c]	19.9 (18.5–21.3)	21.11 (19.8–22.5)	.14
Days until normalcy[d]	4.1 (3.8–4.4)	4.1 (3.8–4.4)	.90
No. red flags recalled[e]	2.0 (1.8–2.1)	1.6 (1.5–1.7)	<.01[f]

[a] ITT patient numbers are <749 because of failure to complete the 14-d phone call.
[b] Potential score ranges from 0 to 100 with high scores indicating more difficulty coping.
[c] *P* value from linear regression model including randomization covariates neighborhood poverty and medical complexity.
[d] *P* value from censored Poisson model with a bound set at 15 d for those parents who had not returned to normal at the 14-d call including randomization covariates neighborhood poverty and medical complexity.
[e] *P* value from a Poisson model with covariates including the number of potential correct answers for the patient's condition, neighborhood poverty, and medical complexity.
[f] $P < .05$.

Our findings should be considered in the broader context of pediatric readmission policies. Our study population, similar to those in pediatric hospitalizations nationally, is largely noncomplex.[42,43] Penalties stem from the idea that readmissions result when hospitals fail to provide adequate transition support. Among standard pediatric discharges, we found that enhancing transition services with a nurse visit increased reuse in children randomly assigned to the intervention group. With this finding, we suggest that lack of support by the discharging hospital may not be the only, or the primary, driving factor for pediatric reuse. The nurse visit may have strengthened postdischarge access to the hospital; similarly, in previous work, higher health system performance was associated with increased pediatric readmission.[44] Our intervention may perform differently if we had a broader-based public health infrastructure including community aid workers and/or extenders capable of providing longitudinal care rather than the episodic, single-visit model we employed. Nevertheless, in our current health care system, nontargeted interventions that are aimed to enhance hospital-to-home transitions may inadvertently increase reuse. Thus, policymakers should consider whether reuse fully captures the adequacy or quality of transitions for children experiencing a standard hospital discharge.

This study has several limitations. First, we could not blind participants to their treatment assignment. Families in the intervention group may have behaved differently knowing their child was "supposed" to receive additional care. Caregivers may have told research assistants their randomization assignment during the outcome call. Given the standardization of the outcome questions, any inadvertent unblinding would not likely bias our results. Second, although intervention adherence rates were high, most exclusions in the PP analyses were related to intervention nonadherence. Third, although our data capture most hospitals in our area, visits to non–hospital-based sites would not be captured. It is unlikely nonhospital events would occur disproportionately in 1 group, thus presenting a minimal risk of bias. In addition, the availability of regional reuse data is a strength of our study and minimizes the potential for missing outcomes. Finally, our sample size was determined on the basis of the primary outcome; thus, our analyses of the secondary use outcomes may be underpowered. Authors of future research should focus on targeting select populations for intervention.

Contrary to our hypothesis, children randomly assigned to receive a single home nurse visit after standard discharge had significantly higher rates of unplanned 30-day acute health care reuse. With these findings, we highlight reuse as a complex metric resulting from the intersection of many factors.

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ABBREVIATIONS

CCHMC: Cincinnati Children's Hospital Medical Center
CI: confidence interval
ED: emergency department
ITT: intention-to-treat
OR: odds ratio
PDCDS: Post-Discharge Coping Difficulty Scale
PP: per protocol

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Address correspondence to Katherine A. Auger, MD, MSc, Division of Hospital Medicine, Department of Pediatrics, Cincinnati Children's Hospital Medical Center, 3333 Burnet Ave, MLC 9016, Cincinnati, OH 45229. E-mail: katherine.auger@cchmc.org

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Postdischarge Nurse Home Visits and Reuse: The Hospital to Home Outcomes (H2O) Trial

Katherine A. Auger, Jeffrey M. Simmons, Heather L. Tubbs-Cooley, Heidi J. Sucharew, Angela M. Statile, Rita H. Pickler, Hadley S. Sauers-Ford, Jennifer M. Gold, Jane C. Khoury, Andrew F. Beck, Susan Wade-Murphy, Pierce Kuhnell, Samir S. Shah and on behalf of the H2O Trial study group

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