Official Title: Supplement to Hospital to Home Outcomes (H2O): A Study to Improve the Fluidity of Transitions Between Hospital and Home

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ABSTRACT

PURPOSE OF STUDY: To identify barriers to successful transitions that are most meaningful to patients and families, and use these identified barriers to iteratively adapt an existing nurse home visit program to address these barriers. This study will also test the efficacy of a nurse home visit intervention in improving post-discharge outcomes.

BACKGROUND: The transition from inpatient hospitalization to outpatient care is a vulnerable time for patients and their families. Poor transitions may lead to complications and worse patient outcomes, both in terms of hospital reutilization, as well as family-centered outcomes, such as missed school and work, or increased out-of-pocket costs.

AIMS: Aim 1 will use qualitative methods to define successful transitions of care from the hospital to home and create meaningful patient- and family-centered outcome measures. **Aim 2** seeks to maximize the effect of the nurse home visit on patient and family-centered outcomes by iteratively testing adaptations to the process and content/approach of the nurse home visit based on the results of Aim 1 using QI science methods. **Aim 3** is a single center, parallel, randomized, standard-of-care-controlled prospective study to determine the efficacy of a nurse home visit program, an intervention adapted from those studied in other populations (i.e., adults, high-risk infants) and re-engineered through Aim 2, in improving pediatric patient transitions from hospital to home. **Aim 4** is a single center, parallel, randomized, standard-of-care-controlled prospective study to determine the efficacy of a nurse phone call. **Post-hoc analysis** will be performed to better understand the results of Aim 3. First we will use qualitative methods in the form of qualitative interviews and focus groups. The purpose of the post-hoc analysis is to understand our Aim 3 results. Semi-structured interviews and focus groups will be conducted with the following key stakeholders: inpatient ward bedside nurses, home health care nurses (who provided the intervention), hospitalist physicians (non-study team), primary care physicians, patients currently hospitalized at CCHMC, and participants previously enrolled in Aim 3 who received a non-traditional nurse home visit. Second, we will request information from the readmission review committees for patients enrolled in Aim 3 who were readmitted within 30-days of their initial hospitalization.

METHODS: Aim 1 will use qualitative methods in the form of focus groups to collect data. We aim to recruit 9 total focus groups, 3 from each income strata, with 10-12 participants in each focus group. Patients will be recruited from the inpatient wards from both the Base Hospital Medicine Service and the Base Surgical Hospitalist Service. **Aim 2** will use quality improvement methods to improve the nurse home visit program. Patients will enter into this arm through the course of clinical care, and a subset of families will be contacted after the home visit to assess the quality and content of the nurse home visit. We will also complete an "Aim 2" optimization period for the follow-up phone calls using similar methods. **Aim 3** will use randomization to study the efficacy of the nurse home visit. Patients will be recruited from the inpatient wards from both the Base Hospital Medicine Service, the Base Surgical Hospitalist Service, Community Pediatrics, Adolescent Medicine, Neurology, and Neurosurgery, and will complete a survey during their hospital stay. They will then be randomized to receive standard-of-care, the nurse home visit. Clinical Research Coordinators will then contact families 14-30-days after the home visit to assess outcomes. Heterogeneity of Treatment Effect: We have multiple planned

analyses to examine potential heterogeneity of treatment effect of the nurse visit. Factors included in the HET analysis are insurance, primary care access, financial strain, caregiver education, hospital service, and medical complexity. **Aim 4** will use randomization to study the efficacy of a nurse phone call. Patients will be recruited from the inpatient wards from the Base Hospital Medicine Service, Community Pediatrics, and Adolescent Medicine, and will complete a survey during their hospital stay. They will then be randomized to receive standard-of-care or the nurse phone call. Clinical Research Coordinators will then contact families 14-30-days after the phone call to assess outcomes. **Post-hoc analysis** Qualitative analysis: We will use qualitative methods in the form of qualitative interviews and focus groups. We aim to recruit 20 members from each stakeholder group for the qualitative interviews and focus groups. The stakeholder groups include 1) parents of currently admitted patients 2) parents of children previously enrolled in Aim 3 intervention arm 3, parents of children previously enrolled in Aim 3 control arm 3) primary care providers 4) inpatient attending physicians 5) bedside nurses 6) homecare nurses. Parents of currently admitted patients will be eligible if they were eligible for Aim 3 (i.e. hospitalized on hospital medicine or neurosurgical services, English speaking, >18 years of age). Patients previously enrolled in Aim 3 will be contacted via phone. Primary care providers will be recruited at standing meetings while they are at CCHMC or via phone. Bedside nurses and inpatient attendings will be recruited from care providers on the general pediatric and neurosurgical floors. Readmission Analysis: As part of an ongoing quality improvement work in the hospital, teams of physicians and nurses review 30 day readmissions to their medical unit. The purpose of this review is to determine if the readmissions were potentially preventable. We will request readmission review data from the readmission teams for patients enrolled in Aim 3.

CONCLUSION: We will identify family-specific barriers to successful transitions of care, and adapt nurse home visits to address these barriers. We will then assess if the nurse home visits reduce these barriers, as well as other risks identified *a priori* such as healthcare reutilization, though a randomized control trial. We expect our findings to support the spread of nurse home visit programs to other patients, conditions, and hospitals.

PURPOSE OF STUDY

The transition process from hospital to home in pediatrics has not been well characterized. **Aim 1** will identify the barriers to successful transitions that are most meaningful to patients and families. A deeper understanding of such barriers will allow us to more effectively tailor interventions to address them. Readmissions are typically used as proxy outcome measures for poor transitions. However, hospitalized children experience far fewer readmissions than adults. Other outcomes studied in adults, such as medication errors (e.g., medication discrepancies) and PCP confidence in managing the patient's future problems,[1] are important but not patient- or family-centered. We hypothesize that there may be other outcome measures that are common and more meaningful to patients and families. Historically, home nursing visits have aided care transitions for medically complex patients requiring respiratory care (e.g., tracheostomy management), enteral or "tube" feedings, or infusion therapy. The nurse home visit paradigm has also been applied to adults and high-risk infants.[2] Nurse home visits, however, have not been studied in children hospitalized for common conditions. Furthermore, while nurse home visit interventions have been successful at reducing health resource utilization, including hospital readmissions, virtually all studies addressed barriers defined *a priori*. **Aim 2** will use a home nursing visit and phone call to address barriers identified in Aim 1. Quality improvement (QI)

methods will be used to adapt the current processes to ensure that the visit and phone call addresses barriers reported by patients and families rather than "health system-centric" barriers. **Aim 3** will test the effectiveness of a nurse home visit intervention in improving post-discharge outcomes, including those identified by families in Aim 1, for children hospitalized with acute illness. **Aim 4** will test the effectiveness of nurse-led phone call in improving post-discharge outcomes, including those identified by families in Aim 1, for children hospitalized with acute illness. **Post-hoc analysis** Qualitative analysis: We will use engagement interviews to provide a comprehensive understanding regarding the results of Aim 3. Aim 3 results were unanticipated with those patients receiving the intervention having a higher odds of unscheduled revisits. There are a number of possible reasons for these results. This could reflect greater access to care or improved parental engagement in their child's health. Alternatively, this could reflect unwarranted healthcare utilization as a result of the intervention. Therefore it is imperative to conduct interviews and focus groups to further understand our results. Readmission analysis: In Aim 3, we found patients randomized to the intervention had more post-discharge healthcare utilization. This was driven, in part, due to an increase in 30 day readmissions. Understanding if the readmissions were necessary or preventable is important in understanding our Aim 3 findings. As part of ongoing hospital improvement work, teams of nurses and physicians review 30 day readmissions on a unit-basis (for example, the medical director and nurses from A6 review all readmissions to that unit). The readmission team assesses if the readmission was necessary or avoidable. We will request the results of these reviews for Aim 3 enrolled patients who were readmitted.

BACKGROUND

Transition from hospital to home

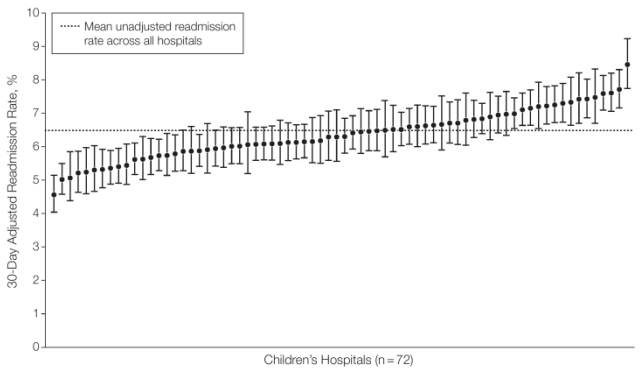
The transition from inpatient hospitalization to outpatient care is a vulnerable time for patients and their families. Families may face missed time at work, loss of income, difficulty coordinating care for and time away from other children, stresses of caring for the sick child, and living in an unfamiliar and disruptive hospital environment. All of these elements contribute to increased family stress.[3-6] Such stress occurs with hospitalizations of any duration, including hospitalizations for common, acute conditions that typically resolve without long-term medical sequelae. For example, families of children hospitalized with bronchiolitis, a common acute pediatric respiratory infection, experienced lasting- not just short-term- worry, distress, anxiety, fear for the future, guilt, stress, and poorer parent health following their child's hospitalization.[7,8] Family stress serves as a challenge to the safe transition of children and families from hospital to home, one that is compounded by the complex nature of the discharge process and the disjointed nature of the healthcare system.[9] One out of every 5 families reports major problems with the transition that, in turn, may place the child at risk of poor outcomes.[5,10] Safe discharge involves numerous steps, including reliable communication with families and primary care providers (PCP), coordination of care, and family understanding of and comfort with the management plan.[11] Ideally, planning for discharge should begin soon after a patient is admitted and should evolve or progress during the hospitalization. Through discharge planning, the patient and family may learn about a new diagnosis or new complications of an existing diagnosis, need to adjust medication regimens, require outpatient follow-up and need to schedule the appointment, and need to understand how care at home will differ from that in the hospital. The amount of information families receive can be overwhelming and affect a family's comfort with caring for

their child after discharge.[12] For example, one parent with whom we recently spoke about the transition home lamented that "When we came home, we didn't know what to do." Families also experience a sense of abandonment at their inability to contact healthcare providers for guidance after discharge.[13] To address information overload and accompanying feelings of uncertainty and abandonment, interventions to aid in transitions are crucial to avoiding post-discharge complications.

Burden of poor transitions

Poor transitions may lead to complications and worse patient outcomes. Readmissions, which often exceed 20% in adults,[14] are thought to reflect poor transitions from hospital to home. In children, readmissions occur less commonly. The mean 30-day readmission rate among 72 children's hospitals was 6.5%; however, there was substantial variability with readmissions ranging from 4.5% to 8% across hospitals, even after accounting for age and underlying conditions (**Figure 1**, each point represents data from one hospital while the bars represent 95% confidence intervals).[15] Some children experience multiple readmissions. Across 43 children's hospitals, 2.9% of patients had four or more readmissions and accounted for 18.8% of total admissions and 23.2% of total inpatient charges over the 365-day period following their index admission.[16]

Figure 1. Adjusted 30-Day Readmission Rate Variation Across 72 Children's Hospitals for All-Condition Admissions



There are additional consequences that may result from poor transitions, including emergency department (ED) revisits, medication errors, PCP dissatisfaction with communication or divergent understanding of discharge care responsibilities, patient or family dissatisfaction with discharge process communication, and unanticipated out-of-pocket costs. ED revisit rates for common pediatric conditions vary across hospitals but typically range from 5% to 11%.[17,18] Hospitalized children also experience a high rate of medication errors (55 medication errors per 100 admissions in one study)[19] that place them at risk for harm.[19-21] The likelihood of error during the transition from hospital to home, when medications are added or changed, is even greater. Poor communication may also lead to dissatisfaction; only one-third of hospital-based physicians (i.e., hospitalists) and PCPs were "satisfied" or "very satisfied" with the state of communication between inpatient and outpatient settings.[22] This same study found that hospitalists and PCPs had differing views on ownership of patient care after discharge, including who would follow-up pending laboratory results and take responsibility for changes in a patient's clinical condition. Without clearly defined physician roles to maintain continuity of care, patients are at greater risk for clinical deterioration and adverse events. Concerns over out-of-pocket costs not addressed during the hospitalization might also affect medication adherence, leading to worse outcomes such as hospital readmissions.[23] For example, among all medical-related admissions in U.S. adults, 33% to 69% are due to poor medication adherence, with a resultant cost of ~$100 billion each year.[24-28]

In summary, poor transitions following hospital discharge impose a significant burden on patients, families, and the healthcare system. Patients and families may experience heightened

stress, lack of clarify around new diagnoses or treatments, and poor clinical outcomes. The healthcare system experiences increased resource utilization. However, the current healthcare system design contributes to this burden with poorly defined physician roles post-discharge and fragmented inpatient-to-outpatient communication.

STUDY DESIGN

Aim 1

Aim 1 of this proposal will use qualitative methods, specifically focus groups. Results from this aim will provide a better understanding of the experiences, challenges, and successes of pediatric inpatient-to-outpatient transitions from the family perspective. These results will inform both the content and implementation of the revised intervention. More importantly, these results will define successful transitions of care from the hospital to home and create meaningful patient- and family-centered outcome measures.

Qualitative methods are the best means to generate consensus themes about patient and family experiences and preferences during inpatient-to-outpatient transitions. Focus groups will be used to gain insight into what families believe to be both the most relevant barriers to successful transition and the outcomes they find to be most meaningful. Participants have the shared experience of a recent hospitalization of a child and will respond to open-ended questions in their own words. Other focus group participants can react and build upon these comments, contributing additional information which might not be captured in individual interviews. The moderator will use follow-up probes to expand and clarify responses and further elucidate the context of the responses. The spontaneity and synergy generated by the focus group dynamics will permit us to gain richly textured insights and understanding about family experiences from their unique perspective.

A stratified purposeful sampling design will be used to define focus group participants. Experts in focus group formation have described the intuitive principle that focus group participants are more willing to talk openly when they are among peers, as opposed to being mixed with participants of different socioeconomic positions.[29,30] We also hypothesize that challenges inherent in the transition process may differ between families of different socioeconomic position as occurs in adult patients.[31] Thus, by using a stratified purposeful sampling design, conversation and interactions between group members of similar socioeconomic positions will be easier and more forthcoming. This sampling strategy will also enable us to illustrate sub-group comparisons.[29] Thus, three strata will be established with participants residing within socioeconomically similar census tracts. Census tracts are defined by the U.S. Census Bureau as relatively homogeneous areas of approximately 4,000 individuals.[32] Census tracts can be easily linked to demographic data for the particular census tract's inhabitants. Census tracts were chosen as our primary geographic unit given their relative homogeneity and their utility in detecting socioeconomic gradients.[33-35]

We will identify the census tract for each potentially eligible focus group participant and link individuals to their census tract's rate of poverty, defined as the percentage of individuals living below the poverty line. Using the distribution of poverty within CCHMC Home Care's primary service area, we have defined thresholds to separate individuals into three socioeconomically distinct groupings. These groupings, which will define the three focus group strata, are based on

the proportion of patients with a home address in a census tract with <5%, 5-20%, or >20% of the population living in poverty.[32] These cut-points were also chosen to ensure a sufficient number of eligible focus group participants within each stratum. Census tracts where >20% of individuals live below the poverty line are considered to be "poverty areas."[36] We used data from the U.S. Census' American Community Survey 2007-2011 to estimate the proportion of individuals living below the poverty line in each of the 614 Ohio census tracts situated within 55 miles of CCHMC.

Aim 2

Aim 2 seeks to maximize the effect of the nurse home visit on patient and family-centered outcomes by iteratively testing adaptations to the process and content/approach of the nurse home visit based on the results of Aim 1 using QI science methods. Although nurse home visits improve particular outcomes in select adult patient populations, we believe that our approach of adapting the visit to address patient- and family-centered barriers is both innovative and important for understanding how an intervention operates under a range of real-world conditions. Aim 2 will produce new, generalizable knowledge by increasing our understanding of key sources of variability in home visit outcomes, including patient and family-specific attributes, visit attributes, or other aspects of the context in which the visit occurs.

We propose a QI design to refine our nurse home visit program in which we will adapt the intervention based on qualitative input from families, test the adapted intervention, and assess improvements by examining changes in key measures over time. The iterative Plan-Do-Study-Act (PDSA) tests will target several *a priori* measures that address clinical outcomes, patient and family experience outcomes, and care delivery processes, and we will target additional patient- and family-centered measures identified during Aim 1. A QI approach is appropriate for refining the intervention because progress is accelerated by learning from each test rather than by aggregating data from many or all the tests.[37] Conducting a series of iterative tests or PDSAs maximizes the effectiveness of an intervention by increasing the understanding of how context influences an intervention, thereby improving its generalizability.[38,39]

Nurse Home Visit Processes

The CCHMC pilot nurse home visit program has been offered to families of children receiving care on the Hospitalist Medicine general service. Families receive a *single* nurse home visit within 48 hours of discharge. A nurse provides a comprehensive physical, psychosocial and safety assessment, medication management and a review of the post-discharge care plan including discharge instructions and PCP follow-up with a goal of ensuring that the child is medically stable and the family is comfortable with providing the child's care. The processes of the pilot nurse home visit will be adapted using knowledge acquired in Aim 1 to fully meet the transition of care needs for patients and families not eligible for traditional home health (longer term home visitation services for the medically complex), but who may be at risk for adverse outcomes associated with their hospitalization and an unsupported transition to home.

Quality Improvement Processes

Several co-investigators and collaborators on this project, including physicians, nurses, and parents will work with frontline medical staff (inpatient nurses, home health nurses, and

physicians) as a team to execute the goals of Aim 2. Many of these team members are already working together during this pilot phase.

Optimizing Nurse Home Visits: We will review the data from Aim 1 to better understand the barriers patients and families face, as well as the goals or outcomes they value. These data will inform our initial approach and cycles of tests will allow us to refine the discrete outcomes within Aim 2 that we will be targeting. *A priori*, these outcomes will be organized within several domains: clinical outcomes such as health care reutilization, patient/family experience outcomes such as confidence in care at home, and care delivery process outcomes such as medicine reconciliation accuracy or follow-up with PCP. Once initial outcomes are defined, we will specify hypotheses about what is needed to achieve or drive the outcomes. These "key drivers" will then focus subsequent cycles of tests.[37] The team will meet every 1 to 2 weeks with the goal of reviewing data and designing new iterations to be tested on the 5-10 nurse home visits that follow.

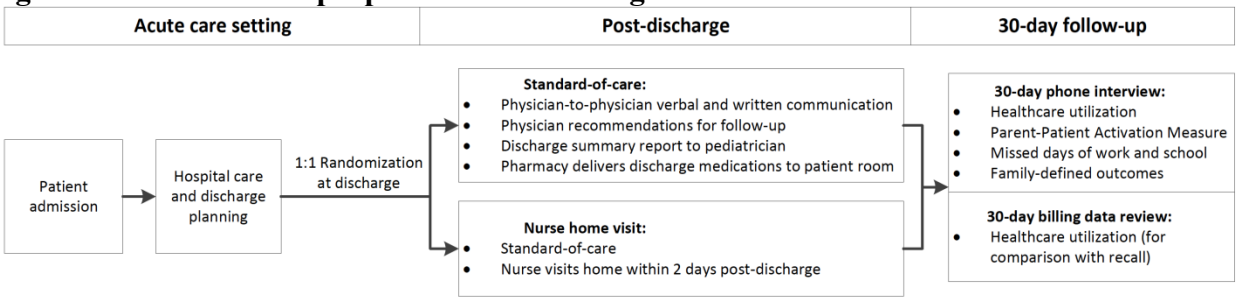
Optimizing Nurse Phone Calls: Using the methods above, already proven highly successful in Aim 2 of this study, we will optimize the nurse phone calls prior to incorporating them in the randomized control trial. We will use the existing visit templates and test small modifications for delivery over the telephone.

Aim 3

A randomized controlled trial is planned for this aim because our understanding of the patient, family, and health systems covariates that might affect our outcomes is limited; randomization is essential to the study design in order to avoid potential bias of intervention effect. Randomization will allow us to balance unknown or unmeasured potential confounders. While it is impossible to blind patients to the trial arm, an earnest effort will be taken to blind the clinical research staff completing the follow-up phone call to the intervention assignment.

We will complete a single center, randomized, standard-of-care-controlled prospective study to determine the effectiveness of a nurse home visit, an intervention adapted from those studied in other populations (i.e., adults, high-risk infants) and re-engineered through Aim 2, in improving pediatric patient transitions from hospital to home **(Figure 2)**. We hypothesize that a structured nurse home visit within 4 days of hospital discharge will significantly reduce the proportion of patients requiring unplanned health system utilization in the 30-day post discharge period compared to patients receiving standard-of-care. We also hypothesize that there will be a significant improvement in family-defined outcome measures that will be identified in Aim 1.

Figure 2: Outline of the proposed research design



Control patients will be randomized to receive standard-of-care at discharge. This care at our institution includes pediatric hospitalist to PCP verbal and written communication prior to discharge, written documentation for the family regarding prescribed medication regimen, recommended follow-up with outpatient PCP and relevant consultant(s), and delivery of prescribed medications from the hospital pharmacy to the patient's bedside **(Figure 2)**. Patients randomized to the intervention arm will receive the same standard-of-care plus a nurse home visit within days of discharge.

Enrolled patients and their families will be randomized 1:1 after discharge to the intervention group or standard-of-care using a permuted block randomization stratified by acute versus chronic underlying illness and hospitalist service general vs. surgical service to ensure equal allocation of the intervention within each stratification block. Random permutations within each block within each stratum will be generated using a random number generator available in SAS Proc Plan. The use of randomization in the study design is crucial for avoiding bias in the evaluation of the effectiveness of the nurse home visit intervention. Patients and families cannot be blinded given that the nature of the intervention is a nurse home visit. However, we will attempt to mitigate the potential bias in the following manner: 1) Families will be asked to refrain from disclosing intervention status to the interviewer at the follow-up phone call; and 2) Study staff will be blinded to treatment assignment when making the follow-up phone call. Study staff will use a written script to administer the survey. At the start of the call, families will be reminded to refrain from disclosing their intervention status.

Heterogeneity of Treatment Effects:
We have multiple planned analyses to examine potential heterogeneity of treatment effect of the nurse visit. Factors included in the HET analysis are insurance, primary care access, financial strain, caregiver education, hospital service, and medical complexity. Medical complexity will be determined by the pediatric medical complexity algorithm (PMCA). The PMCA is a publicly available algorithm that identifies children with complex chronic disease (who have accessed tertiary hospital care). The algorithm includes three levels of medical complexity: children with complex chronic disease (C-CD), children with non-complex chronic disease (NC-CD), and children without chronic disease (CD). In order to calculate the PMCA we will collect additional administrative data for all patients enrolled in Aims 3 and 4. This data will include: ICD9 Codes/ICD10 codes, procedure codes, admission date, discharge dates, admitting and discharge departments. We will capture all outpatient, urgent care, ED, and hospital events within the specified time window (February 1, 2012 to April 30, 2016). The PMCA will be calculated based on a 3-year window before the index hospitalization.

Aim 4
A randomized controlled trial is planned for this aim because our understanding of the patient, family, and health systems covariates that might affect our outcomes is limited; randomization is essential to the study design in order to avoid potential bias of intervention effect.
Randomization will allow us to balance unknown or unmeasured potential confounders. While it is impossible to blind patients to the trial arm, an earnest effort will be taken to blind the clinical research staff completing the 14-day follow-up call to the intervention assignment.

We will complete a single center, randomized, standard-of-care-controlled prospective study to determine the effectiveness of a nurse phone call program, an intervention adapted from those studied in other populations (i.e., adults, high-risk infants) and re-engineered through Aim 2, in improving pediatric patient transitions from hospital to home. We hypothesize that a structured nurse telephone call within 4 days of hospital discharge will significantly reduce the proportion of patients requiring unplanned health system utilization in the 30-day post discharge period compared to patients receiving standard-of-care. We also hypothesize that there will be a significant improvement in family-defined outcome measures that will be identified in Aim 1.

Control patients will be randomized to receive standard-of-care at discharge. This care at our institution includes pediatric hospitalist to PCP verbal and written communication prior to discharge, written documentation for the family regarding prescribed medication regimen, recommended follow-up with outpatient PCP and relevant consultant(s), and delivery of prescribed medications from the hospital pharmacy to the patient's bedside. Patients randomized to the intervention arm will receive the same standard-of-care plus a nurse phone call within days of discharge.

Enrolled patients and their families will be randomized 1:1 after discharge to the intervention group or standard-of-care using a permuted block randomization stratified by home state of residence (Ohio vs. Kentucky) to ensure equal allocation of the intervention within each stratification block. Random permutations within each block within each stratum will be generated using a random number generator available in SAS Proc Plan. The use of randomization in the study design is crucial for avoiding bias in the evaluation of the effectiveness of the nurse phone call intervention. Patients and families cannot be blinded given that the nature of the intervention is a nurse phone call. However, we will attempt to mitigate the potential bias in the following manner: 1) Families will be asked to refrain from disclosing intervention status to the interviewer at the follow-up phone call; and 2) Study staff will be blinded to treatment assignment when making the follow-up phone call. Study staff will use a written script to administer the survey. At the start of the call, families will be reminded to refrain from disclosing their intervention status.

Post-Hoc Analysis

Qualitative Analysis: The post-hoc analysis of this proposal will use qualitative methods, specifically interviews and focus groups. At the completion of the post-hoc analysis, we will have an improved understanding of the experiences, challenges, and successes of pediatric inpatient-to-outpatient transitions from the perspective of families and providers. Qualitative methods are the best means to generate consensus themes about patient and family experiences and preferences during inpatient-to-outpatient transitions. Interviews will be used to gain insight into what families and providers believe to be both the most relevant barriers to successful transition and the outcomes they find to be most meaningful. Participants will respond to semi-structured interviews and focus groups. The interviewer will use follow-up probes to expand and clarify responses and further elucidate the context of the responses. This qualitative methods process will permit us to gain unique perspectives and understand more deeply our results.

Readmission Analysis:
Review of all readmissions occur at the unit level lead by physicians and nurses on the units. We will request information regarding the review of the readmissions including assessment of preventability or possibility of avoiding the readmission. If there are any readmissions to the units which were not reviewed, we would ask the readmission team to please review the case as they normally would. If they are unable to complete the standard readmission review, the assessment of preventability would be missing in our study. We will compare the percentage of readmissions designated as potentially preventable in those patients randomized to the intervention in Aim 3 compared to the percentage of readmissions designated as potentially preventable in those patients randomized to the control group in Aim 3.

DURATION

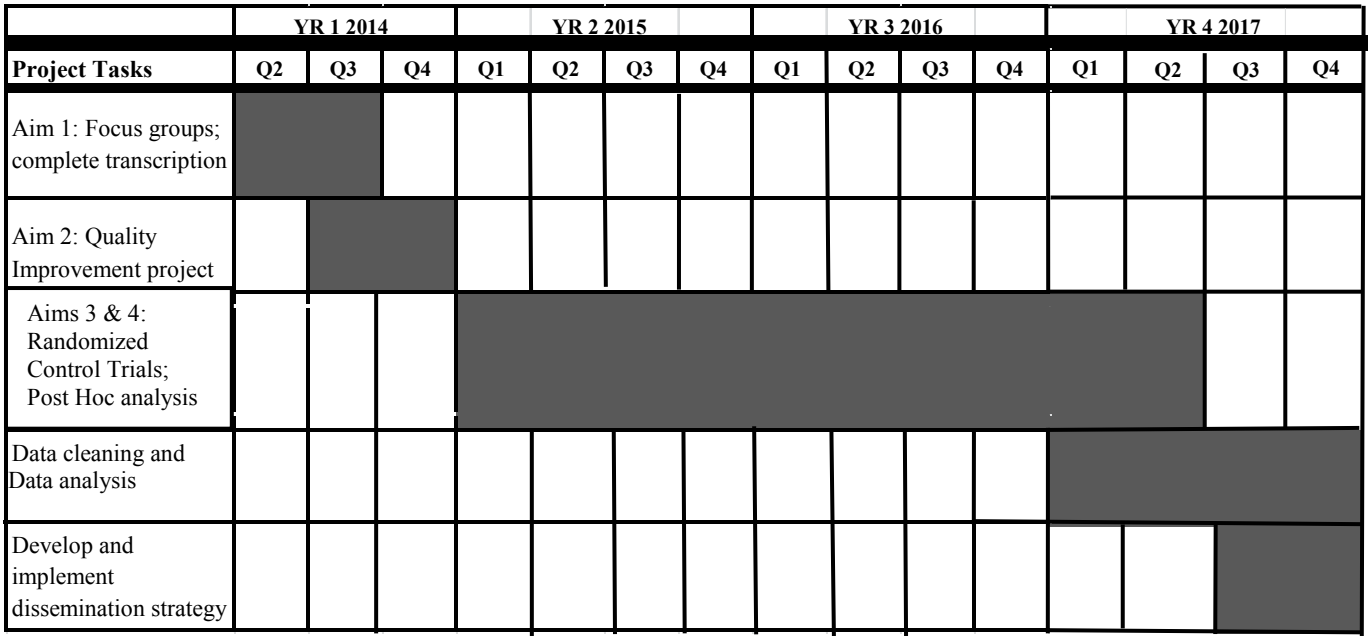
We expect the consent process for **Aim 1** to take approximately 30 minutes, and the focus groups will be 90 minutes in duration. The nurse home visits in **Aim 2** range from 30-90 minutes, and we expect the follow-up phone call to take no longer than 15 minutes. We expect the follow-up calls to confirm return visits to primary care to take no longer than 15 minutes. We expect the consent process and initial survey for **Aim 3** to take approximately 30 minutes, with the intervention group receiving the 30-90 minute home visit or phone call, and all groups receiving the follow-up phone call which should take no longer than 15 minutes. We expect the consent process and initial survey for **Aim 4** to take approximately 30 minutes, with the intervention group receiving the 15-45 minute nurse phone call, and all groups receiving the follow-up phone call which should take no longer than 15 minutes. The interviews and focus groups in the **Post-hoc analysis** will last 60 minutes or less.

Data analysis will take place sequentially by Aim, and we expect to have initial manuscripts and dissemination plans completed by April 2017. However, it is likely that manuscripts will continue to be written into 2017. Due to the post-hoc analysis, we are extending the completion of final data analysis and dissemination plans to September 2017.

Timeline

SELECTION & RECRUITMENT OF PARTICIPANTS

Inclusion criteria for Aims 1-3 are that the patient must be under 18 years of age and be admitted to either the Hospital Medicine Service at Base or Liberty, the Surgical Hospital Medicine Service at Base, the Adolescent Medicine Service at base, the Community Pediatrics Service, Neurosurgery Service, or the Neurology Service. **Exclusion criteria** for Aims 1-3 are if



the patient is discharged to a residential facility, their home residence is outside the home nursing service area (in Ohio within 55 miles of Base), if they are eligible for "traditional" home care services, or if the caregiver is non-English speaking.

Inclusion criteria for Aims 4 is that the patient must be under 18 years of age and be admitted to either the Hospital Medicine Service at Base or Liberty, the Adolescent Medicine Service at base, or the Community Pediatrics Service. They must live in Ohio within 55 miles of Base or in Kentucky Counties Boone, Kenton, or Campbell. **Exclusion criteria** for Aim 4 is if the patient is discharged to a residential facility, if they are eligible for "traditional" home care services, or if the caregiver is non-English speaking.

Inclusion criteria for the qualitative post-hoc analysis is that the patient must be admitted to either the Hospital Medicine Service at Base , the Adolescent Medicine Service at base, the Community Pediatrics Service at base, or the Neurosurgical services. The parents must reside within the home nursing service area (in Ohio within 55 miles of Base). Exclusion criteria for post-hoc analysis includes if the caregiver or provider is non-English speaking , if the patient is admitted for a mental health reason (e.g. suicidal ideation), or if the patient is admitted for sexually transmitted infection.

Aim 1

We anticipate conducting 3 focus groups per socioeconomic strata, resulting in 9 groups with 6-8 parent/guardian participants within each group. Previous focus group work has shown that not all

parents or caregivers will be able to attend the focus groups given their demanding schedules, childcare priorities, and transportation barriers. Thus, we will seek to recruit 10-12 participants per group to account for the possibility of participants failing to show up as scheduled. Recruitment will take place on the hospital wards during a child's admission. We anticipate it will take approximately 2 months to recruit the 120-160 participants necessary to ensure that we have 90-110 for our focus group sample. We expect that we will reach thematic saturation by the conclusion of these groups, meaning no new ideas or themes will be generated at that point and recruitment will be suspended.

Aim 2
Eligible patients and families will be identified by frontline clinical providers, with no input from the research team. We believe that up to 600 families will participate in this Aim. Clinical research coordinators will contact all of the families that participate in this aim via phone to participate in a short follow-up call.

Clinical research coordinators will also identify up to 100 patients during this Aim that receive primary care at one of the three CCHMC primary care clinics (Pediatric Primary Care Center, Hopple Street Clinic, and Fairfield Primary Care). We will review the patient's chart to assess return visits to primary care 30-days after admission, then will call the families to confirm their recall of these visits.

For the phone call optimization, we believe that up to 150 families will participate in this Aim. These families will receive the nurse phone call within 96 hours of discharge, then will receive a phone call from a clinical research coordinator 1-7 days after the visit to complete a short phone call about their experience with the call and any feedback they may have to improve the call.

Aim 3
All patients and families that meet the above inclusion and exclusion criteria will be eligible for the study, and will be approached, depending on CRC schedule. We anticipate enrolling up to 2000 families during this aim. We will conduct planned HET analyses.

Aim 4
All patients and families that meet the above inclusion and exclusion criteria will be eligible for the study, and will be approached, depending on CRC schedule. We anticipate enrolling up to 2000 families during this aim.

Post-Hoc Analysis
Qualitative Analysis: All patients, families, and care providers that meet the above inclusion and exclusion criteria will be eligible for the study. We anticipate enrolling up to 20 participants from each of the following groups: 1) parents of currently admitted patients 2) parents of children previously enrolled in Aim 3 intervention arm 3) parents of children previously enrolled in Aim 3 control arm 4) primary care providers 5) inpatient attending physicians 6) bedside nurses 7) homecare nurses.

Readmission Analysis: We will include all patients enrolled in Aim 3 who were readmitted to CCHMC within 30 days of their initial hospitalization.

PROCESS OF OBTAINING CONSENT

Aim 1

Research personnel will approach families during the hospital stay, provide study information, obtain written consent, and schedule focus group participation. Families will have as much time as they need to consider enrollment in the study during their stay in the hospital. Families will be given time to read the consent forms, and study staff will also verbally go through the forms and allow families to ask questions. For patients at Liberty, we will call them to discuss the consent document over the phone. If they agree to participate, we will have them sign the consent when they arrive for the focus group.

Aim 2

As Aim 2 is based in Quality Improvement Methods, families will not be consented during this Aim. They are free to choose to receive the home visit or not, and study personnel will not contact the families while they are admitted. However, families that receive a follow-up phone call after their home visit will be asked to give verbal consent over the phone prior to completion of the survey.

In order to confirm parent recall of return visits to primary care 30-days after discharge, we will attempt to contact families eligible during Aim 2 who receive primary care at CCHMC for a short follow-up call. We will also confirm their return visits to primary care by reviewing their electronic medical record. We are requesting a waiver of consent for this review as we believe that making the request to review the record during the phone call will bias our results.

For the phone call optimization, we will use a similar process as described above. Either a clinical research coordinator or a home care resource nurse will approach patients and families in the hospital to offer them a nurse phone call after discharge; families are free to choose to receive the call or not. If they choose to receive a nurse phone call, the home care resource nurse will schedule a time to complete the nurse phone call, and the clinical research coordinator will have the family complete a W9 form and get good phone numbers for the feedback call 1-7 days after the nurse phone call. Because this aim is quality improvement in nature, we are asking for a waiver of written consent; families will be asked to provide verbal consent before completing the phone call.

Aim 3

Patients admitted to CCHMC will be recruited for the study during their hospital admission. A CRC will screen the patient to review inclusion and exclusion criteria; eligible patients and their families will be invited to participate in the randomized control trial. The parent or caregiver will provide informed written consent and patients with a developmental age of 8 years or older will provide written assent. Families will have as much time as they need to consider enrollment in the study during their stay in the hospital. Families will be given time to read the consent and assent forms, and study staff will also verbally go through the forms and allow families to ask questions. The ACE questionnaire will be limited to parents ages 18 or older.

Aim 4

Patients admitted to CCHMC will be recruited for the study during their hospital admission. A CRC will screen the patient to review inclusion and exclusion criteria; eligible patients and their families will be invited to participate in the randomized control trial. The parent or caregiver will provide informed written consent and patients with a developmental age of 8 years or older will provide written assent. Families will have as much time as they need to consider enrollment in the study during their stay in the hospital. Families will be given time to read the consent and assent forms, and study staff will also verbally go through the forms and allow families to ask questions. The ACE questionnaire will be limited to parents ages 18 or older.

Post-Hoc Analysis

Qualitative Analysis: Research personnel will approach families either via phone or during the hospital stay, provide study information, obtain verbal consent, and schedule a time for the interview. Research personnel will also approach clinicians and nurses either via phone or in-person at CCHMC to obtain verbal consent and schedule an interview time and/ or focus group. Families, clinicians and nurses will have as much time as they need to consider enrollment in the study. On enrollment we will ask participants permission to share their experiences and opinions regarding the Aim 3 results.

REQUEST FOR WAIVER of Documentation of Consent for Post-Hoc Analysis
We ask that participants have a waiver of written consent and instead give verbal consent. Participants will have as much time as they need to consider enrollment in the study. Study staff will explain the study and allow time for participants to ask questions. Please see attached Study Summary Sheet for these participants that will be given to them to allow for verbal consent to participate in the engagement interview and/or focus groups. We are requesting a waiver of documentation of consent and the following justifications support such a request.

1. Due to conducting a portion of our interviews over the phone we cannot obtain a documentation of consent. This study could not be practicably carried out without a waiver.
2. This study procedure will not adversely affect the rights or welfare of the participants. The purpose of the study is to gain a deeper understanding of our Aim 3 results. Participants will be given a summary sheet of the study and also be given time to think about participating in the study and given time to ask questions.
3. All transcripts will be stripped of identifiers and we will ensure confidentiality of participants' responses, including asking participants to protect the confidentiality of responses made by others.

Readmission Review:
REQUEST FOR WAIVER of Documentation of Consent for Readmission Review
We ask for a waiver of written consent as the assessment of preventability is done as a review of existing medical records. This review is part of an ongoing quality improvement project not directly part of this research study.

REQUEST FOR WAIVER of Documentation of Consent for Heterogeneity of Treatment Effect
We ask for a waiver of written consent as this administrative data is done as a review of existing medical records.

STUDY PROCEDURES

Aim 1

An open-ended semi-structured question guide will be developed by the research team to use for the focus groups. We will also include a short, anonymous demographic survey for the parents to fill out before the focus group, and will include patient demographics (age, gender, race, insurance, address) collected from the child's medical record. The questions are designed to stimulate and engage the participants to respond in their own words and to extract what is most meaningful to them. An experienced focus group moderator will use probes to further elucidate the responses and expand discussion by other participants. The question guide will be revised in an iterative fashion after the first and second groups to refine questions that were unclear and to add questions about unanticipated issues arising in the first groups. The same question guide will be used in subsequent groups so that consistent questions are posed to all participants. Participants will complete a brief demographic questionnaire at the beginning of each session. Focus groups will last approximately 90 minutes. We will ensure confidentiality of participants' responses, including asking participants to protect the confidentiality of responses made by others. The focus groups will be audio-taped and transcribed verbatim. Transcripts will be stripped of identifiers and reviewed for accuracy. The focus groups will be held in the CCHMC Family Resource Center (FRC) at dates and times convenient to families.

Aim 2

Data for this aim will be collected in-hospital after enrollment, during the nurse home visit, during the follow-up phone call for a subset of families, and though medical record review. On intake, the home visiting nurse will collect information on demographics, indication for the visit, and goals for the nurse home visit mutually-agreed upon by the care team and family. We also believe that there will be iterative qualitative and quantitative elements that the nurses may address during the home visit, which will be defined based on the focus groups in Aim 1. Clinical research coordinators (CRCs) will review the medical record of each patient that was referred for a nurse home visit to assess if medication reconciliation occurred at the follow-up visit, if the mutually-agreed upon goals were addressed at the visit, and if the patient had any unplanned hospital, ED, or outpatient utilization. Assessing unplanned utilization for all patients will be limited to reviewing CCHMC billing data, but we plan to compare hospital billing data to parent report for the subsample of patients that receive a follow-up call. The follow-up call, completed 31-45 days after the admission, will also assess parental confidence, if the family followed up with the PCP or subspecialist, and other iterative qualitative and quantitative elements that will be defined based on the findings from Aim 1. All data and follow-up phone call surveys will be entered into a password protected electronic database.

We will measure and track a core set of outcome measures from key outcome 3 domains of clinical, patient and family experience, and care delivery processes throughout Aim 2. The core clinical outcome measure will be 30-day post-discharge health care reutilization, defined for this Aim as readmission to the hospital or revisit to the ED. The core patient and family experience outcome measure will be an assessment of the family's comfort in managing care of the patient at home, completed at the end of the nurse home visit. Measured on a 5-point Likert scale, this single question will also be asked before hospital discharge by the home visit nurse to establish a family baseline. The core care delivery process measures will focus on two key processes: medicine reconciliation- measured by the number of clarifying actions or adjustments the home

nurse must make during the visit- and addressing key barriers discussed by families and inpatient providers prior to discharge-measured as a yes/no- that all key needs were addressed. We expect these core measures, with some modifications based on data collection strategies, will also be used during the randomized trial in Aim 3. We expect to add to and modify this set of measures based on the Aim 1 qualitative findings.

In order to validate parent report as a reliable measure of return visits to primary care, we will contact families during this Aim that receive primary care at CCHMC 30-days after discharge. This call will assess their recall of return visits to primary care. We will also review their electronic medical record to compare their recall to their actual visits. All data and follow-up phone call surveys will be entered into a password protected electronic database and all data reviewed by those not making the calls will be deidentified.

For the nurse phone call optimization, patients and families will be approached in the hospital to schedule a time to complete the nurse phone call. On intake, the home visiting nurse will collect information on demographics, indication for the call, and goals for the nurse call, mutually-agreed upon by the care team and family. We also believe that there will be iterative qualitative and quantitative elements that the nurses may address during the home visit, which will be defined based on early testing. The follow-up call led by the clinical research coordinator will collect feedback about the nurse phone calls and use this feedback to improve further calls in an iterative fashion.

Aims 3 and 4

Initial Questionnaire: Face-to-face interviews will be conducted in the hospital with the parent or caregiver at the time of enrollment. We will assess demographic characteristics, such as race, ethnicity, and age for both the parent/caregiver and patient. We will assess parent or caregiver marital status, education, household income, employment status, resilience, and parental activation. In addition, we will assess the ACE (adverse childhood experience) score of parents ages 18 years or older. The ACE score is a measure of childhood trauma that has occurred in the past. It does not indicate current exposure. Higher scores (ACE score greater than or equal to 4) have been associated with poorer adult health outcomes. Parental ACE scores have demonstrated an association with risk for childhood adversity in an outpatient setting. The questions encompass all forms of childhood trauma, including whether the participant was exposed to a household member that was depressed or suicidal or if the participant had been abused as a child. The ACE questionnaire will be provided as a handout for the study participant to fill out. It will be supplemented with a handout with the contact information of an inpatient social worker. It will be returned by the study participant in a sealed envelope to the research coordinator. It may be left blank by the study participant if they choose not to answer the questions. We will also assess the patient's medical history and their access to primary care, as well as other variables that arise from Aims 1 and 2. Survey data will be entered into a password protected electronic database.

Aim 3 Nurse Home Visit Intervention: The intervention for Aim 3is a revised nurse home visit. This intervention will build upon the baseline nurse home visit program by incorporating approaches to effectively address barriers to transition as determined in Aims 1 and 2. The current program involves a *single* nurse home visit within 96 hours after discharge and includes

physical and self-management assessment with the goal of ensuring patient stability and caregiver confidence. While we expect that many elements and processes of the current nurse home visit will remain intact, in Aim 1 we will be assessing current users' perceptions of the services as well as better defining the patient- and family- desired outcomes. In Aim 2, we will test small changes to the home visit elements and processes as informed by Aim 1 results.

Aim 4 Nurse Phone Call Intervention: The intervention for Aim 4 is a revised nurse phone call. This intervention will closely resemble the existing nurse home visit intervention currently being studied. The current program involves a *single* nurse home call within 96 hours after discharge and includes physical and self-management assessment with the goal of ensuring patient stability and caregiver confidence. While we expect that many elements and processes of the current nurse home visit will remain intact, in the optimization phase we will be assessing early users' perceptions of the and we will test small changes to the phone call elements and processes as informed by early testing.

Follow-up Questionnaire: A follow-up questionnaire to assess 14-day post-discharge outcomes will be conducted in both the control and intervention groups 14-30 days post-discharge. All efforts will be made for the follow-up questionnaire to be completed with the same parent or caregiver who completed the initial questionnaire. If this is not possible we will re-collect demographic information for the secondary parent or caregiver completing the follow-up questionnaire. We will collect the primary outcome measures of unplanned post-discharge utilization, as well as the secondary outcomes defined during the focus groups in Aim 1, and will re-measure the parental activation. Survey data will be entered into a password protected electronic database.

For approximately 40 of our patients, the research coordinator asked the parent's race as opposed to the patient's race for Aim 3 only. We are requesting permission to contact these participants via text message and phone call to ask the patient's race. We will also be asking the patients some questions regarding their experience with the intervention (nurse home visit) in Aim 3. We are asking these additional questions in order to use this feedback for future research studies as well as to help the flow of the call.

Medical Record Review: We will receive all enrolled patients 30-day reutilization (readmission and ED revisit) data from HealthBridge. HealthBridge is an organization that receives admission and emergency room data from hospitals throughout the Greater Cincinnati area. This will allow us to track reutilization outcomes at 30-days, while completing the call with families at 14-days. This will ensure that we have similar data for our primary outcomes from all patients.

Health Network at Cincinnati Children's: We are working closely with the Health Network at Cincinnati Children's (HNCC) to determine how much overlap exists between their patients and the patients enrolled in H2O. We are requesting permission to share our enrolled patient list with them, which will allow them to notify us which patients we've enrolled are also receiving services, such as intensive case management or a community health worker, among others, from HNCC. This will allow us to incorporate this as a covariate in our analysis so we can study the effect of visits on patients in HNCC vs. those not in the network. This will also allow us pilot data for future clinical care partnerships with HNCC.

We are also requesting permission to receive additional data about our enrolled patients who are cared for by HNCC. Specifically, we would like to study their medication adherence (via pharmacy claims data), as well as reutilization and adherence to recommended follow-up appointments.

We are requesting informed consent be waived to allow us to collect a few key data elements from the charts on patients we are unable to enroll. For these unenrolled patients, demographic data such as race and insurance status will be drawn from the electronic patient registration system. Home address will be recorded simply to obtain their census tract of residence, and then their address will be deleted, along with any HIPAA information (eg dates), from the database. Census tract demographics will then be used to compare additional demographics between enrolled and unenrolled patients. Re-admission and length of stay of both enrolled and unenrolled patients will be determined by review of the electronic chart. Prospective outcome data (ED visit or admission) for both enrolled and unenrolled patients will be determined through automated searches of the CCHMC billing database and HealthBridge data. We believe that this approach is no more intrusive than a retrospective chart review would be or than a retrospective look at our unenrolled population. Mostly importantly, it will help ensure our findings are due to the home visit.

Post-Hoc Analysis

Qualitative Analysis:

An open-ended semi structured question guide will be developed by the research team to use for the interviews and focus groups. The interview and focus group questions are designed to stimulate and engage the participants to respond in their own words and to extract what is most meaningful to them. A copy of sample questions, representative of the questions in the individual interviews and focus groups is attached to the IRB. Interviews will last approximately 30 minutes and focus groups will last approximately 60 minutes. We will ensure confidentiality of participants' responses, including asking participants to protect the confidentiality of responses made by others. All focus groups and interviews will be attended by two study team members, one will ask questions and take notes the second will be responsible for additional note taking. The focus groups and interviews will be audio-taped and transcribed verbatim. Transcripts will be stripped of identifiers and reviewed for accuracy

DATA ANALYSIS/METHODS

Aim 1

An inductive, modified grounded theory approach will be used for analysis of the qualitative data. Transcripts will be independently reviewed by a multidisciplinary team of 3-4 researchers including a pediatrician, nurse, project specialist, and qualitative methods expert to identify emerging concepts and themes related to hospital transitions, experiences, and preferences. The different disciplines/training of team members allows for multiple perspectives and prevents the perspective of one researcher from biasing data interpretation. A multidisciplinary team also enhances the credibility and dependability of the interpretation of the results.

During the initial phase of coding, analysis will begin with the independent review of one transcript. The team will meet to discuss the transcript and to identify initial ideas, concepts, and

themes and to assign codes. A preliminary codebook will be designed by the team and these codes will be conceptualized and defined. Each team member will then independently use the preliminary codebook to code transcripts. The team will meet regularly to discuss coding in a collaborative reflective fashion and to resolve any coding differences through consensus.[40] The codebook will be modified in an iterative fashion, adding, subtracting, and refining codes as needed and grouping related codes. Weekly coding meetings will be held until the completion of the coding of all transcripts allowing for ongoing scrutiny and feedback about the interpretation of the data. All coded transcript comments will be maintained in an electronic database. As a measure of quality assurance, at the completion of coding, the team will systematically examine the electronic record of statements for each code to identify and correct miscoded statements. At the conclusion of the data analysis, we will conduct member checking, whereby findings are reviewed with a set of parents or caregivers who participated in the focus groups. In another effort at triangulation, our findings will also be reviewed with several home-visiting nurses and pediatricians. The purpose of these reviews is to verify the findings and to identify any inconsistencies with stakeholders and participants. In addition to using a multidisciplinary team of researchers, this data review process represents an additional step to enhance the credibility of the interpretation of the data.[40,41]

Themes will be used to refine the intervention for the implementation phase (Aim 2) to better address the needs of families. Themes about experiences and preferences will be identified and used to develop measures of patient- and family-centered outcomes that will be assessed during the randomized controlled trial (Aim 3).

Aim 2

For both the home visits and the phone calls, we will evaluate the effects of adaptations on measures using statistical process control (SPC) methods. SPC is an analytic method originating in industrial engineering for assessment of the control of a process within targeted parameters. In this proposal, the *a priori* core measures will be tracked and plotted graphically in time series fashion using run and Shewart (control) charts. We will assess the stability of each measure by obtaining baseline data for at least 20 visits prior to adaptation and will use SPC principles to determine when a change in the home visit process leads to a meaningful change in the measures, known as special cause variation.[42,43] The graphical nature of SPC makes it ideal for the evaluation of frequent changes in a process; in contrast to traditional pre-post intervention analyses which are based on data aggregation (such as average values), SPC displays individual data points for maximum visualization of variation over time. Further, SPC provides immediate feedback as data is collected regarding the effectiveness of adaptations to meet desired goals. The steps of analysis include 1) evaluation of baseline data for each of the three core measures; 2) establishment of control limits to help determine when a change in the intervention results in a meaningful change in measures; 3) weekly sequential plotting of visit-level data; and 4) weekly evaluation by research team to determine when special cause has occurred and which adaptation precipitated the cause.

Aim 3

All primary analyses will include the intent to treat population.

Working hypothesis 1: Patients who receive the nurse home visit intervention will have a significantly lower occurrence of any all cause rehospitalization, ED/urgent care revisit, and/or unscheduled follow-up within 30-days post-discharge when compared to the patients enrolled in the control group after 30 days post-discharge. The dependent variable will be a dichotomized indicator of any occurrence of rehospitalization, ED revisit, and/or unscheduled follow-up within 30-days post-discharge. Differences in this outcome between intervention and control groups will be evaluated using logistic regression with the stratification variable (presence or absence of underlying chronic condition and hospitalist medicine general vs. surgical service) included in the model to account for the sampling design.

Working hypothesis 2: Patients who receive the nurse home visit intervention will have significantly higher parent activation scores 14-days post-discharge when compared to the patients enrolled in the control group after 14 days post-discharge. For this secondary outcome, the dependent variable will be a continuous measure of parent activation. Difference in this outcome between intervention and control groups will be evaluated using one-way analysis of variance (ANOVA) using a linear model containing a treatment effect indicator. Parental activation scores will be checked for normality and data transformations will be entertained, if needed. Baseline differences will be examined between groups, again using a linear model. If, by random chance, there is a difference between the groups, the first analysis will be repeated but adding the baseline as a covariate.

The sample size was determined based on the comparisons between the control group (standard-of-care) and intervention group (nurse home visit) for the primary outcome measure, a dichotomized indicator of all cause reutilization (i.e., rehospitalization, ED revisit, or unscheduled follow-up) within 30-days post-discharge, and the secondary outcome measure, parent activation score. A sample size of **1500** patients and their families (600 standard-of-care and 600 nurse home visits) was chosen to balance precision and feasibility. Assuming the control group primary outcome rate is 0.20, this sample size allows detectable differences of 0.07 or more (a 35% reduction or more from the control group rate) with 80% power. This detectable difference is lower than differences found in prior studies of adults. The estimated utilization rate of 0.20 in the control group is based on CCHMC data that indicates hospitalist service readmission rates of 5% on the general service and 15% on the surgical service, a 10% ED revisit rate, and a 4% outpatient service utilization rate; we assume that 10% of enrolled patients will come from the surgical service.

In all cases, secondary analyses will be performed including potential covariates, which may affect the impact of the intervention. We will look at the association between both the dependent variable of interest and the potential covariate/confounder and between the intervention and the potential covariate or confounder. Those associated with either the dependent variable or the intervention at $p<0.15$ will be entered into the initial model. Backward elimination will be used, variables significant at $p<0.05$ and those involved in confounding (i.e., if elimination from the model changes the beta coefficient for the intervention by more than 10%) will be retained in the model. Variables considered as potential covariates are patient age, parent or caregiver age, education, marital status, household income, employment status, and access to primary care.

Additional secondary analyses of the reutilization rate will exclude unforeseen readmissions for newly developed conditions not related to known diseases during the index hospitalization. In addition to the intent to treat analysis, a per-protocol analysis will also be employed. Analysis of secondary outcomes identified through Aim 1 will be tailored to the outcome measure. For example, if parents or caregivers identify days of work missed as an important outcome, our analysis of days of work missed will be restricted to only those parents/caregivers reporting work outside the home. We will take a two-part approach to analysis. First, we will treat it as a binary outcome, comparing the percentage of caregivers that missed at least one day of work during the 30-day follow-up period between the two study arms using logistic regression. Second, we will treat the number of days of work missed as a count outcome and use poisson regression to compare the two study arms. No interim analysis is planned.

Heterogeneity of Treatment Effects:
We have multiple planned analyses to examine potential heterogeneity of treatment effect of the nurse visit. Factors included in the HET analysis are insurance, primary care access, financial strain, caregiver education, hospital service, and medical complexity. Medical complexity will be determined by the pediatric medical complexity algorithm (PMCA). The PMCA is a publicly available algorithm that identifies children with complex chronic disease (who have accessed tertiary hospital care). The algorithm includes three levels of medical complexity: children with complex chronic disease (C-CD), children with non-complex chronic disease (NC-CD), and children without chronic disease (CD). In order to calculate the PMCA we will collect additional administrative data for all patients enrolled in Aims 3 and 4. This data will include: ICD9 Codes/ICD10 codes, procedure codes, admission date, discharge dates, admitting and discharge departments. We will capture all outpatient, urgent care, ED, and hospital events within the specified time window (February 1, 2012 to April 30, 2016). The PMCA will be calculated based on a 3-year window before the index hospitalization.

Aim 4

Analyses: For the primary outcome, the dependent variable will be a dichotomized indicator of any occurrence of healthcare reutilization within 30 days of hospital discharge. Differences between phone intervention and control groups on this outcome will be evaluated using logistic regression with census tract poverty and discharge service unit included in the model. Other potential covariates (e.g. baseline characteristics with large differences between groups) will be included in a secondary analysis model evaluating the effectiveness of the phone intervention. For secondary outcomes, PDCS total score and number of days back to normal routine perceived by the caregiver at 14-day post-discharge will be analyzed as continuous variables. Differences between the phone intervention and control groups will be evaluated using linear regression with census tract poverty and discharge service unit and other potential covariates included in the model.

Sample size: Assuming a 20% reutilization rate in the control group, a sample size of 750 in the control group and 450 in the phone intervention group will achieve 80% power to detect a 7.1% decrease in reutilization rate (12.9% event rate) for the phone call intervention group with alpha=0.05, allowing for 11% noncompliance.

For our secondary outcomes, allowing for 11% noncompliance and 5% attrition, the sample size will achieve 80% power to detect a mean difference of 3.1 points on the PDCS between control and phone intervention groups assuming a standard deviation of 16 points for both groups. The sample size will achieve 80% power to detect a mean difference of 0.98 days for return to normal routine assuming a standard deviation of 5 days for both groups. Both estimates assume alpha 0.05 and a 2-sided test.

Post-Hoc Analysis

Qualitative Analysis:

The team will meet to discuss the interviews and identify ideas, concepts, and themes of the interviews. Weekly meetings will be held until the completion of the interviews allowing for ongoing scrutiny and feedback about the interpretation of the data. Interview and focus group transcripts will be de-identified and reviewed by investigators and lead CRC trained in qualitative data analysis. The investigators and lead CRC will meet on a regular basis to discuss the transcripts, and will define and organize themes in an iterative fashion. The results of these interviews and focus groups will provide a deeper understanding of our results.

Readmission Analysis:

We will compare the percentage of readmissions designated as potentially preventable in those patients randomized to the intervention in Aim 3 compared to the percentage of readmissions designates as potentially preventable in those patients randomized to the control group in Aim 3

FACILITIES AND PERFORMANCE SITES

All research activity will occur within the CCHMC Burnet Campus and Liberty Campus inpatient wards. Other CCHMC sites such as College Hill Campus will not be included.

POTENTIAL BENEFITS

The potential benefits of the proposed research are to improve the nurse home visit and phone call program and inpatient to outpatient transitions experiences for families, nurses, and PCPs. Subjects receiving home visits or phone calls could potentially benefit directly from this intervention. Additionally, information obtained from the research findings may benefit other families in the future. The risk of loss of confidentiality is reasonable in relation to the anticipated benefits to the subjects, especially with the appropriate precautions noted.

POTENTIAL RISKS, DISCOMFORTS, INCONVENIENCES AND PRECAUTIONS

We anticipate minimal risks with this study. There is a minor risk to loss of confidentiality, but all measures will be taken to ensure the data collection and storage systems are secure. The database will be secured by password protection. In order to facilitate follow-up within the confines of the study, the database information will not be de-identified. However, any future projects utilizing this database would be approved under separate IRB protocol and could be restricted to de-identified data. Families may feel uncomfortable answering certain questions in the focus groups or the questionnaires, but they can always choose not to answer those questions. We will also ask that other focus group participants keep the information confidential. Data

received from HealthBridge will be sent in a secure manner and data will be stored following the same procedures listed above.

RISK/BENEFIT ANALYSIS

While immediate benefits to any given individual are unlikely, and the longer-term benefits of improving the nurse home visits are unclear, this study involves minimal risk to the individuals recruited. The primary risk is of breach of confidentiality. This will be mitigated by strict confidentiality practices. However, we believe that the study has a favorable risk/benefit tradeoff. It is also possible that patients and families who receive the nurse home visits or phone calls will find them helpful in understanding the child's illness or how to manage the condition at home.

Similarly, we believe the minimal risk to unenrolled patients' privacy of using the electronic registration database to determine demographic and length-of-stay data, and performing the automated search of the CCHMC billing database to determine the primary and secondary outcomes warrants waiving informed consent for these patients. Data on the unenrolled patients will allow us to comment on whether or not our enrolled sample is systematically different from those we did not enroll. We believe our potential results will be best utilized to improve care if any limits to their generalizability are elucidated. We believe the benefit to the potential impact of the research findings significantly outweighs the minimal risk to the privacy of unenrolled patients of recording data available via registration and billing databases.

RESPONSE PROCECURES FOR HARDSHIP AND SERIOUS EVENTS

If the caregiver, at any time during the research encounter requests assistance with any challenge or hardship, we will notify the inpatient social worker with the family's permission. This will occur within 24 hours and could be generated by responses to the Adverse Childhood Experiences questionnaire or qualitative report. The PI will be contacted if there are any difficulties in getting in touch with the social worker so that he can help facilitate access to the appropriate resources.

In the unlikely event that a family member volunteers thinking about a serious adverse event, the PI will be notified immediately. The PI and social worker (if available) will assist in triage including the use of 911 and the psychiatric emergency room.

PRIVACY AND CONFIDENTIALITY

All study personnel will have completed appropriate HIPAA compliance training. As noted above, PHI will be recorded electronically and stored in a secure, password-protected database. Anonymity will not be possible within the confines of this study in order to facilitate the focus groups and follow-up, but could be a condition required for further IRB protocols related to this database. However, participants will be given a study identification number, which may be used for future analyses. We will not guarantee, during the consent process, that the data collected will be deidentified.

COST AND PAYMENT FOR PARTICIPATION

None of the study costs will be passed on to participants or their third party payors. The cost of the nurse home visits are covered under the grant and by CCHMC. In **Aim 1,** families that

participate in the focus groups will receive a $50 gift card, as well as be provided food and beverages at the focus groups. In **Aim 2,** families that receive a phone call to assess the visit will receive a $10 gift card upon completion of the survey. Families that complete a nurse phone call feedback call will be paid $10 as well. In **Aims 3 and 4,** families that complete the survey during the hospital stay will receive a $5 gift card upon completion of the survey, and another $15 gift card upon completion of the follow-up survey. If parents do not want to provide social security number or receive reimbursement for participation, they can participate without receiving payment. In the **Post-hoc analysis**, parent participants that complete the interview will receive $10 gift card upon completion of the interview, they can participate without receiving payment.

References

1. Hesselink G, Schoonhoven L, Barach P, et al. Improving patient handovers from hospital to primary care: a systematic review. Annals of internal medicine 2012;157:417-28.
2. Cibulskis CC, Giardino AP, Moyer VA. Care transitions from inpatient to outpatient settings: ongoing challenges and emerging best practices. Hosp Pract (Minneap) 2011;39:128-39.
3. Bent KN, Keeling A, Routson J. Home from the PICU: are parents ready? MCN Am J Matern Child Nurs 1996;21:80-4.
4. Melnyk BM. Intervention studies involving parents of hospitalized young children: an analysis of the past and future recommendations. Journal of pediatric nursing 2000;15:4-13.
5. Smith L, Daughtrey H. Weaving the seamless web of care: an analysis of parents' perceptions of their needs following discharge of their child from hospital. J Adv Nurs 2000;31:812-20.
6. Snowdon AW, Kane DJ. Parental needs following the discharge of a hospitalized child. Pediatr Nurs 1995;21:425-8.
7. Lapillonne A, Regnault A, Gournay V, et al. Impact on parents of bronchiolitis hospitalization of full-term, preterm and congenital heart disease infants. Bmc Pediatr 2012;12:171.
8. Leidy NK, Margolis MK, Marcin JP, et al. The impact of severe respiratory syncytial virus on the child, caregiver, and family during hospitalization and recovery. Pediatrics 2005;115:1536-46.
9. Davis MM, Devoe M, Kansagara D, Nicolaidis C, Englander H. "Did I do as best as the system would let me?" Healthcare professional views on hospital to home care transitions. Journal of general internal medicine 2012;27:1649-56.
10. Co JP, Ferris TG, Marino BL, Homer CJ, Perrin JM. Are hospital characteristics associated with parental views of pediatric inpatient care quality? Pediatrics 2003;111:308-14.
11. Snow V, Beck D, Budnitz T, et al. Transitions of Care Consensus policy statement: American College of Physicians, Society of General Internal Medicine, Society of Hospital Medicine, American Geriatrics Society, American College Of Emergency Physicians, and Society for Academic Emergency Medicine. Journal of hospital medicine : an official publication of the Society of Hospital Medicine 2009;4:364-70.
12. Weiss M, Johnson NL, Malin S, Jerofke T, Lang C, Sherburne E. Readiness for discharge in parents of hospitalized children. J Pediatr Nurs 2008;23:282-95.
13. Coleman EA, Mahoney E, Parry C. Assessing the quality of preparation for posthospital care from the patient's perspective: the care transitions measure. Med Care 2005;43:246-55.
14. Joynt KE, Orav EJ, Jha AK. Thirty-day readmission rates for Medicare beneficiaries by race and site of care. JAMA : the journal of the American Medical Association 2011;305:675-81.

15. Berry JG, Toomey SL, Zaslavsky AM, et al. Pediatric readmission prevalence and variability across hospitals. JAMA 2013;309:372-80.
16. Berry JG, Hall DE, Kuo DZ, et al. Hospital Utilization and Characteristics of Patients Experiencing Recurrent Readmissions Within Children's Hospitals. Jama-Journal of the American Medical Association 2011;305:682-90.
17. Florin TA, French B, Zorc JJ, Alpern ER, Shah SS. Variation in Emergency Department Diagnostic Testing and Disposition Outcomes in Pneumonia. Pediatrics 2013.
18. Morse RB, Hall M, Fieldston ES, et al. Hospital-level compliance with asthma care quality measures at children's hospitals and subsequent asthma-related outcomes. JAMA : the journal of the American Medical Association 2011;306:1454-60.
19. Kaushal R, Bates DW, Landrigan C, et al. Medication errors and adverse drug events in pediatric inpatients. JAMA 2001;285:2114-20.
20. Kaushal R, Jaggi T, Walsh K, Fortescue EB, Bates DW. Pediatric medication errors: what do we know? What gaps remain? Ambul Pediatr 2004;4:73-81.
21. Lye PS. Clinical report--physicians' roles in coordinating care of hospitalized children. Pediatrics 2010;126:829-32.
22. Ruth JL, Geskey JM, Shaffer ML, Bramley HP, Paul IM. Evaluating communication between pediatric primary care physicians and hospitalists. Clin Pediatr (Phila) 2011;50:923-8.
23. Karaca-Mandic P, Jena AB, Joyce GF, Goldman DP. Out-of-pocket medication costs and use of medications and health care services among children with asthma. JAMA 2012;307:1284-91.
24. Berg JS, Dischler J, Wagner DJ, Raia JJ, Palmer-Shevlin N. Medication compliance: a healthcare problem. Ann Pharmacother 1993;27:S1-24.
25. Levy G, Zamacona MK, Jusko WJ. Developing compliance instructions for drug labeling. Clin Pharmacol Ther 2000;68:586-91.
26. McDonnell PJ, Jacobs MR. Hospital admissions resulting from preventable adverse drug reactions. Ann Pharmacother 2002;36:1331-6.
27. Senst BL, Achusim LE, Genest RP, et al. Practical approach to determining costs and frequency of adverse drug events in a health care network. American journal of health-system pharmacy : AJHP : official journal of the American Society of Health-System Pharmacists 2001;58:1126-32.
28. Osterberg L, Blaschke T. Adherence to medication. N Engl J Med 2005;353:487-97.
29. Crabtree BF, Miller WL. Doing qualitative research. 2nd ed. Thousand Oaks, Calif.: Sage Publications; 1999.
30. Stewart D, Shamdasani P, Rook D. Focus Groups: Theory and Practice, second edition. Thousand Oaks, CA: SAGE; 2007.
31. Kangovi S, Grande D, Meehan P, Mitra N, Shannon R, Long JA. Perceptions of readmitted patients on the transition from hospital to home. J Hosp Med 2012;7:709-12.
32. American Factfinder. U.S. Census Bureau, 2012. 2012, at http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml.)
33. Krieger N, Chen JT, Waterman PD, Rehkopf DH, Subramanian SV. Painting a truer picture of US socioeconomic and racial/ethnic health inequalities: the Public Health Disparities Geocoding Project. Am J Public Health 2005;95:312-23.
34. Krieger N, Chen JT, Waterman PD, Soobader MJ, Subramanian SV, Carson R. Geocoding and monitoring of US socioeconomic inequalities in mortality and cancer incidence:

does the choice of area-based measure and geographic level matter?: the Public Health Disparities Geocoding Project. Am J Epidemiol 2002;156:471-82.
35. Krieger N, Waterman P, Chen JT, Soobader MJ, Subramanian SV, Carson R. Zip code caveat: bias due to spatiotemporal mismatches between zip codes and US census-defined geographic areas--the Public Health Disparities Geocoding Project. Am J Public Health 2002;92:1100-2.
36. Bishaw A. Areas with concentrated poverty: 2006-2010. In: Commerce USDo, ed. Washington, D.C.: Economics and Statistics Administration, U.S. Census Bureau; 2011.
37. Langley GJ, Moen RD, Nolan KM, Nolan TW, Norman CL, Provost LP. The improvement guide: a practical approach to enhancing organizational performance. 2nd ed. Hoboken: Jossey-Bass; 2009.
38. Christensen CM. The ongoing process of building a theory of disruption. J Prod Innov Manag 2006;23:39-55.
39. Pawson R, Tilley N. Realistic evaluation. Thousand Oaks: Sage Publications; 1997.
40. Miles MB, Huberman AM, Saldaña J. Qualitative data analysis : a methods sourcebook. Third edition. ed. Thousand Oaks, Calif.: Sage Publications; c.2014.
41. Patton MQ. Qualitative research and evaluation methods. 3 ed. Thousand Oaks, Calif.: Sage Publications; 2002.
42. Box GEP, Hunter JS, Hunter WG. Statistics for experimenters: design, innovation and discovery. 2nd ed. Hoboken: John Wiley and Sons, Inc.; 2005.
43. Moen RD, Nolan TW, Provost LP. Quality improvement through planned experimentation. 3rd ed. New York: McGraw-Hill; 2012.