

IMPLEMENTATION SCIENCE WORKSHOP

Implementation Science Workshop: Primary Care-Based Multidisciplinary Readmission Prevention Program

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In this paper, we aim to describe our QI process, which included the development, testing, and evaluation of a primary care-based multidisciplinary follow-up program for individuals at risk for hospital readmission in an academic medical center.

Editor's note: In this installment of Implementation Science Workshop, Dr. Cavanaugh and colleagues describe implementation and evaluation of a readmission prevention program at the University of North Carolina. In an accompanying commentary, Elizabeth Yano of the West Los Angeles VA highlights strengths and weaknesses of their approach, emphasizing generalizable lessons for learning health care organizations. – Lindsay Jubelt, MD, MS, Contributing Editor

INTRODUCTION

Approximately 20 % of Medicare beneficiaries discharged from the hospital are readmitted within 30 days, costing approximately \$17.4 billion annually.¹ Because many of those readmissions are preventable, patients, payers, and providers have prioritized improvement in discharge and care transitions. Several multifactorial approaches have been successful in reducing hospital readmissions but have not focused on how primary care practices contribute to the transitional care process.^{2–8}

Systematic reviews have not clarified which interventions are most effective in reducing rehospitalization. However, the Centers for Medicare & Medicaid Services (CMS) Hospital Readmission Reduction Program is leading to increased public awareness and financial incentives to reduce hospitalization. Although many institutions are currently working to implement changes in care transitions, there is little guidance for developing an effective primary care intervention through quality improvement (QI).^{9–11}

SETTING AND PARTICIPANTS

The University of North Carolina Internal Medicine Clinic (UNC IMC) is a large academic practice that serves 14,000 patients with approximately 44,000 visits per year. Our clinic is recognized as a National Committee for Quality Assurance (NCQA) Level 3 Patient-Centered Medical Home and has a 15-year history of QI activities, most of which have focused on the management of chronic diseases.^{12–17}

Approximately 270 UNC IMC patients are admitted to UNC Hospitals monthly, and approximately 20 % of these are readmitted within 30 days. As of January 2012, our clinic had no standardized hospital follow-up process. Timing and location of follow-up (i.e. primary care, specialist, urgent care) were left to the discretion of the discharging team. Follow-up appointments were frequently advised but not scheduled. For patients who did receive follow-up in our clinic, visit content was not standardized.

PROGRAM DESCRIPTION

In January 2012, the UNC IMC set hospital readmissions as a clinic QI priority and created a project team including physicians, nurses, pharmacists, care managers, and support staff. We adopted the Institute for Healthcare Improvement's State Action on Avoidable Rehospitalizations guide as a framework for our intervention.¹⁸ To improve coordination, representatives from existing UNC readmission initiatives,

including care managers and QI staff, were involved in all aspects of the improvement process.

Before developing solutions, we analyzed the existing environment. We measured the number of our patients that were hospitalized and rehospitalized within 30 days each month. We designed a process to identify UNC IMC patients discharged daily, allowing us to intervene in real-time. We reviewed ten medical records of readmitted patients and performed root cause analyses. Using process mapping we found many opportunities for streamlining the flow of information and scheduling of patients. We determined that key areas for improvement were care management, timely follow-up, and standardizing content of visits.

Care Management and Timely Follow-Up

The clinic-based care manager was responsible for identifying discharged patients, risk-based triaging, scheduling appointments, and working with the patient to ensure transportation. She reviewed a daily report to identify patients discharged and stratified them according to a locally developed readmission risk classification. She called moderate-risk or high-risk patients to schedule an appointment in the hospital follow-up clinic within five calendar days of hospital discharge. Low risk patients were

eligible to receive an appointment if referred by a provider. Because of limited appointment availability during the testing phase, patients were scheduled for an appointment if there were available appointments at the clinic within five days of discharge. Most clinic patients were still handled by usual procedures while we developed a program for clinic-wide implementation. Patients scheduled for an appointment in the follow-up clinic received a reminder call the day prior to their appointment. During this call, the care manager advised patients to bring all medication bottles and addressed barriers to care, such as transportation.

Standardization of Program Content

On the day of their hospital follow-up visit, patients were seen by a Clinical Pharmacist Practitioner (CPP) who coordinated the 60-min appointment. A 20-min attending physician appointment was embedded within the visit. In the State of North Carolina, CPPs are advanced practice providers and obtain prescribing authority through a collaborative agreement with a physician. The focus of the CPP expanded beyond medications and included all key visit components (Fig. 1). The physician performed a physical exam, diagnosed new problems, addressed goals of care when appropriate, and

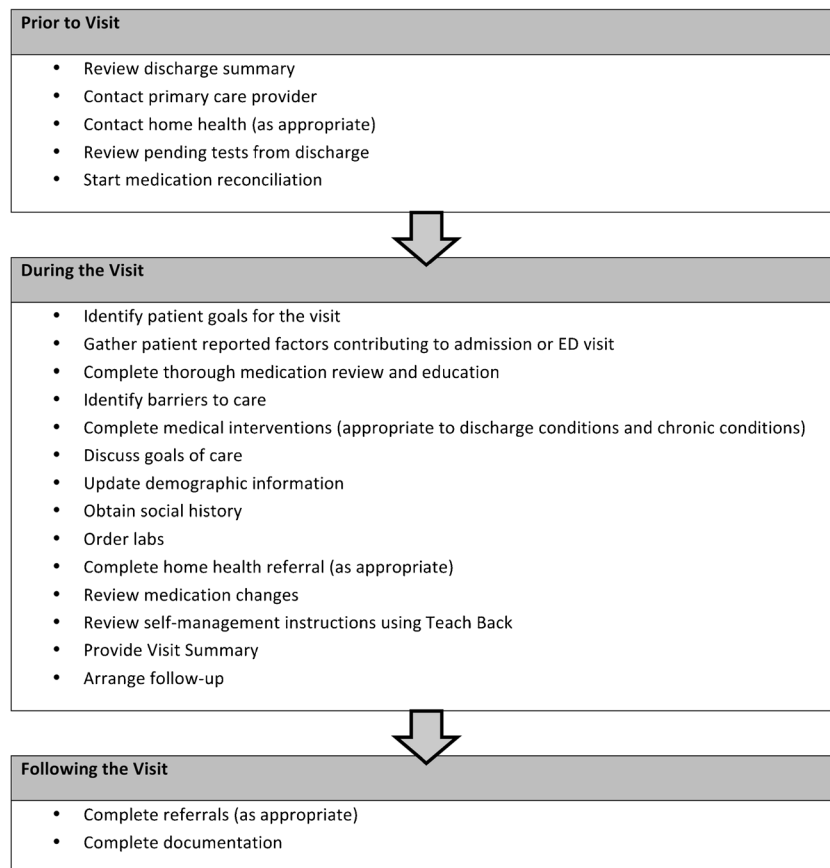


Figure 1. Visit components.

assisted in patient education. When the CPP was not available, patients were seen by a medical resident trained on the visit components and supervised by attending physicians familiar with these visits.

Process Refinement

The multidisciplinary team utilized the Model for Improvement and small tests of change to refine the processes and content.¹⁹ After testing the processes on several patients, the team gathered patient and provider feedback. Refinements were made before seeing the next group of patients. To reduce clinic visit duration and heterogeneity between visits, a patient intake questionnaire and note template were developed. Feedback from patients and caregivers reinforced the need for reminder phone calls and suggested that patients were satisfied with the multidisciplinary team. We improved the phone scripts describing the purpose and importance of this visit to patients. We developed run charts to measure and track the program's progress. These included quantity of hospital discharges, time to follow-up in our clinic (Fig. 2), and number of completed hospital follow-up visits. We found that frequent small-scale process evaluation and adjustments were required to optimize the program.

PROGRAM EVALUATION

To evaluate the efficacy of our program before implementing it throughout our practice, we conducted a retrospective cohort study comparing a cohort of patients who received the intervention with those who received usual care during the same time period. This study was approved by the UNC Institutional Review Board.

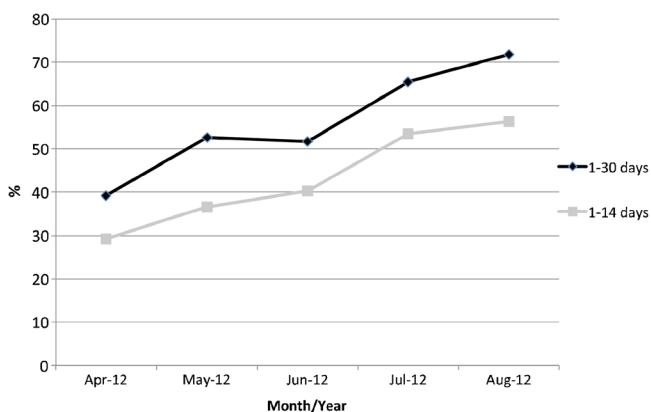


Figure 2. Time to follow-up within 14 and 30 days run chart.

Intervention patients included all UNC IMC eligible patients discharged after 1 April 2012 who were seen in the hospital follow-up clinic between 2 April 2012 and 31 August 2012, regardless of reasons for admission. Eligible patients were those with an established PCP in the UNC IMC. Exclusion criteria were: discharged to hospice, skilled nursing facility, physical rehabilitation facility, or substance abuse rehabilitation facility; index hospitalization for a scheduled procedure, scheduled infusion, obstetrics, suicidal ideation or discharging service was psychiatry; and patients who left the hospital against medical advice.

Usual care patients were selected from the pool of patients that met the inclusion/exclusion criteria and that were not referred to the hospital follow-up clinic after a discharge. They were selected using a random number generator and were matched to an intervention group patient based on the UNC readmission risk classification (Appendix 1: University of North Carolina General Readmission Risk Stratification, available online) at the time of discharge and had an index discharge within 1 month of the respective intervention patient. Individual patients could be included in both the usual care and hospital follow-up clinic group if the individual was admitted more than once during the study period and the index discharge and subsequent admission were greater than 30 days apart.

Demographic and clinical data were abstracted from inpatient and outpatient encounters in the electronic health record. Comorbid disease state definitions are defined in Appendix 2 (available online).

The primary outcomes were hospital readmission at 30 and 90 days. Secondary outcomes were composites of hospital readmission and ED visits at 30 days and 90 days. ED visits were not counted as separate events if they resulted in a hospitalization. We assessed time to follow-up as a process indicator.

Analysis

Demographic and clinical data in the intervention group and usual care group were compared using a chi-square test for dichotomous variables and Student's *t*-test for continuous variables. Fisher's exact test was used to compare dichotomous variables with five or fewer individuals in $\geq 25\%$ of categories. For continuous variables found to have a non-normal distribution, a Wilcoxon-Mann-Whitney test was used to compare groups.

The time to our primary outcomes of 30-day and 90-day readmissions was compared between intervention and usual care groups with multivariable Cox proportional hazards regression models. We also compared the time to our secondary composite outcomes (30-day and 90-day emergency department [ED] visits and readmissions) between groups. Models were adjusted for covariates that were found to be significantly different between groups in bivariate analyses or had the potential to be a confounder. A sensitivity analysis was performed to address two potential biases: 1) patients whom

Table 1. Baseline Characteristics of Hospital Follow-up Clinic and Usual Care Groups. Comorbidities Are Defined in Appendix 1 (Available Online)

	Intervention (n=54)	Usual Care (n=54)	P value
Age (mean, SD)	61.1 (13.5)	60.6 (12.2)	0.82
Female	35 (65 %)	24 (44 %)	0.03*
Race/ethnicity			0.33
Black	23 (43 %)	20 (37 %)	
White	29 (54 %)	34 (63 %)	
Other	2 (4 %)	0 (0 %)	
Insurance			0.83
None	5 (9 %)	6 (11 %)	
Medicaid	10 (19 %)	8 (15 %)	
Medicare	28 (52 %)	26 (48 %)	
Dual	6 (11 %)	10 (19 %)	
Private	5 (9 %)	4 (7 %)	
Readmission risk			1
Low	11 (20 %)	11 (20 %)	
Moderate	30 (56 %)	30 (56 %)	
High	13 (24 %)	13 (24 %)	
Comorbidities			
COPD or Asthma	25 (46 %)	13 (24 %)	0.016*
Heart Failure	17 (31 %)	13 (24 %)	0.39
Cirrhosis	2 (4 %)	12 (22 %)	0.004*
Chronic Kidney Disease	13 (24 %)	15 (28 %)	0.66
Diabetes Mellitus	21 (39 %)	24 (44 %)	0.56
Hypertension	39 (72 %)	40 (74 %)	0.83
Coronary Artery Disease	18 (33 %)	15 (28 %)	0.53
Alcoholism (current)	5 (9 %)	5 (9 %)	1
Depression	12 (22 %)	24 (44 %)	0.014*
Baseline Utilization 1 Year Prior (mean, SD)			
Primary Care visits	6.2 (5.3)	6.3 (4.0)	0.98
ED visits	1.1 (1.3)	1.3 (2.3)	0.57
Hospitalizations	2.5 (2.4)	3.4 (3.3)	0.13
Combined ED visits & hospitalizations	3.6 (3.0)	4.7 (4.6)	0.16
Length of Index Admission Stay (mean, SD)	2.9 (2.9)	3.4 (2.5)	0.32
Number of Medications at Hospital Discharge	13.8 (6.6)	13.7 (6.7)	0.90
Discharged with Home Health Care	18 (33 %)	13 (24 %)	0.29

* $p < 0.05$

we attempted, but were unable to contact; and 2) patients who did not attend their scheduled hospital follow-up appointment. The details and results of this analysis are described in Appendix 3 (available online). We considered a two-sided p value of < 0.05 statistically significant. All data analyses were performed using Stata 11.0 (College Station, TX).

Results

Between 1 April and 31 August 2012, we identified 67 hospital follow-up visits. After exclusions, the intervention group included 52 patients with 54 discharges. The usual care group consisted of 52 patients with 54 discharges. Reasons for exclusion are described in Appendix 4 (available online).

Patient Characteristics

The mean age of the study population was 60.9 years; 55 % were female, and 58 % were Caucasian (Table 1). The groups

were adequately matched based on readmission risk classification. More women and patients with pulmonary disease were in the intervention group; more patients in the usual care group had cirrhosis or depression. The majority of patients in both groups had insurance, most commonly Medicare. Primary indications for hospitalization were quite variable (Appendix 5, available online).

Primary and Secondary Outcomes: Readmissions, ED Visits, and Composite ED Visits and Readmissions

The intervention group had significantly fewer readmissions at 30 and 90 days. ED visits were also reduced in the intervention group, although not statistically significant. The composite of readmissions and ED visits was significant at 30 and 90 days (Table 2).

Time to Follow-up

Median time to first UNC IMC follow-up was 5 days earlier for patients seen in the hospital follow-up clinic compared to usual care controls (Table 2).

Survival Analyses

The hazard ratios (HR) for 30-day and 90-day readmissions in the unadjusted model were both lower in the intervention group (HR 0.32, 95 % CI 0.12–0.91; HR 0.34, 95 % CI 0.16–0.72, respectively) (Fig. 3a). When we adjusted for covariates, the association was somewhat attenuated for 30-day readmissions (HR 0.54, 95 % CI 0.17–1.69), but remained statistically significant for 90-day readmissions (HR 0.42, 95 % CI 0.18–0.97).

The HR of 30-day and 90-day composite outcomes of ED visits and readmissions were lower in the intervention

Table 2. Readmissions, ED Visits, Composite Outcomes and Time to Follow-up

	Intervention (%) (n=54)	Usual Care (%) (n=54)	P value
30-day readmissions	5 (9)	14 (26)	0.023*
90-day readmissions	10 (19)	24 (44)	0.004*
30-day ED visits	6 (11)	12 (22)	0.121
90-day ED visits	11 (20)	17 (31)	0.188
30-day composite (ED or readmission)	10 (19)	24 (44)	0.004*
90-day composite (ED or readmission)	18 (33)	32 (59)	0.007*
Days to First IMC Follow-up (Median)	7 (IQR 6, 11)	12 (IQR 7.5, 25.5)	$< 0.001^*$
Days to First UNC Clinic Follow-up (Median)	6.5 (IQR 5, 10)	10.5 (IQR 7, 17)	$< 0.001^*$
Hospital Follow-up within 30 days	54 (100)	46 (85)	0.003*

* $p < 0.05$

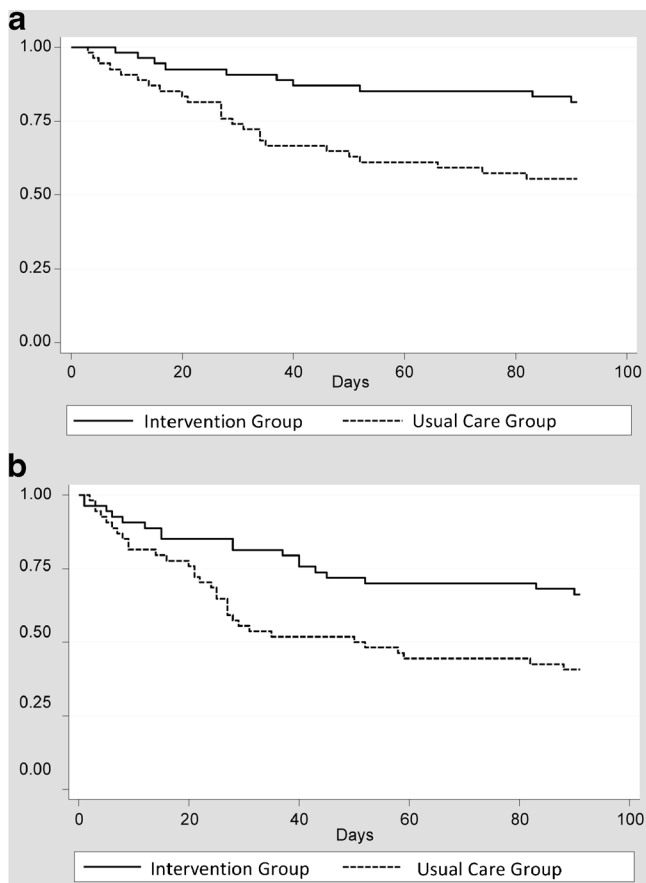


Figure 3. Unadjusted Kaplan Meier survival curves of 90 day readmissions and composite outcomes (ED visits or readmissions). (a) Hospital readmissions over 90 days. (b) Composite outcomes (ED visits or hospital readmissions) over 90 days.

group compared with the usual care group in unadjusted models (HR 0.37, 95 % CI 0.18–0.78; HR 0.46, 95 % CI 0.26–0.82, respectively) (Fig. 3b). Adjusting for covariates in both the 30-day and 90-day composite models resulted in minimal changes (HR 0.54, 95 % CI 0.17–1.69; HR 0.42, 95 % CI 0.18–0.97, respectively).

CHALLENGES AND FUTURE PLANS

Based on these preliminary data, this primary care-based hospital follow-up program reduced 30-day readmission rates by approximately 65 %. Key components include real-time care management, improved access to care, and content standardization in a multidisciplinary visit.

Only a small percent of the total discharged patients were seen in this new intervention. Although we observed improvements in our process measures each month, our sample size was too small to detect improvements using control charts. As such, we conducted a retrospective chart

review to evaluate efficacy before deciding to implement the program for all clinic patients.

For this retrospective cohort study, we tried to mitigate potential selection bias by controlling for differences in the measured characteristics of the groups. We performed sensitivity analyses to estimate the effect size using different group classification criteria. Sensitivity analyses showed that though attenuated, the effect was still present when different classification criteria were applied (Appendix 3, available online). This increased our confidence of the program's efficacy.

As we expand this model to match supply and demand, we will need to evaluate attendance rates, effort expended in care management, and overall cost effectiveness. We plan to expand our work to other practitioner types and clinics.

This study suggests that attention to primary care practice structure in the transition from inpatient to outpatient settings can reduce the rate of readmissions. This approach takes advantage of the relationship between the patient and the primary care home and may facilitate a more efficient and effective model of care.

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Conflict of Interests: AccessCare provided funding that was used to support this program, including the salaries of Jamie Cavanaugh, Shana Ratner, and Robin Roche.

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APPENDIX 1: UNIVERSITY OF NORTH CAROLINA GENERAL READMISSION RISK STRATIFICATION

The risk stratification is based on the number of chronic disease states, number of hospitalizations in the past year, and number of medications. Patients with three or more chronic disease states or hospitalization in the past year and ten or more medications are considered high risk. Patients with two or fewer chronic disease states or hospitalization

in the past year, regardless of number of medications, are considered moderate risk.

APPENDIX 2: COMORBIDITY DEFINITIONS

To define comorbidities including chronic obstructive pulmonary disease or asthma, heart failure, diabetes, hypertension, coronary artery disease, and depression, we required the condition to be listed either on the index hospitalization discharge summary or on the general problem list of the EHR; in addition, an appropriate medication to treat this condition had to be listed in the index hospitalization discharge summary. Cirrhosis and chronic kidney disease required only a mention of this condition in the discharge summary or problem list, and alcoholism was defined to include active problem drinking in the prior 6 months, as noted in the hospital discharge summary or clinic notes.

APPENDIX 3: SENSITIVITY ANALYSIS

To address the first potential bias (patients whom we attempted but were unable to contact), nine control patients in the main analysis were switched to the intervention group because we tried to schedule them in the hospital follow-up clinic. Among these nine controls, five did not answer when called, two answered but declined to be scheduled, one was not available when called, and one was a wrong telephone number. To address the second potential bias (patients who did not show to their scheduled hospital follow-up appointment), an additional 16 patients were excluded from the main analysis because they were scheduled an appointment in the hospital follow-up clinic, but did not show, and were added to the intervention group. After the above was completed, we had 79 intervention and 54 usual care group index hospitalizations.

In this analysis, we found the HR for 30-day readmissions was attenuated, but 90-day readmissions remained strong (unadjusted HR 0.59, 95 % CI 0.28–1.26; HR 0.53, 95 % CI 0.29–0.95, respectively). Because the composite outcomes violated the proportional hazards assumption, we did not evaluate them with a Cox proportional hazards model. An unadjusted logistic regression model of 30-day and 90-day composite outcomes showed large effect sizes, but were not statistically significant (OR 0.53, 95 % CI 0.22–1.26; OR 0.43, 95 % CI 0.20–0.92, respectively).

APPENDIX 4: PRIMARY ANALYSIS REASONS FOR EXCLUSION

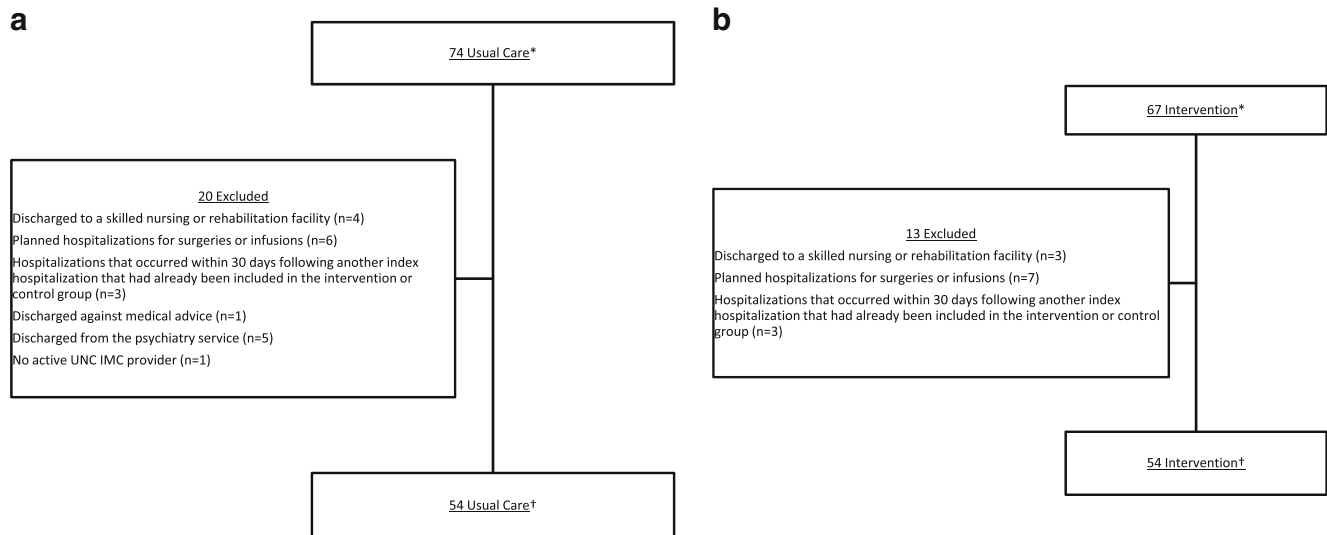


Figure 4. Primary analysis reasons for exclusion. a Usual Care. *After exclusions, the usual care group consisted of 52 patients with 54 hospitalizations. †Five patients were represented in both the intervention and usual care groups with separate hospitalizations that were more than 30 days apart from the time of discharge to readmission. **b Intervention Group.** *Sixty patients had 67 index hospitalizations connected to 67 hospital follow-up clinic visits. †After exclusions, the intervention group included 52 patients with 54 discharges.

APPENDIX 5

Table 3. Primary Reason for Admission

Primary reason for admission	Overall Frequency* (%)
Chronic Obstructive Pulmonary Disease or Asthma	7 (6)
Pneumonia	8 (7)
Myocardial infarction	1 (1)
Heart failure	6 (6)
Other pulmonary indications	4 (4)
Arrhythmias and coronary atherosclerosis (except myocardial infarction)	9 (8)
Acute renal failure or end stage renal disease	4 (4)
Gastrointestinal bleed	3 (3)
Liver disease	5 (5)
Other gastrointestinal indication	9 (8)
Neurologic indication (syncope or stroke)	11 (10)
Other infection	22 (20)
Substance-abuse related	4 (4)
Other	15 (14)

*There were no statistically significant differences between groups