Improving Patient Prioritization During Hospital-homecare Transition: A Mixed Methods Study of a Clinical Decision Support Tool

NCT04136951

March 13, 2023

Background

Homecare settings across the United States provide care to more than 5 million patients every year. About one in five homecare patients are rehospitalized during the homecare episode, with up to two-thirds of these rehospitalizations occurring within the first 2 weeks of services. Timely allocation of homecare services might prevent a significant portion of these rehospitalizations. The first homecare nursing visit is one of the most critical steps of the homecare episode. This visit includes an assessment of the patient's capacity for self-care, medication reconciliation, an examination of the home environment, and a discussion regarding whether a caregiver is present. Hence, appropriate timing of the first visit is crucial, especially for patients with urgent health care needs. However, nurses often have limited and inaccurate information about incoming patients, and patient priority decisions vary significantly between nurses.

Our team has developed an innovative clinical decision support system (CDSS) called *Priority for the First Nursing Visit Tool* (PREVENT) to assist nurses in prioritizing patients in need of immediate first homecare nursing visits [18]. PREVENT was developed with rigor, using a strong theoretical foundation (transition theory) [19] and methodology for eliciting experts' decisions to create clinical decision support tools [20]. PREVENT was constructed using data mining, regression modeling, and expert homecare nurses' ratings of example patients who were transitioned from hospital to homecare. The goal was to identify key patient characteristics that are essential to support early homecare admission decision making. Overall, more than 70 patient demographic and clinical characteristics (eg, comorbidities, level and availability of social support, and detailed functional status) were considered for inclusion in the final prediction model from which PREVENT was developed. The final PREVENT CDSS uses 5 factors (including the number of medications, number of comorbid conditions, presence of a wound, presence of a comorbid condition of depression, and patient's functional status) to produce a recommendation on whether a specific homecare patient should be prioritized for the first homecare nursing visit. See

We completed a pilot efficacy study [9] to measure the efficacy of PREVENT, conducted at a large urban hospital in Brooklyn, New York. In collaboration with the Visiting Nurse Service of New York (VNSNY), we enrolled 176 patients admitted to homecare from the hospital during April and May 2016. In the control phase (n=90 patients), we calculated the PREVENT priority score but did not share the score with the homecare admission staff who influence visit scheduling. In the experimental phase, the PREVENT score was shared with the homecare admission staff (n=86 patients). During this phase, patients identified as high priority received their first homecare nursing visit about a half-day sooner as compared with the control phase (1.8 days vs 2.2 days; P=.09). Rehospitalizations from

homecare decreased by almost 50% (9.4% point reduction) when comparing the control (21.1%) and experimental phases (11.7%), with a significant difference between the rehospitalization (survival analysis) curves (log-rank *P* =.03). We acknowledge that this pilot study had a relatively small sample size and potentially insufficient adjustment for background variables. However, these results were promising in that high-priority patients received their first homecare visit sooner and overall rehospitalization rates were lower.

Methods

Mixed Method Approach

We are using an embedded mixed methods design. We will conduct a pre- and postintervention trial of PREVENT's integration into clinical practice using homecare admissions from two New York City urban hospitals serving diverse racial and ethnic populations. We will use quantitative methods, including logistic regression and survival analysis, to evaluate the effects of the tool on process and patient outcomes. We will utilize qualitative methods integrated with quantitative methods to gain an in-depth insight into technology adoption and implementation.

Setting

On the basis of our consultations with New York-Presbyterian (NYP) hospitals' leadership and our goal of exploring the effectiveness of the PREVENT system in different settings and among sites serving an ethnically diverse population, we will conduct the study at 2 NYP hospitals: (1) NYP Hospital/Columbia University Irving Medical Center (large academic medical center), a 745-bed adult academic medical center providing emergency, primary, and specialty care in all the major fields of medicine, and (2) NYP Allen Hospital (small community hospital), a 196-bed community hospital serving northern Manhattan, Riverdale, and other communities in the Bronx. As a homecare site, we will use VNSNY—the largest not-for-profit home health agency in the United States serving up to 48,500 patients and health plan members daily.

Study Intervention: PREVENT

The PREVENT tool will be integrated with the hospitals' electronic health record (EHR) via a locally developed system called iNYP, which integrates with the EHR and provides advanced data review capabilities of all EHR data. iNYP is a Java-based service-oriented web app that builds on Columbia University's 25-year history of clinical information system innovation [28,29]. iNYP is available as a custom tab within the commercial hospital EHR (supplementing the native results review capabilities) and is also accessible from a web browser or a mobile device. iNYP is widely used by most clinicians alongside the EHR, including the homecare admission staff. The PREVENT score will be

calculated automatically from EHR data that populate the patient discharge summary or other parts of the EHR. We have cross-mapped the elements (eg, number of medications and comorbid conditions) needed for the calculation of the PREVENT score to confirm that the required elements are readily available in the EHR system. VNSNY admission staff will receive an auto-populated field within the homecare referral containing the PREVENT recommendation about visit priority, presented as high priority and medium or low priority. Before any data collection, we will test the accuracy of the PREVENT score on the first 50 priority calculations and correct the EHR integration if any mistakes are found.

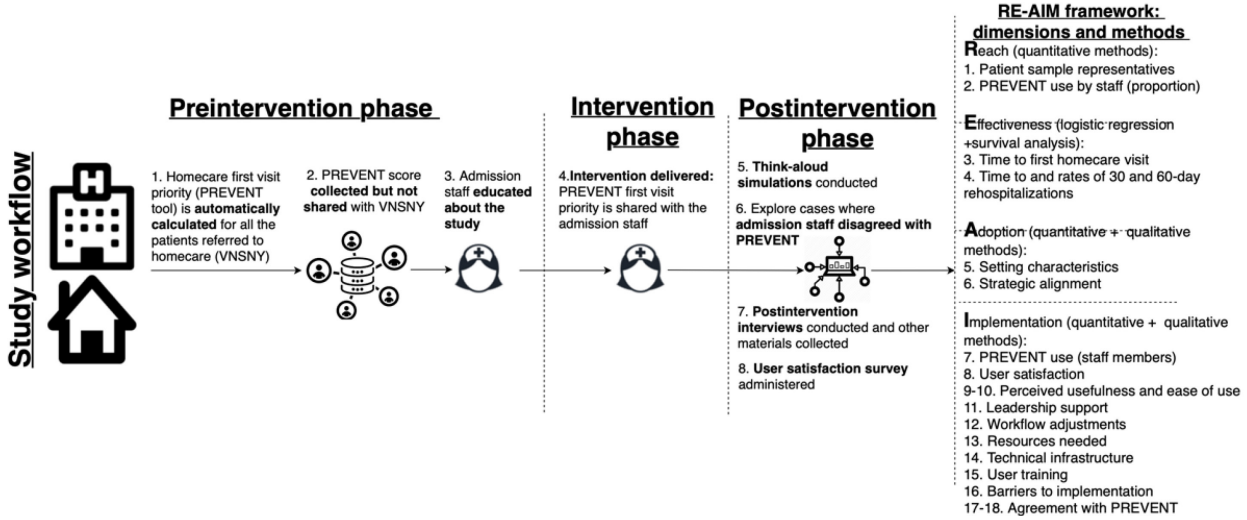
Standard VNSNY Patient Admission Workflow

During our preliminary work, we determined that the scheduling and assignment unit assumes responsibility for patient admission to the VNSNY. The unit comprises several admission staff members who are involved in the admission processes, including intake coordinators, clinical associate managers, and schedulers. Homecare admission starts with standard homecare referral signed by the referring physician.

The referrals are passed to the intake coordinators (administrative staff) who enter the referral information into the VNSNY EHR system. Next, clinical field managers give patients a welcome call and coordinate the general start of care dates. After that, schedulers identify the date of a first homecare nursing visit. Each geographic location (based on city boroughs and street addresses) is served by several admission staff members.

Study Workflow

The workflow of PREVENT implementation consists of 3 phases: preintervention phase, intervention phase, and postintervention phase.



Preintervention Phase

During this phase of the study, 3 research activities will be implemented. First, the PREVENT priority score will be automatically calculated for all the patients referred to VNSNY from the 2 hospitals (step 1). Second, the PREVENT score (and priority recommendation based on the score) will be collected but not shared with homecare admission staff over about 3 months (step 2). Third, after the preintervention phase data are collected, the study team will conduct several 30-min educational sessions for the admission staff about the development and validation of PREVENT and this study (step 3). We will work with the VNSNY scheduling and assignment unit management to identify all the VNSNY staff eligible (15-20 staff) to be exposed to PREVENT's recommendations during the study. We will ensure that each eligible admission staff member undergoes at least one educational session about the study workflow.

Intervention Phase

To minimize periodical and time effects, the intervention phase will start at both hospitals on the same date. The PREVENT recommendation will be shared with the homecare intake coordinators for about 3 months (step 4). The intake coordinator will enter the PREVENT recommendation into the *special recommendations* field of the VNSNY EHR system. This field stores information about any special programs or services patients should receive in homecare, such as recommendations for frontloading of visits. Next, clinical field managers and schedulers will incorporate the PREVENT priority recommendations in their processes related to visit scheduling and patient prioritization. The field clinician will then conduct the first nursing visit. For cases where patient prioritization was not possible, we will ask the admission staff to document why a priority visit could not happen (such as the patient refused or short staffing; step 5).

Study Instruments

Qualitative interviews and think-aloud simulations will be guided by two robust interview guides we will develop for this study. The guides will incorporate aspects of the RE-AIM framework dimensions as questions. The guides are as follows: (1) postintervention simulation guide (think-aloud protocol) and (2) postintervention phase interview guide. Each interview guide will include semi-structured open-ended questions to be answered by the admission staff. The *Postintervention phase interview guide* will include questions about PREVENT's perceived usability and ease of use, leadership support, workflow adjustments, adequacy of training sessions, and barriers to implementation such as any

changes the respondent made to his or her regular workflow to use PREVENT's recommendations.

The End-User Computing Satisfaction Instrument [31-33] will be used to quantitatively measure satisfaction. The 12 item instrument measures concepts such as accuracy and ease of use and has been used to evaluate many types of applications, including decision support. A score of 54 corresponds to the 70th percentile. Any concept scoring less than the 70th percentile from either user group will guide future tool revision.

Sample Size Calculation

In this study, we will calculate the PREVENT scores for all patients referred to VNSNY from the 2 hospitals (see study setting) in a 3 month period during the preintervention phase (scores not shared) and a 3 month intervention phase (scores shared) for an estimated total of 2094 patients and 1508 high-priority patients, respectively. This calculation is based on the pilot study rehospitalization decrease.

In the pre-experimental phase of the study, we used secondary data extracted from EHR to calculate PREVENT score. In the experimental phase, we will retrospectively apply the PREVENT algorithm on all patients referred from the two hospitals to homecare settings. We will then use descriptive statistics to identify the number of high and low/medium priority patients (based on PREVENT score) that were referred to homecare. Sample size and justification: Administrative data shows that average monthly referrals to homecare in the first semester of 2018 from New York-Presbyterian Hospital/Columbia University Irving Medical Center and New York-Presbyterian Allen Hospital were 279 and 70 patients, respectively, or a total of 1,396 referrals in a four-month period. Of those, we expect that approximately 50% patients will be classified as high risk by PREVENT. In this study, we will be calculating the PREVENT scores for all patients referred to homecare from these two hospitals in a four-month period during the pre-intervention phase. This sample size is sufficient to estimate the number of high priority patients for the later experimental phase of the study.

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