New Knowledge, Innovations & Improvements: Research

NK1EO The organization supports the advancement of nursing research.

NK1EO: Provide one completed IRB-approved nursing research study.

Introduction

Massachusetts General Hospital (MGH) was a participant in the ANCC-commissioned multi-site study “READI (Readiness Evaluation And Discharge Interventions): Implementation as a Standard Nursing Practice for Hospital Discharge.” The multi-site study team included:

- Marianne Weiss, DNSc, RN, Principal Investigator, Marquette University College of Nursing
- Kathleen Bobay, PhD, RN, NEA-BC, Loyola University Marcella Niehoff School of Nursing
- Ronda Hughes, PhD, RN, FAAN, University of South Carolina College of Nursing
- Linda Costa, PhD, RN, NEA-BC, University of Maryland School of Nursing
- Olga Yakusheva, PhD, University of Michigan School of Nursing

Gaurdia Banister, PhD, RN, NEA-BC, FAAN, Executive Director, Institute for Patient Care served as the MGH Site Principal Investigator. In this role, Banister worked with the Multi-Site Research Team to obtain MGH IRB approval and plan the logistics of the study at MGH including:

- conducting nursing staff training on the implementation unit
- managing data collection by implementation unit clinical nursing staff
- obtaining electronic data abstracts of patient level data on patient characteristics and the outcomes of interest, hospital characteristics, and unit-level staffing data.

The READI study design involved unit level implementation of the discharge readiness assessment protocols. Recognizing that preparation for discharge occurs throughout the hospitalization, it was important for all nurses on the unit to be trained in the protocols to ensure a unified approach to quality discharge preparation. A hallmark of the READI study was that clinical nurses on the implementation unit collected discharge readiness assessment data as part of their clinical care of patients. These data were simultaneously used for patient care and for research purposes. All other data for the study were extracted from electronic records.

While the study outcomes were measured quantitatively as readmission and Emergency Department (ED) visits, a key aspect of the study was evaluation of the implementation process and the value of participation in research. Banister and MGH clinical nurses participated in interviews and focus groups to inform the results of this study.
Research Question and Hypothesis

This study aims to evaluate the impact of unit-based implementation of discharge readiness assessment on readmissions and ED use within 30 days post-discharge. Three protocols, each adding a component to discharge readiness assessment, were used to introduce, in sequence:

1. discharge readiness assessment by the discharging nurse
2. discharge readiness assessment by the discharging nurse informed by patient self-report of discharge readiness [patient-informed nurse assessment]
3. patient-informed nurse assessment, with the addition of an instruction to the discharging nurse to initiate and document nursing action(s) for patients with low readiness scores.

Specific Aim 1: Determine if discharge readiness assessment by the discharging nurse using the RN-RHDS-short form (RN-RHDS protocol), when implemented as a standard pre-discharge nursing practice, contributes to reduced readmissions and ED visits within 30 days post-discharge.

- **Hypothesis 1**: Patients discharged using the RN-RHDS protocol will have fewer hospital readmissions and ED visits within 30 days post-discharge compared to patients discharged under usual care conditions.

Specific Aim 2: Determine if nurse assessment informed by patient self-assessment using the PT-RHDS short form contributes to improved post-discharge outcomes (readmissions and ED use within 30 days post-discharge) by adding patient’s perspective to the RN-RHDS protocol (RN-RHDS+PT-RHDS protocol).

- **Hypothesis 2**: Patients discharged using the RN-RHDS+PT-RHDS protocol will have fewer hospital readmissions and ED visits within 30 days post-discharge compared to patients discharged using the RN-RHDS protocol.

Specific Aim 3: Determine if adding a structured format for documenting nurse actions triggered by low discharge readiness assessment scores improves patient outcomes (readmission and ED use within 30 days post-discharge).

- **Hypothesis 3**: Patients discharged by nurses using the RN-RHDS+PT-RHDS protocol plus a Nurse Discharge Action Guide [NDAG] (RN-RHDS+PT-RHDS+NDAG protocol) will have fewer post-discharge readmissions and ED visits than patients discharged using the RN-RHDS+PT-RHDS protocol; the effect will be strongest for patients with low RHDS scores.

Specific Aim 4: Conduct cost-benefit analysis of implementing discharge readiness assessment as standard practice, by comparing cost-savings from reduced post-discharge utilization against implementation costs.

Study Rationale

Preparation of patients for discharge is a primary function of hospital-based nurses and readiness for discharge is an important outcome of hospital care. Inadequacies in discharge preparation have been well-documented and linked to difficulty with self-management after hospital discharge and with increased likelihood of emergency
department (ED) use and readmission. Prior studies by the multi-site research team have led to recommendations for implementation of discharge readiness assessment as a standard nursing practice for hospital discharge.

The value of implementing discharge readiness assessment as a standard practice lies in timely, rapid, and systematic determination of nurse and patient perspectives on 4 aspects of discharge readiness (personal status, knowledge, coping ability, expected support). The assessment results enable the nurse to initiate pre-discharge risk-mitigating actions that enhance patient readiness and avert adverse post-discharge outcomes that may result in ED visits and readmissions.

The rationale for MGH's decision to participate in the READI study was based on:
1. MGH's commitment to providing exemplary care to patients throughout the continuum of care including discharge.
2. MGH's dedication to advancing nursing science
3. MGH's commitment to involving nurses at all levels in nursing research by creating a spirit of inquiry in the practice environment.

Literature Review

Reducing readmission and ED utilization rates is central to health care improvement and reform efforts (Naylor et al., 2011). Recent research has linked hospital nurse staffing to readmission rates (McHugh et al., 2013; Weiss et al., 2011). With Medicare readmission rates approaching 20% (Jencks et al., 2009) and financial penalties for high rates of readmissions within 30 days of discharge, novel approaches to engaging hospital nurses in readmission reduction efforts hold significant promise for promoting high-quality affordable patient care.

Problems with hospital discharge are well documented. Perceived inadequacies in discharge planning, teaching, and coordination are associated with greater likelihood of post-discharge problems, ED utilization, and readmissions (Banja et al., 2007; Bull et al., 2000; Coleman et al., 2005; Henderson & Zernicki, 2001; Jack et al., 2009). Most readmissions within 30 days are viewed as preventable (Medpac, 2007) and occur as a result of failures in the adequacy of discharge preparation (Minott, 2008).

Large scale initiatives to improve discharge transitions have focused on communication and coordination of care between hospital and community providers using specialized roles for transition support (Coleman et al., 2006; Jack et al., 2009; Naylor et al., 1999, 2004, Nielsen et al., 2008). The role of the acute care staff nurse has been virtually ignored in discharge transition initiatives, despite the fact that, in most hospitals, the staff nurse is responsible for the complex processes of preparing patients for discharge (Foust, 2007; Nosbusch, Weiss, & Bobay, 2011).

Readiness for discharge is an outcome of discharge preparation. In previous research by this study team, the 21-item Readiness for Hospital Discharge Scale (RHDS) has been developed and tested with multiple inpatient groups (Weiss et al., 2006, 2007, 2008, 2009; Lerret & Weiss, 2011). In measuring readiness for discharge to home following adult medical-surgical hospitalization, patient self-report [PT-RHDS] and nurse
assessment [RN-RHDS] forms of the scale have demonstrated an association with post-discharge utilization (readmissions and ED visits) (Weiss et al., 2007, 2010, 2011). The RHDS was reduced to an 8-item version for use in clinical practice and was more strongly associated with readmission than the 8-item PT-RHDS in 2 adult samples in the Midwest and Eastern US (Weiss et al., 2010; Weiss et al., 2014). Patients with low readiness scores by nurse assessment experienced more than a 6-fold increase in the likelihood of being readmitted (Weiss et al., 2014).

Currently there is no standard approach for preparing patients for discharge from acute care hospitals. The body of evidence from prior studies by the research team lays the foundation for the recommendation that pre-discharge readiness assessment be implemented as a standard nursing practice for hospital discharge (Weiss et al., 2011).

**Participants: MGH READI Study Team**

<table>
<thead>
<tr>
<th>Name/Credential</th>
<th>Title</th>
<th>Department/Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gaurdia Banister RN, PhD, NEA-BC, FAAN</td>
<td>Executive Director/Site Principle Investigator</td>
<td>The Institute for Patient Care and the Yvonne L. Munn Center for Nursing Research</td>
</tr>
<tr>
<td>Cristina Bethune, RN, BSN, MHA</td>
<td>Nursing Director</td>
<td>Cardiac Medicine (Ellison 10)</td>
</tr>
<tr>
<td>Judi Silva RN, MSN, NE-BC</td>
<td>Nursing Director</td>
<td>Cardiac Intervention (Ellison 11)</td>
</tr>
<tr>
<td>Cindy Aiena, MBA</td>
<td>Executive Director</td>
<td>Finance</td>
</tr>
<tr>
<td>Hasna Hakin, RN, MSN, DNP, CCRN</td>
<td>Student, Doctor of Nursing Practice</td>
<td>MGH Institute of Health Professions</td>
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<tr>
<td>Antigone Grasso, MBA</td>
<td>Director</td>
<td>Patient Care Services Management Systems and Financial Performance</td>
</tr>
<tr>
<td>Dawn Sorel</td>
<td>Corporate Manager, Decision Support</td>
<td>Finance</td>
</tr>
<tr>
<td>Bethany Marullo</td>
<td>Administrative Fellow</td>
<td>Administration</td>
</tr>
<tr>
<td>Nancy Raye, RN, MSN</td>
<td>Staff Specialist</td>
<td>Patient Care Services Management Systems and Financial Performance</td>
</tr>
</tbody>
</table>

In addition to the individuals noted in the grid, over 70 clinical nurses from Cardiac Medicine Unit (Ellison 10) participated in the study.

**Study Protocol Training**

Education regarding the implementation protocols and training in study procedures occurred at multiple levels and times throughout the study. Of the eligible staff, the percent of trained staff was extremely high.
Methods

Study Design

A prospective, parallel cohort, stepped implementation study design (Handley et al., 2011) with difference-in-difference analysis was used to evaluate outcomes (likelihood of readmissions and ED visits within 30 days post-discharge). Four sequential cohorts of patients on units where usual care (baseline cohort 0) is followed by a stepwise implementation of 3 discharge readiness assessment protocols (cohort 1 [AIM1]: RN-RHDS protocol; cohort 2 [AIM2]: RN-RHDS+PT-RHDS protocol; cohort 3 [AIM3]: RN-RHDS+PT-RHDS+NDAG protocol) will be compared to 4 concurrent cohorts of patients on usual care/control units. Patient outcome (readmissions/ED use) differences were examined between each sequential implementation cohort (first difference) while also controlling for any changes in institutional practices or seasonal trends using usual care cohorts at each concurrent step (second difference).

The implementation protocols were incorporated into existing unit operational processes for hospital discharge. The decision to implement at the unit-level, with comparable units serving as control units, was made because spill-over effects of nurse training and cross assignment of nurses to implementation and control patients on the same unit would likely contaminate the control patient samples. For Aim 4, a cost-benefit analysis was conducted to compare the savings from reduction in post-discharge readmissions and ED visit costs at each step of implementation to usual care, after accounting for recurring and non-recurring implementation costs.
Study Timeline and IRB Approval

The study underwent expedited review by the Marquette University IRB and was initially approved on September 6, 2013 with subsequent annual continuing reviews. The multi-site study period was set for July 1, 2014 to June 30, 2017. The targeted start date for the MGH study period was January 15, 2015 as noted in the chart below. The MGH portion of the study was approved on January 20, 2015 with the following determination by the IRB: expedited. Due to the date of the MGH IRB approval, the study timeline for the MGH portion of the study was January 20, 2015 to October 1, 2016.

### Data Collection and Data Pull Schedules

<table>
<thead>
<tr>
<th>Phase Start Date</th>
<th>1/15/15</th>
<th>6/1/15</th>
<th>10/16/15</th>
<th>3/1/16</th>
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<tbody>
<tr>
<td>Date Ranges for Each Phase</td>
<td>1/15/15-5/31/15</td>
<td>6/1/15-10/15/15</td>
<td>10/16/15-2/29/16</td>
<td>3/1/16-6/30/16</td>
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<tr>
<td>Phases for Study Units</td>
<td>Baseline 4 months + 2 weeks training</td>
<td>Phase 1 4 months + 2 weeks training</td>
<td>Phase 2 4 months + 2 weeks training</td>
<td>Phase 3 4 months No training</td>
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<tr>
<td>Implementation</td>
<td>Baseline</td>
<td>RN-RHDS</td>
<td>RN-RHDS +PT-RHDS</td>
<td>RN-RHDS +PT-RHDS +NDAG</td>
</tr>
<tr>
<td>Control</td>
<td>Baseline control</td>
<td>Concurrent control</td>
<td>Concurrent control</td>
<td>Concurrent control</td>
</tr>
<tr>
<td>Unit Level Data Pull Due</td>
<td>8/1/15</td>
<td>12/15/15</td>
<td>5/1/16</td>
<td>9/1/16</td>
</tr>
<tr>
<td>Patient Level Data Pull Due</td>
<td>9/1/15</td>
<td>1/15/16</td>
<td>6/1/16</td>
<td>10/1/16</td>
</tr>
<tr>
<td>Unit Level Annual Data Pull Due</td>
<td><strong>7-1-15</strong></td>
<td><strong>7-1-16</strong></td>
<td><strong>7-1-15</strong></td>
<td><strong>7-1-16</strong></td>
</tr>
</tbody>
</table>

*Do not disclose to staff prior to training for each phase*

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Research Sample: Study Participants, Sample Size, Sampling Plan

This study used a multi-level, nested sample consisting of patients, cared for by nurses, within units, within hospitals. The patient sample included adult patients (18+) being discharged home with or without home care services from medical-surgical nursing units of 34 Magnet-designated hospitals. On the implementation units, all eligible patients and their discharging nurses were included in the sample. On control units, all
eligible patients were included following the same sample inclusion criteria as the implementation units.

Two units were included from each participating hospital. One was randomly selected by the study team as the implementation unit and the other as the control unit. Where possible, these units were of similar type (either medical, surgical, or medical-surgical). Critical care units and oncology specialty units were excluded. The two study units selected at MGH were:

Implementation Unit: Cardiac Medicine Unit (Ellison 10): a thirty-six adult in-patient care unit with complex cardiac and medical patients. The population includes cardiac arrhythmia patients requiring medical and post procedure management, heart failure patients awaiting transplant and requiring intensive monitoring and complex coronary artery disease patients.

Control Unit: Cardiac Intervention Unit (Ellison 11): a thirty-six adult in-patient care unit consisting of patients with acute coronary syndromes, arrhythmias, heart failure and other vascular diagnoses. Most patients on this unit require a catheter-based procedure, either coronary or peripheral and many patients have electrophysiology studies and procedures as well.

**Patient Sample Size and Power Analysis**

For the study model with a full set of stand-alone and interaction terms for a 4x2 difference-in-difference design (4 study steps [0/1/2/3] and 2 study conditions [implementation/usual care]) with control variables (patient characteristics, unit-level nurse staffing controls, hospital fixed effects), the minimum sample size required to achieve 80% power and p<.05 significance for small effect sizes (.02 change in R²) in main study aims, including subgroup analysis for patients with low readiness (Aim 3) is 24,304 patients (Ender, 2011). With 34 hospitals, the minimum per site would be 715 patients per hospital (358 patients per implementation and 358 patients per control unit; 89 patients per unit in each of the 4 phases). To account for clustering at the 4x2 cohort-implementation step cells, the data will be oversampled (Ender, 2011) by 50% for the final sample of 537 patients per unit (134 patients per unit per phase). Assuming a range of 75 to 200 discharges per unit per month and 50% of patients meeting inclusion criteria for discharge to home, the target sample was expected to accrue on smaller study units in 4 months. To ensure that the results of the analyses were properly adjusted for confounding due to any unrelated system-wide changes in patient care practices or seasonal trends that occurred during the study period, the start and end date of each implementation and data collection step were the same for paired implementation and control units.

Because the study design includes a time trend, patients were enrolled throughout the entire study period. Therefore, the number of patients enrolled per hospital varied based on volume and exceeded the minimum sample estimates. Frequency weighting was used to adjust for sample size differences among units.
To assure an adequate maximum for the study, the total number of subjects requested was calculated as follows:

1. 17.5 months (4 months per phase x 4 phases + 2 weeks training x 3 phases) multiplied by the number of eligible subjects in the first or highest month of data collection.
2. Then multiply by 2 to account for the control unit.
3. Then increase the number by 50% (multiply the result of #2 above by 1.5) to assure the number of subjects do not exceed what is being requesting from the IRB.

**Measures**

The **RN-RHDS short form** was used to guide the nurse’s assessment of a patient’s readiness for discharge. A parallel patient form, the **PT-RHDS short form**, was used for patient self-assessment. The RN-RHDS/PT-RHDS are 8-item short forms of a 21-item instrument that has undergone rigorous testing. The 21-item instrument has reliability estimates in adult medical-surgical patients age 18 to 102 for both RN-RHDS and PT-RHDS of >.80 for total and subscales and confirmatory factor analyses in 2 studies have supported a 4-factor structure (personal status, knowledge, perceived coping ability, expected support) (Weiss et al., 2007, 2011). Using the long forms of the instrument, PT-RHDS was inversely associated with readmission within 30 days following hospital discharge (Weiss et al., 2007) and ED visits (Weiss et al., 2011). The positive predictive value of PT-RHDS for readmission progressively increased with age, especially in the oldest (85 years and older) (Bobay, Yakusheva, & Weiss, 2010). In a subset (n=162) of the 1892 adult medical-surgical patients in the Weiss et al. (2011) study, RN-RHDS was associated with post-discharge utilization (readmission or ED visit) with an odds ratio of .57 indicating a 43% reduction in utilization for a 1 point increase in the RN-RHDS (on a 10 point scale), while PT-RHDS showed no association (Weiss et al., 2010).

Item reduction resulted in a short form with 8 items (2 per subscale) that explain 94% of RN-RHDS and 93% of PT-RHDS scale variance (Weiss et al., manuscript in preparation). In its reduced forms, Cronbach’s alpha reliability estimates for RN-RHDS and PT-RHDS were .82 and .83 using the dataset from Weiss et al. (2011). In a replication of the Weiss et al., 2010 study with 254 adult medical-surgical patients and their discharging nurses using the RHDS short forms in place of the long forms, RN-RHDS again was highly predictive of 30-day readmission and the nurse form was more predictive than the patient form. Using a cutoff score of <7 as indicative of low readiness, RN-RHDS short form was associated with a 6-9 fold increase in odds of readmission even in the model adjusted for numerous patient characteristics (Weiss et al., 2014).

The **Nurse Discharge Action Guide (NDAG)** consists of a list of potential nursing actions that can be initiated related to discharge transition support. The NDAG (attachment NK1EO.a) consists of a list of possible actions that can be initiated by the discharging nurse in response to a low readiness assessment. The NDAG was developed from a literature review and has undergone pilot testing in a sample of 44 patients. Results indicated that 45% of patients had nursing actions initiated, with one quarter of these being triggered after the completion of the RHDS assessment. Ten
percent (n=4) reported low readiness scores. All had actions prior to the assessment and one had an additional action initiated after the assessment. The findings of this pilot study suggest that nurses intervene for readiness risk both in anticipation of discharge and at the time of discharge readiness assessment and that the use of the NDAG can serve as a trigger for action by the nurse. The number and type of nurse actions taken will be analyzed in response to low readiness scores and the relationship of action to the outcomes of interest (i.e. readmission and ED visits).

For this study, the NDAG was completed following discharge readiness assessment (RN-RHDS+PT-RHDS) for all patients on the implementation units. Nurses were instructed that initiation and documentation of an action on the NDAG was essential for any patient with a score of <7 on any item of the RN-RHDS or PT-RHDS. To facilitate completeness of data capture, nurses were provided with an open-ended response option that was coded for content by the researchers. The open-ended response captured any actions taken by the nurse that are not included in the list of actions on the NDAG.

**Education and Training Procedures**

Education regarding the implementation protocols and training in study procedures occurred at multiple levels and times throughout the study. Cristina Bethune, RN, BSN, MHA, Nursing Director, Cardiac Medicine Unit (Ellison 10), served as the master trainer/coordinator of training for clinical nurses on the implementation unit. Bethune was trained by the study team. The training consisted of a detailed review of study design and procedures, and of methods for training clinical nurses. The trainings of Master Trainers occurred via webinar/videoconferencing using Go-To-Meeting®. All training documents and all study materials were made available on the study website.

Bethune conducted start-up training for clinical nurses in the 2 weeks prior to the start of Phase 1. She utilized with voiced-over Powerpoint slides, non-voiced over Powerpoint presentation with a script, and PDFs of the presentation and script. Phase 1 training was an in-person training in group or individual conferencing as determined by site preference, and took approximately 1 hour. The content of the Phase 1 training included: (1) the purpose of the study and the evidence base for discharge readiness assessment, and (2) a detailed review of the RN-RHDS instrument and study procedures, including human subjects protection. Phase 2 and 3 training used similar Powerpoint presentations and included new steps added to the study protocol at each phase as well as a reminder of the overall study goals. Phase 2 and 3 training took approximately 30 minutes. Logs were kept of participation in training to assure all clinical nurses were trained.

**Data Collection Methods**

The measured outcomes of the implementation were readmissions and ED visits in the first 30 days post-discharge. Data for these outcomes were extracted from hospital electronic information systems.
Control Variables

The following patient characteristics were extracted from electronic hospital records: age, sex, race/ethnicity, APR-DRG with severity and mortality indices, and type of admission (medical/surgical), discharge disposition (home, home with home health), length of stay, ICU stay, and payer. Based on our prior research that demonstrated a relationship between RN hours per patient day (RNHPPD) and readmissions (Weiss et al., 2011), the following unit-level nurse staffing variables will be included in the analytic models: RNHPPD, skill mix (% RN, %BSN). These data were collected monthly from nursing administrative databases and specifications will be consistent with NQF/NDNQI.

Cost Data Collection

Training costs and time spent by nurses completing nurse and patient assessments (to be recorded by the nurse on study documents) were estimated and ED/readmission costs and reimbursement (to be extracted from study hospital financial systems) were obtained from hospital financial databases. In cases where hospital specific cost data were not available, age and diagnosis-adjusted average costs were imputed from the available cost data collected for the study.

RN-RHDS, PT-RHDS, and NDAG: Data collection forms included a patient study ID number. Hospital medical record and encounter number (i.e. unique patient identifier for the index hospitalization) were collected for linking to post-discharge utilization data. These identifiers were deleted prior to transmission of study data to the study team. Clinical nurses were identified with a Nurse Research ID. This number sequence was not identifiable to the study team and was only used for statistical processes for adjustment of standard errors to account for nurses caring for multiple patients in the sample. This number was entered on the RN-RHDS form.

On the implementation units, for phase 1, the discharging clinical nurse completed the RN-RHDS within 4 hours prior to discharge. For phase 2, the discharging nurse informed the patient about the study and asked the patient to complete the PT-RHDS within 4 hours prior to discharge. If the patient had difficulty reading or writing, the discharging clinical nurse asked the questions verbally. The clinical nurse reviewed the PT-RHDS responses and then completed the RN-RHDS. For phase 3, the discharging clinical nurse followed the procedures for phase 2 and then recorded any nursing actions deemed appropriate based on the discharge readiness assessment on the NDAG. There was no on-unit data collection on control units.

It was recognized that each hospital had different operational logistics and resource constraints that may limit the feasibility of a one-size-fits-all model for data collection. Because of this, three implementation options were offered. Option 1: RN-RHDS, PT-RHDS, and NDAG data will be collected from all eligible patients and discharging nurses via scannable paper records. Option 2: RN-RHDS, PT-RHDS, and NDAG will be loaded into electronic health records. RN-RHDS and NDAG will be completed by the nurse as part of routine discharge care. The PT-RHDS will be completed on paper by the patient (or by the discharge nurse if patient is unable to complete paper forms) and
entered into the electronic record. Data was collected using the method described in Option 1 for the MGH portion of the study.

**Electronic Data**

Annual and unit-level characteristics and staffing data were obtained from nursing administration databases at each hospital site. Patient characteristics were extracted from electronic health record systems. Specification files were provided to hospital IT departments. Study ID numbers were linked to patient characteristics files and medical record numbers were de-identified. The file provided by the hospital to the READI multi-site team was fully de-identified.

**Nurse Focus Groups**

Each study site conducted a focus group involving 5-10 nurses from the implementation unit at the end of the data collection period.

**Multi-site Analysis Plan**

Data was analyzed using patient-level nested logistic regression models using STATA11.0 statistical software (StataCorp, 2009). The statistical approach was a difference-in-difference multinomial logistic regression, which estimated incremental changes in patient’s probability of readmissions and ED visits between the study steps (baseline/RN-RHDS/RN-RHDS+PT-RHDS/ RN-RHDS+PT-RHDS+NDAG study cohorts (implementation/control). This strategy allowed investigators to determine the incremental value of adding PT-RHDS and NDAG to the RN-RHDS protocol, and thus the optimal protocol for implementing discharge readiness assessment.

For **Aim 1** (Hypothesis 1), the RN-RHDS protocol was compared to usual care using the difference-in-difference approach. The reduction in readmission or ED risk directly attributable to the implementation of RN-RHDS was estimated by first computing the reduction in risk following the change in nursing practice on the implementation units (first difference), and then subtracting any change in readmission or ED risk from baseline through implementation on the control units (second difference).

For **Aim 2** (Hypothesis 2), the incremental effect of the RN-RHDS+PT-RHDS protocol was estimated in comparison to RN-RHDS (first difference) and subtracting any concurrent change on the control units (second difference).

For **Aim 3** (Hypothesis 3), the RN-RHDS+PT-RHDS+NDAG was compared to RN-RHDS+PT-RHDS and to control units, thus estimating the incremental change in readmission and ED use risk directly attributable to adding NDAG. A test was also conducted to determine whether the incremental change from adding NDAG was greater for patients with low readiness (RN-RHDS or PT-RHDS scores less than 7) than for patients above the low-readiness cut-off.

Hypothesis testing was performed using standard significance tests of regression coefficients at a p=.05 level. There were controls for patient characteristics, unit-level nurse staffing variables, and hospital fixed effects to control for hospital-level differences (including differences in implementation method/option); data nesting was
tested and standard errors were adjusted for unit-implementation cohort clustering in all models; the analyses was weighted to adjust for unequal group size from unintended oversampling on large units.

For **Aim 4**, the estimated marginal effects on readmission and/or ED visits and the actual or imputed post-discharge utilization costs were used to estimate the cost-saving from reduced post-discharge utilization if it was found that implementing discharge readiness assessment had a significant impact on readmissions and/or ED visits. Implementation cost measures were subtracted and the net cost savings associated with implementation were computed. Non-recurring implementation costs were analyzed and time to break-even was estimated.

**MGH Specific Results**

The total sample over all phases and units for the MGH portion of the study was 4070 patients. The chart below shows the number of discharges, eligible patients, and READI study forms (RN-RHDS) completed for each phase.

The following charts show the percentage of eligible patients enrolled by month. Fidelity to enrolling and completing study forms was extraordinarily high in all phases of the MGH portion of the study.
Fields marked with an XXXXXXXX signify that data on forms PT-RHDS and NDAG were not being collected during this phase of the study.
Sample Characteristics

Patient characteristics (% and standard deviation) in each phase for the implementation and control units are presented in the following table.

The control unit patients were older, had more ICU stays, and a higher readmission rate within 30 days. The implementation unit had a higher percentage of patients with a medical diagnosis though the number with unknown diagnosis type (medical or surgical) was higher on the control unit.

<table>
<thead>
<tr>
<th>PATIENT SAMPLE CHARACTERISTICS</th>
<th>Implementation</th>
<th>Control</th>
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</thead>
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<tr>
<td></td>
<td>Baseline</td>
<td>Phase 1</td>
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<tr>
<td>Age</td>
<td>63.9 (0.6)</td>
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<tr>
<td>Male</td>
<td>63.8 (1.9)</td>
<td>67.4 (1.8)</td>
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<tr>
<td>Female</td>
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<td>Medical</td>
<td>61.3 (1.9)</td>
<td>64.8 (1.9)</td>
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<tr>
<td>Surgical</td>
<td>33.9 (1.8)</td>
<td>31.4 (1.8)</td>
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<td>Medical/Surgical Unknown</td>
<td>4.7 (0.8)</td>
<td>3.9 (0.8)</td>
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<tr>
<td>Had ICU stay</td>
<td>13.9 (1.3)</td>
<td>12.4 (1.3)</td>
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<tr>
<td>Lives alone**</td>
<td>. (.)</td>
<td>20.8 (1.9)</td>
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<tr>
<td>Functionally Independent**</td>
<td>. (.)</td>
<td>93.2 (1.2)</td>
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<tr>
<td>&gt;4 meds at DC**</td>
<td>. (.)</td>
<td>50.3 (2.4)</td>
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<tr>
<td>LOS</td>
<td>5.0 (0.2)</td>
<td>4.6 (0.2)</td>
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<tr>
<td>Readmission Within 30 d</td>
<td>11.0 (1.2)</td>
<td>9.4 (1.1)</td>
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<tr>
<td>ED visits Within 30 d</td>
<td>2.9 (0.7)</td>
<td>2.2 (0.6)</td>
</tr>
</tbody>
</table>

* Standard errors in parentheses.
** Values only available if RN RHDS form was completed.
The following table contains information about the characteristics of patients readmitted within 30 days. Patients who were readmitted had a longer length of stay than the total sample on both the implementation and the control unit. All other characteristics are similar to the total sample characteristics.

<table>
<thead>
<tr>
<th>PATIENT SAMPLE CHARACTERISTICS READMISSIONS WITHIN 1-30 DAYS AFTER DISCHARGE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Age</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Male</td>
</tr>
<tr>
<td>Female</td>
</tr>
<tr>
<td>Medical</td>
</tr>
<tr>
<td>Surgical</td>
</tr>
<tr>
<td>Medical/Surgical Unknown</td>
</tr>
<tr>
<td>Had ICU stay</td>
</tr>
<tr>
<td>Lives alone**</td>
</tr>
<tr>
<td>Functionally Independent**</td>
</tr>
<tr>
<td>&gt;4 meds at DC**</td>
</tr>
<tr>
<td>LOS</td>
</tr>
<tr>
<td>Readmission Within 30 d</td>
</tr>
<tr>
<td>ED visits Within 30 d</td>
</tr>
</tbody>
</table>

* Standard errors in parentheses.
** Values only available if RN RHDS form was completed.
Nurse Assessment of Discharge Readiness (RN_RHDS) Scores

The solid line is the mean RN-RHDS score for each phase. The bars are the number of completed (scanned) RN-RHDS forms. The data demonstrates that the RN-RHDS scores rose progressively from Phase 1 to Phase 2 to Phase 3. The increase in average RN-RHDS scores from phase to phase are statistically significant (p<.001).

The table that follows is the month to month RN-RHDS means scores (out of a possible score of 10) for each phase. The data demonstrates that there is a progressive rise in scores across the 3 Phases.

<table>
<thead>
<tr>
<th>RN READINESS FOR DISCHARGE SCORES (NUMBER) BY MONTH AND PHASE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Month 1</td>
</tr>
<tr>
<td>---------</td>
</tr>
<tr>
<td>Phase 1</td>
</tr>
<tr>
<td>Phase 2</td>
</tr>
<tr>
<td>Phase 3</td>
</tr>
</tbody>
</table>
The solid line is the mean PT-RHDS score for each phase. The bars are the number of completed (scanned) forms. This number may be different than fidelity reported earlier from fidelity logs. Patient perception of readiness rose from Phase 2 to Phase 3. The increase in average PT-RHDS scores from phase to phase are statistically significant (p<.001).

The table below contains the month to month RN-RHDS mean scores (out of a possible score of 10) for each phase. The scores rise from Phase 2 to Phase 3.
Agreement Between RN-RHDS and PT-RHDS Scores

<table>
<thead>
<tr>
<th></th>
<th>PT-RHDS ≥7</th>
<th>PT-RHDS &lt;7</th>
</tr>
</thead>
<tbody>
<tr>
<td>RN-RHDS ≥7</td>
<td>1257 (90.5%)</td>
<td>55 (4.0%)</td>
</tr>
<tr>
<td>RN-RHDS &lt;7</td>
<td>49 (3.5%)</td>
<td>28 (2.0%)</td>
</tr>
<tr>
<td></td>
<td>1389 (100%)</td>
<td></td>
</tr>
</tbody>
</table>

90% of patients were deemed to be ready for discharge by nurse and patient assessments. For the remaining 10%, nurses and patients disagreed on readiness in 7.5% of cases; in only 2.0% of cases, nurses and patient agreed that readiness for discharge was low.

Almost all patients were deemed ready for discharge (by nurse and patient assessments). There are opportunities for nursing interventions in the 10% of patients with low readiness assessment scores which is documented in the NDAG results below.

Nurse Discharge Action Guide: Phase 3

The chart below shows the number of nurse actions recorded on the NDAG form based on RN-RHDS average scores on the 8 items in each scale. The mean scores were compared for the total scale of less than 7 and equal to or greater than 7 in columns 1 and 2. In columns 3 and 4, the number of recorded actions were compared if any item score on any item of the RN-RHDS and if all RN-RHDS item scores were =/>7. Columns 3 and 4 represent the instruction to nurses in Phase 3 to act on any item score <7.

Mass General Hospital

Phase 3 NDAG Actions by RN Score (3/1/16 to 6/30/16)
In columns 1 and 2, among patients where the average RN-RHDS scores was <7 (low readiness), 100% had actions initiated to mitigate the risk of low readiness. Most of these patients (88%) had more than 1 intervention initiated by the clinical nurse. Conversely, only 29% of patients with RN-RHDS scores of 7 or above had an action initiated.

In columns 3 and 4, among patients where at least 1 item on the RN-RHDS was scored below <7 (low readiness), 88% had a clinical nursing action with 76% having more than 1 action initiated to mitigate the risk of low readiness. Conversely, only 20% of patients with all RN-RHDS items scores at 7 or above had an action initiated.

It appears that the instruction in Phase 3 to triggered additional actions to prepare the patient for discharge in addition to those already initiated, especially in patients with RN-RHDS scores <7. These findings suggest that clinical nurses act on their discharge readiness assessments.

The chart below shows the number of clinical nurse actions recorded on the NDAG form based on PT-RHDS average scores on the 8 items in each scale. The mean scores were compared for the total scale of less than 7 and equal to or greater than 7 in columns 1 and 2. In columns 3 and 4, the number of recorded actions were compared if any item score on any item of the PT-RHDS and if all PT-RHDS item scores were =>7. Columns 3 and 4 represent the instruction to clinical nurses in Phase 3 to act on any item score <7.

<table>
<thead>
<tr>
<th>Total PT Score &lt;7</th>
<th>Total PT Score &gt;=7</th>
<th>Any PT Score &lt;7</th>
<th>All PT Scores &gt;=7</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 Actions</td>
<td>6% (N=20)</td>
<td>2% (N=2)</td>
<td>7% (N=18)</td>
</tr>
<tr>
<td>&gt;1 Actions</td>
<td>16% (N=51)</td>
<td>57% (N=52)</td>
<td>43% (N=14)</td>
</tr>
<tr>
<td>No NDAG</td>
<td>6% (N=18)</td>
<td>18% (N=16)</td>
<td>2% (N=5)</td>
</tr>
<tr>
<td>0% (N=0)</td>
<td>72% (N=233)</td>
<td>23% (N=21)</td>
<td>87% (N=213)</td>
</tr>
</tbody>
</table>

Mass General Hospital
Phase 3 NDAG Actions by PT Score (3/1/16 to 6/30/16)
In columns 1 and 2, among patients where the average PT-RHDS scores was <7 (low readiness), 93% had clinical nurse actions initiated to mitigate the risk of low readiness. Most of these patients (79%) had more than 1 intervention initiated by the clinical nurse. Conversely, only 22% of patients with PT-RHDS scores of 7 or above had an action initiated.

In columns 3 and 4, among patients where at least 1 item on the PT-RHDS was scored below <7 (low readiness), 75% had a clinical nursing action with 57% having more than 1 action initiated to mitigate the risk of low readiness. Conversely, only 6% of patients with all PT-RHDS items scores at 7 or above had an action initiated.

These findings suggest that clinical nurses acted on individual item scores indicating low readiness on PT-RHDS form. The NDAG appears to trigger adherence to recommendations for clinical nurse actions for low readiness scores.

**Readmission and ED Visit Rates**

The chart below shows readmission rates and ED visit rates within 30 days and from 31-60 days post-discharge. The standard deviations are noted in parentheses.

Comparisons of the effect of the discharge readiness assessment protocols on readmissions and ED visits will be conducted in the multi-site analysis where adequate hospital, unit, and patient level controls can be included in the analytic models.

<table>
<thead>
<tr>
<th></th>
<th>Baseline</th>
<th>Phase 1</th>
<th>Phase 2</th>
<th>Phase 3</th>
<th>Baseline</th>
<th>Phase 1</th>
<th>Phase 2</th>
<th>Phase 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Readmission ≤30 days</strong></td>
<td>12.5 (1.5)</td>
<td>10.7 (1.4)</td>
<td>8.0 (1.3)</td>
<td>8.8 (1.3)</td>
<td>16.7 (2.3)</td>
<td>15.7 (2.0)</td>
<td>17.3 (2.4)</td>
<td>9.3 (1.3)</td>
</tr>
<tr>
<td><strong>Readmission 31-60 days</strong></td>
<td>4.6 (0.8)</td>
<td>3.6 (0.8)</td>
<td>6.6 (1.2)</td>
<td>4.0 (0.9)</td>
<td>5.3 (1.3)</td>
<td>4.3 (1.1)</td>
<td>7.0 (1.4)</td>
<td>4.6 (1.0)</td>
</tr>
<tr>
<td><strong>ED visits ≤30 days</strong></td>
<td>3.3 (0.8)</td>
<td>2.9 (1.0)</td>
<td>3.3 (0.8)</td>
<td>4.3 (1.0)</td>
<td>1.1 (0.7)</td>
<td>4.1 (1.1)</td>
<td>4.6 (1.2)</td>
<td>1.1 (0.5)</td>
</tr>
<tr>
<td><strong>ED visits 31-60 days</strong></td>
<td>1.1 (0.4)</td>
<td>2.3 (0.6)</td>
<td>1.6 (0.5)</td>
<td>1.8 (0.7)</td>
<td>1.9 (0.7)</td>
<td>2.3 (0.8)</td>
<td>1.6 (0.7)</td>
<td>1.1 (0.5)</td>
</tr>
</tbody>
</table>
Association Between RN-RHDS/PT-RHDS and Readmissions/ED Visit Rates

The correlation between RN-RHDS and PT-RHDS was 0.41. RN-RHDS was associated with the readmission rate and ED visit rate between 31 and 60 days. For each 1 point decrease in the mean RN-RHDS score, there was a 6 percentage point increase in the readmission rate and ED visit rate between 31 and 60 days. There was no association of PT-RHDS with readmissions or ED visits.

**Discussion**

**Summary of Key MGH Findings**

On the implementation unit, there was an extraordinarily high number of patients who were eligible for, and participated in, the study. Of the number of eligible patients, clinical nurses enrolled 88.0% - 99.9% throughout the three phases of the study which contributed to the high fidelity. The control unit and implementation unit had similar patient characteristics except in age, ICU stays, readmission rates, and medical diagnosis. Patients who were readmitted had longer lengths of stay on both the implementation and the control units.

The scores on the nurse assessment of discharge readiness rose from phase 1 to phase 3 and was statistically significant (p<.001). The same was true for the patient self report of discharge readiness and this was also statistically significant (p<.001). In 90.5% of the discharges, there was agreement between the nurse and the patient that the patient was ready for discharge.

In phase three of the study, clinical nurses were instructed to implement a nursing action as guided by the Nurse Discharge Action Guide, if they assessed their patient to be low on the readiness scale (less than 7) or if the patient assessed his or her
readiness at less than 7. Nursing actions included in the Nurse Discharge Action Guide focused on four areas:

1) additional physical/emotional recovery
2) additional or reinforcement of teaching
3) coordination of care needed
4) additional support needs.

In a high proportion of cases where nurses assessed their patients for low readiness or when patients scored themselves as low on the readiness scale, clinical nurses implemented one or more nursing actions to mitigate the risk of low readiness.

The charts showing the readmission and ED visit rates cannot be interpreted until the multisite analysis is completed in July 2017. However, the MGH findings lend support for the study hypotheses as there was a correlation between the RN readiness of discharge and the patient readiness for discharge tools and lower RN readiness assessment scores (RN-RHDS) were significantly associated with higher readmissions and ED visits between 31 and 60 days post-discharge.

Analysis of the MGH Findings

Nursing Director and clinical nurse engagement was essential. This engagement contributed to the large numbers of patients enrolled in the study. The nurses were committed to their full participation in this research study and advancing nursing practice. Patients who were readmitted were likely sicker because they had a longer length of stay on the control and implementation unit. This is consistent with MGH trends showing increasing acuity of patients and the complexity of care required.

Throughout the phases, the nurse assessment of discharge readiness increased. This may be due to the increasing nursing mastery of the form as well as the intentionality of focusing on patients discharge. Furthermore, this research study provided an opportunity for clinical nurses to be more engaged in their role in the discharge planning process and the importance of identifying barriers to discharge early on in admission. This intentionality may have contributed to the patient assessment of discharge readiness. Perhaps clinical nurses were doing something different in their interactions with patients (i.e. better assessment, taking a proactive approach to discharge planning and/or improved communication with patients) that could have contributed to the higher self report. Furthermore, there have been multiple initiatives at MGH to address and facilitate patient progression. These efforts are designed to improve the discharge planning process. This may also account for the concordance between the nurses’ and patients’ perceptions of readiness for discharge.

When clinical nurses assessed their patient for low readiness or the patient self assessment was low on the readiness scale, they overwhelmingly initiated actions to address the deficit. The clinical nurses relied on and trusted the information captured on the assessment and took appropriate action. This finding is extremely important as it was based on two points of assessment that were deliberate and planned. Not only was the nurse assessment quantifiable using a tool to assess discharge readiness but the same was true for the patient. Having a structured assessment and a plan of action goes beyond the standard communication between a patient and his or her nurse and
the care team.

**Implications of the MGH Findings**

Assessment of readiness for discharge is paramount with the increasing focus on reducing length of stay. Furthermore, ensuring that patients are ready to go home has implications for patient safety, patient satisfaction, and clinical outcomes including the social and financial costs of readmissions. While the entire care team is responsible for discharge, the role of the clinical nurse in the discharge process is critical. It is the clinical nurse who is with the patient continuously during the hospital stay. Leveraging the expertise of the clinical nurse, along with providing effective tools for the assessment of readiness by both the nurse and the patient, provides a rich opportunity to advance nursing practice. Potential changes in current practice could include utilizing a standardized approach to the discharge process using the readiness for discharge tool. New staff could be oriented to the use of the tool in orientation while current staff could receive unit-based education regarding the practice change. Ideally, the tool could be incorporated into the electronic patient record system and utilized not only at MGH, but throughout the health system.

MGH has adopted the Stay Connected Program, an evidence-based bundle of interventions implemented on a subset of inpatient units targeted toward patients rated as at high risk for readmission. The goal of the program is to make additional resources available to patients and staff to assist with a successful transition out of the acute care environment to their discharge destination. Incorporating a practice such as the readiness for discharge tool could enhance the current success of this program.

The study is a part of a larger multi-site study and additional analysis is needed to further elucidate additional opportunities. In advancing nursing research, the commitment of leadership at the unit level is critical to success. Offering leadership education regarding research design, methodology, analysis, and synthesis increases leadership confidence in conducting research and can impact how this is communicated and ultimately valued by staff. In addition, the Yvonne L. Munn Center for Nursing Research is a valued resource to all nursing staff and demonstrates the commitment of Nursing & Patient Care Services to advancing research. It provides an infrastructure that promotes innovation and mobilization of resources for both funding and development, to support research initiatives that advance clinical practice and optimize quality patient-centered outcomes. These resources include access to nurse scientists for mentorship, educational offerings, consultation, budget development and writing support.

As more becomes known about the use of standardized tools to assess readiness for discharge, nurses must consider how the use of such tools can influence health policy. The Centers for Medicare and Medicaid Services (CMS) provide financial incentives to hospitals to lower readmission rates. Other insurers are also looking closely at this. Nursing’s role in decreasing readmissions provides an opportunity to showcase the unique contributions of nursing practice in promoting optimal short-term and long term outcomes of the hospitalization experience.
Dissemination of the Findings

The preliminary findings of the READI (Readiness Evaluation And Discharge Interventions): Implementation as a Standard Nursing Practice for Hospital Discharge research study was included in a poster presentation on May 9, 2017 on Nursing Research Day at MGH (attachment NK1EO.b). As more of the findings become available from the multi-site analysis, there are plans to submit abstracts at local, national and international conferences.
References


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