UNPACKING TRANSITIONAL CARE: FACILITATORS, BARRIERS, AND QUALITY IMPACTS OF A MULTIDISCIPLINARY PROGRAM TO REDUCE 30-DAY READMISSIONS

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A dissertation submitted to the faculty at the University of North Carolina at Chapel Hill in partial fulfillment of the requirements for the degree of Doctor of Philosophy in the Department of Health Policy and Management in the Gillings School of Global Public Health.

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ABSTRACT

Rachel M. Machta: Unpacking Transitional Care:
Facilitators, Barriers, and Quality Impacts of a Multidisciplinary Program to Reduce 30-day Readmissions
(Under the direction of Morris Weinberger)

Several provisions in the Affordable Care Act incentivize healthcare systems to move from traditional fee–for-service towards payments rewarding high-quality care. Notably, the Hospital Readmission Reduction Program penalizes hospitals with excess readmissions. This dissertation sought to evaluate the facilitators, barriers and quality impacts of a computer- based transitional care checklist implemented at a large academic medical center.

The evaluation is composed of two parts: 1) a process evaluation to understand program implementation and 2) an impact evaluation to understand program effectiveness. For the process evaluation, we conducted 25 semi-structured interviews with transitional care providers. The impact evaluation was a retrospective cohort analysis of discharges from UNC Hospitals. Patients were eligible for the study if they were discharged between July 2014 and September 2015 and had a 20-30% risk of readmission. We looked at how the *overall* checklist and the different *provider components* of the checklist affected unplanned all-cause 30-day readmissions.

Our sample included 10,083 eligible discharges. The overall readmission rate was 25.9%. While the entire sample was qualified for the program, out of five possible components, on average patients had less than two complete. Among provider components, completion rates ranged from 17.5% for discharging physicians to 46.7% for case managers. We found a not

statistically significant but modest protective effect of the checklist on readmissions (OR = 0.92; 95% CI, 0.81-1.04). In addition, most provider components were protective against readmissions, but confidence intervals included one. Odds ratio ranged from 0.87 for the discharging physician component (95% CI=0.75-1.00) to 0.95 for the case management component (95% CI= 0.83-1.09). We predicted having all the components would reduce readmissions approximately 5-8 percentage points if implemented completely.

This study describes the potential of hospitals in real-world settings to reduce readmission using a pre-discharge checklist. Overall, the checklist had a promising but limited impact on readmissions. This is at least partially related to challenges with implementation. Healthcare systems could improve the implementation of similar programs by utilizing mid-level managers and champions to: communicate how the program aligns with existing priorities, clarify team roles and interdependencies, and ensure tools support new workflows.

Dedicated to my grandmothers, Harriet Brooks and Phyllis Machta.

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LIST OF ABBREVIATIONS

ACA	Affordable Care Act
AME	Average Marginal Effect
CCS	Clinical Classifications Software
CFIR	Consolidated Framework for Implementation Research
CI	Confidence Interval
CMS	Centers for Medicare & Medicaid Services
CTP	Care Transitions Program
DX	Diagnosis
EMR	Electronic Medical Record
HCC	Hierarchical Condition Category
HRRP	Hospital Readmission Reduction Program
ICD	International Classification of Diseases
IV	Instrumental Variable
N	Sample Size
OR	Odds Ratio
UNC	University of North Carolina

CHAPTER 1. INTRODUCTION

Specific Aims

Hospital readmissions are common, costly, and may result in undue patient harm. Nearly one fifth of all Medicare beneficiaries discharged from hospitals are readmitted within 30 days.[1] Though some readmissions are unavoidable, evidence suggests that many are potentially preventable.[2] To increase value, many health care systems have targeted reducing 30-day hospital readmission rates. The Affordable Care Act (ACA) authorized the Hospital Readmission Reduction Program (HRRP), which penalizes hospitals with excess readmissions for certain high-volume, high-cost conditions. Initially these conditions were acute myocardial infarction, heart failure and pneumonia; chronic obstructive pulmonary disease and elective hip or knee replacement were added in 2015; and coronary artery bypass graft surgery is slated to begin in 2017. Hospital readmissions are also a metric for many new models of care including Accountable Care Organizations and bundled-payment initiatives.[3,4] Thus, hospitals have strong incentives to initiate strategies to reduce readmissions.

Transitional care has emerged as one prominent strategy to reduce readmissions by increasing health care continuity and enhancing coordination of care. Transitional care encompasses a range of activities that occur during a patient's hospital stay or immediately post-discharge such as: core discharge planning, medication reconciliation, and patient education strategies. A growing evidence base suggests that transitional care may achieve higher quality health care at lower costs.[5–7] Despite current enthusiasm for transitional care, many gaps exist in our understanding about its structure and effectiveness. Research to date is limited by small

sample sizes and a narrow focus on specific diseases or populations and a poor understanding of necessary program components.[6,8]

The overall objective of this study is to produce useful evidence for key stakeholders to support patients as they transition from the hospital to the home. The Care Transitions Program at the University of North Carolina (UNC) Hospitals is a multicomponent and multidisciplinary pre-discharge computer-based checklist that has a strong focus on communication among members of the care team and across care settings. My central hypothesis is that Care Transitions Program can reduce 30-day readmission rates in moderate and high-risk patients discharged from the hospital. I tested my central hypothesis by pursuing three specific aims.

Aim 1: Identify provider-reported barriers and facilitators to delivering transitional care. I conducted 25 semi-structured interviews with case managers, pharmacists, nurses, and discharging physicians sampled from across units at UNC Hospitals where the Care Transitions Program was active. Interviews explored factors associated with the implementation and delivery of the Care Transitions Program including issues related to workflow, usability, and team-based care.

Aim 2: Determine whether the computer-based transitional care checklists reduce 30-day hospital readmissions. I used logistic regression to examine the overall effectiveness of the care transitions program during the period between July 2014 and September 2015. To deal with possible selection bias I considered an instrumental variable approach. Proposed instruments included: weekend discharge, recent unit and service line performance, and discharge caseload.

Aim 3: Determine whether different provider components of the computer-based transitional care checklists reduce 30-day hospital readmissions. The checklist is composed

of 5 components organized by provider role: case managers, medication transition specialists, pharmacists, discharging physicians, and bedside nurses. We used a logistic regression approach, harnessing the natural variation in the program implementation to determine different component effectiveness: specifically, comparing individuals with partial checklist to each other.

This research provides important insights and new evidence regarding a current strategy to reduce hospital readmissions. The qualitative research (Chapter 3) is useful for health system looking to improve the delivery of transitional care program. In addition, by examining both the overall effectiveness of the transitional care program (Chapter 4) and the specific components of transitional care (Chapter 5) we provide practical evidence on how to target future programs.

Background

Hospitals today continue to struggle to respond to the HRRP. For example, more hospitals were penalized through the HRRP in 2015 (78%) than in 2013 (64%); and the total penalty increased from $290 million in 2013 to $428 million in 2015.[3] Moreover, major teaching hospitals and safety-net hospitals were more likely to incur financial penalties.[3] These results suggest that there is a gap in knowledge and/or implementation of effective strategies to lower readmission rates.

Despite widespread interest in transitional care interventions, studies have reported variable results on its effectiveness. Reasons for inconsistencies across studies may lie in the components of transitional care (what should be done) and how it is implemented (what is being done). Even strategies with a strong evidence base in one setting, often fail to achieve similar outcomes when applied in a new setting. The variation among outcomes in different studies and in different settings suggests challenges associated with: shifting provider behaviors, altering workflows and existing practices, and maximizing usability. These aspects of implementation

and delivery are often not captured in traditional quantitative analysis and are poorly understood.

Past qualitative work on transitional care has principally focused on the patient and caregiver experience. However, less is known about either the experience of the provider or aspects of organizational culture, both of which are critical to the implementation of effective interventions. Only one study that I know of investigated the provider perspective. This study interviewed project leaders, case managers, and transitional care nurses.[9] It did not consider the perspective of the broader members of the transitional care team (e.g. pharmacist, and physicians). Furthermore, the study examined an intervention in a large insurance organization, which might be different in important ways than one provided by a health care system.

Strategies to reduce readmissions vary but often include a dedicated transitions provider, medication reconciliation, patient engagement, and communication with outpatient providers.[10,11] Research on the effectiveness of transitional care strategies is mixed. One review concluded that despite some studies with significant findings, "the strategies than an individual hospital can implement to improve transitional care remain largely undefined,"[10] another found that only high-intensity interventions that included a home visit within three days of discharge were effective at reducing readmissions,[7] and a third stated: "the current evidence base may not be adequate to facilitate change even for highly incentivized hospitals."[8]

Significance

The following research is significant because it provides timely evidence on the facilitators, barriers, and impacts on quality of care of a of a hospital-wide computer-based transitional care checklist. This significance rests on four considerations:

1. Hospital readmissions represent an important cost and quality issue.

Readmissions to the hospital represent a significant driver of total healthcare costs.[7] Almost 20 percent of Medicare fee-for service patients are re-hospitalized within 30 days, with unplanned readmissions costing Medicare more than $17 billion a year.[1] Though most readmissions are unavoidable, many are potentially preventable. Several factors contribute to hospital readmissions, but experts generally agree that excess readmissions result from fragmented care.[12] Significant variation in readmission rates in hospitals and regions across the country suggests that this is an important quality indicator.[1]

2. Under the Affordable Care Act (ACA), hospitals have new financial incentives to initiate strategies to reduce 30-day readmissions. Historically, the financial burden of rehospitalizations was borne by payers providing hospitals with few incentives to focus on readmission rates. Starting in 2012, the Centers for Medicare & Medicaid Services (CMS) began to reduce payments to hospitals with excess readmissions for three high volume high cost conditions: heart failure, acute myocardial infarction, and pneumonia. The numbers of diagnoses affected as well as the severity of the penalties are already increasing. And, other non-federal payers are following suit.

3. Transitional care has emerged as a promising practice to improve quality of care and reduce 30-day readmissions. Transitional care is designed to support patients as they transition from the hospital to the home. It encompasses a broad range of services that occur during a patients hospital stay or immediately post-discharge.[6] Interventions include; improved core discharge planning, care coordination, patient education and self-management support. Transitional care is usually targeted towards vulnerable populations or individuals with specific diagnoses (e.g. heart failure).[13] Given its potential to achieve higher quality at lower costs,

transitional care has emerged as a health reform priority with several channels in the ACA to promote its expansion.[6]

4. Despite enthusiasm for transitional care, significant gaps exist in our understanding. A growing evidence base suggests that transitional care may help reduce excess readmissions.[6] Multicomponent strategies are more effectives than single components strategies.[7] As a result, there has been a rise in "bundled" interventions and how-to guides on improving care transitions.[14] Despite growing prominence of transitional care, many gaps exist in our understanding. For example, one systematic review concluding that, "the current evidence base may not be adequate to facilitate change even for highly incentivized hospitals." [8] Research to date is limited by small sample sizes and a narrow focus on specific diseases, payers, or populations. Few studies have looked at which specific components of transitional care are associated with reductions in 30-day readmission rates.[6]

CHAPTER 2. APPROACH

Setting. This study was conducted at University of North Carolina (UNC) Hospitals, an 830-bed public academic medical center that comprises NC Memorial Hospital, NC Children's Hospital, NC Neurosciences Hospital and NC Women's Hospital. UNC admits more than 37,000 patients a year and its 30-day readmission rate is typical for its peers (12.24% in 2014). UNC Hospitals is part of a larger system of hospitals and providers, together referred to as UNC Healthcare, which includes (but is not limited to) UNC Hospitals and seven affiliate hospitals and hospital systems across the state.

This study includes outcome data from two of UNC Hospitals' affiliates: REX Healthcare and Chatham Hospitals. REX is a 660-bed not-for-profit private acute care facility located approximately 25 miles from UNC, and Chatham Hospital is a 25-bed community hospital located approximately 30 miles from UNC.

Prior to April 2014, UNC Hospitals used a well-established, internally developed electronic medical record (EMR) that was operational in both inpatient and outpatient settings. In April 2014 they switched to a large commercial vendor. During our study period, REX, and Chatham shared that EMR.

Care Transitions Program (CTP). In the fall of 2013, UNC launched the hospital-wide CTP modeled after the Institute for Healthcare Improvement's strategy to reduce unnecessary readmissions.[14] UNC formed a transitions leadership team of providers and administrators from across the hospital. The leadership team developed a checklist of services that were to be

completed prior to patient discharge, including: (1) needs assessment by case managers, (2) medication history by medication transition specialists (pharmacy technicians), (3) medication reconciliation and counseling by pharmacists, (4) communication to outpatient provider by physicians, and (5) self-care education using teach-back and scheduling of timely follow up by bedside nurses (Table 2.1).

Over a seven-month period, CTP was rolled out across the hospital (including medicine, heart and vascular, and surgery services), instead of specific diseases or payers. CTP targeted all moderate and high-risk patients identified with an algorithm based on the number of admissions in the past year, chronic conditions, and medications. It was estimated that the algorithm would identify approximately 40 discharges per day and that patients would have a 20-30% readmission risk (Table 2.2). CTP was implemented without adding staff, though many staff roles were repurposed from previous quality improvement projects.

CTP was modified over time. Originally, the checklist was paper-based (September 2013 -June 2014). Seven months after the paper checklist was introduced, UNC implemented a new EMR (April 2014), and the checklist became computer-based two months later (June 2014). Ten months later, the original 19-item checklist was streamlined to 13 items based upon early experience (April 2015). The five components remained the same; however, certain provider roles were simplified (e.g. the case manager items were condensed from four items to two items). A timeline of the events is shown in Figure 2.1

Aim 1

Conceptual framework. Aim 1 was guided by the Consolidated Framework for Implementation Research (CFIR) and its derivative the Care Transitions Framework.[15,16] CFIR was developed in recognition of the need in health services research to evaluate not only

summative, but also formative, outcomes. Using snowball sampling, Damschroder et al. identified existing published theories on implementation science and combined constructs into one unified framework (2009). The CFIR is composed of five major domains: intervention characteristics, outer setting, inner setting, characteristics of the individuals involved, and the process of implementation[16] (Table 2.3). These domains and construct examine the conditions under which implementation occurs. Furthermore, they offer a general taxonomy and conceptualization of key implementation constructs.[15]

The Care Transitions Framework was adapted from CFIR to address distinctive features of care transitions. Building upon CFIR through an updated literature review and input from a technical expert panel, the Care Transitions Framework is designed to enhance the usability and relevance of CFIR to care transitions.[15] The Care Transitions Framework explicitly addresses the iterative and interactive nature of complex system change. It includes two new domains—one for intermediary outcomes related to the implementation and one for outcomes of the interventions themselves.

Participants. We used purposeful sampling to identify CTP *providers* (case managers, medication transition specialists, pharmacists, discharging clinicians, bedside nurses) and *managers* (unit managers and department directors who oversaw frontline providers) across medical and surgical care units. We targeted high- and low-performing units based on recent checklist completion.

Interviews. Interview topics included: services provided through CTP and how they differed from regular discharge care; quality and quantity of communications with other CTP providers; appropriateness of targeted groups; and feedback and expectations around program

performance. Semi-structured interviews lasted 30- 45 minutes. Interviews were digitally recorded, professionally transcribed, de-identified and transferred to Atlas.ti (Berlin, Germany) for analysis.

Data analysis. We used template analysis, a procedure for coding and classifying fragments of interview transcripts that combines inductive and deductive approaches.[17] First, we developed a template of *a priori* codes based on CFIR. Second, two coders (RMM, MCR) independently applied the initial coding template to five transcripts. Third, the initial coding template was revised and emergent thematic codes were added. Fourth, the revised template was used to code five *new* transcripts; consensus about the concepts and definitions in the template was reached to ensure inter-rater agreement. Fifth, the remaining transcripts were each coded in Atlas.ti by two coders. Finally, coded fragments were merged, sorted by construct, and analyzed. The full research team developed summaries by reviewing quotations and identifying main themes and exemplar quotes. Code summaries were discussed, combined, and modified until agreement was reached.

Aim 2 & Aim 3

Conceptual model. Aims 2 and 3 rely on a conceptual model proposed by Donabedian that provides a framework for examining health services and quality of care. According to Donabedian's model, information about the quality of care comes from three domains, **(1) structure**, which is the context in which care is delivered, **(2) process**, which are the treatment or service being provided to the patient and **(3) outcomes**, which are the results of the treatment.[18] This proposal includes the addition of antecedent conditions (including relevant patient and environmental factors) by Coyle and Battles that influence patient outcomes.[19] Figure

2.2 provides a framework for understanding how the Care Transitions Program (aim 2) and its components (aim 3) affect patient outcomes, accounting for relevant patient outcome.

Data sources. The Carolina Data Warehouse (CDW) is the main data source for aims 2 and 3. CDW is a central repository containing: EMR, administrative, demographic, and clinical encounter (e.g. ICD-9/10, service line, and payer information) data for UNC Hospitals. In addition, patient records at the CDW were merged with state vital statistics to provide data on patient death.

Study sample. Patients were included in our study if they met criteria for the CTP program:(1) ≥18 years, (2) discharged from a medicine, heart and vascular, or surgical unit at UNC Hospitals and (3) moderate or high risk (Table 2.2). We also restricted the sample to those admitted on or after July 1, 2014 and discharged on or before September 30, 2015 (Figure 2.1).

We followed criteria developed by the Yale New Haven Health Service Corporation/ Center for Outcomes Research & Evaluation for the CMS (Yale/CMS) 30 –day all-condition readmission measure to refine our study population. Specifically, discharges were excluded from this study if the patient (1) had an admission for rehabilitation condition, (2) was admitted for a condition category with high-competing mortality risk in the post-discharge period, (3) died during the hospitalization, (4) was transferred to another acute care facility or (5) was discharged against medical advice.[20] In addition, we excluded patients who lived > 150 miles from UNC Hospitals as it is less likely we would have good information on their readmission (Table 2.4).

Key variables and measures. The primary outcome was unplanned all-cause 30-day readmission. We used unplanned all-cause readmission rather than readmission related to the previous hospital for at least three reasons. First, readmission for any cause is likely to be an undesirable outcome. Second, there is no convenient or reliable way to determine whether a

readmission is related to previous hospitalization or whether it could be potentially preventable. Finally, this approach is consistent with existing reported CMS measures.[20]

We defined readmission as an admission to UNC, REX, or Chatham Hospitals that occurs within 30 days after the discharge date of an eligible index admission. Consistent with the Yale/CMS measure, we excluded planned readmissions, defined as those for maintenance chemotherapy or for any of 32 procedures that are typically planned (e.g. coronary artery bypass graft) and not coded for an acute diagnoses or complications of care (Appendix 2.1 & 2.2).[20,21]

Our primary exposure was completion of CTP checklist items. We operationalized CTP exposure differently for aims 2 and 3. For Aim 2 we were interested in the completion of the *overall* CTP checklist. For each discharge, we calculated the number of components completed. A priori, we defined CTP exposure as ≥ 4 components complete; however, we conducted sensitivity analyses under all alternative definitions (i.e. ≥ 1 components complete, ≥ 2 components complete, ≥ 3 components complete, and 5 components complete). For Aim 3 we were interested in the role of different *provider components* of CTP checklist. For each component, we considered it complete if all the items under it were complete (e.g. the pharmacist indicated they had completed: an admission medication reconciliation, a discharge medication reconciliation, medication counseling with the patient, and a handoff transitions note).

To assess completion of individual items we used the following criteria. If no checklist was initiated for an eligible patient, each item for that patient was coded as incomplete. Among patients with a checklist, most providers electronically signed their name to signify completeness; however, some used free text. If a provider signed their name, marked an item "NA" (not applicable) or provided a rationale for why a task was not carried out that did not describe a coordination challenge with the program, we considered the item complete.

Otherwise, the item was marked incomplete. Because checklist were integrated into the patients EMR, two or more providers could access the checklist at the same time, and checklists were not necessarily completed in order.

Risk adjustment. Following the Yale/CMS recommendation and consistent with previous CMS risk-standardization strategies, we used the CMS Hierarchical Condition Categories Model (CMS-HCCs) to group ICD-9 codes into risk adjustment variables that are clinically coherent and carry similar risks (e.g. severe infection, diabetes and end stage renal disease). CMS risk variables were constructed using ICD codes related to the final discharge condition of the index admission, our final list include 21 risk variables (Appendix 3). We also included age and whether or not the service line was surgical.

Instrumental variables. Because patients' severity level and unobservable factors might be correlated with both receipt of CTP and readmission risk, we considered an instrumental variable approach**.** Valid instruments must: 1) explain variation in the endogenous treatment variable and 2) not predict the dependent variable except through the treatment variable. Based upon qualitative interviews and published literature, we tested the following possible instruments:

Weekend discharge. We hypothesized that discharges during the weekend would be less likely to receive CTP than discharges during the week. We knew from interviews that CTP providers (i.e., pharmacists and case managers) are staffed less on the weekend and thus CTP delivery, which typically occurs on the day of discharge, would be less common. A potential concern with this instrument is that it may be related to patient severity; however, we did not find support for this in our data. Weekend has also been used previously for a related set of analyses.[22]

Recent unit and service line performance on CTP. We hypothesized that acute care units and service lines that performed "well" for a previous set of patients on CTP items are likely to perform "well" for the next set of patients, independent of patients' readmission risk. To develop a measure of recent performance, we created variables representing the rate of CTP services delivered for the last ten patients discharged from the same unit and service line respectively. While some CTP providers (e.g. nurses) are assigned to patients based on their acute care units, others (e.g. discharging physicians) are assigned based on service line. Because there were changes to how patients were attributed to CTP providers during our study time period, this combination of instruments captures the concept of provider behavior, a commonly used instrument.[23]

Discharge caseload. Given that providers reported that time was sometimes a barrier to delivering CTP, we hypothesized that discharges that occurred on days with more CTP discharges than average would be less likely to receive checklists than discharges that occurred on days with less CTP discharges than average. We calculated a mean discharge caseload for each unit by month, and then calculated the difference between that day's discharge rate and the mean.

Statistical analysis. We used logistic regression with and without an instrumental variable approach to correct for potential endogeneity of the treatment variable. In the latter case, a two-stage residual inclusion (2SRI) model was used as the more common two-stage least squares approach yields inconsistent estimates in non-linear models.[24] We conducted three types of IV specification tests. First, we used an F test to determine instrument strength. Second, because we had multiple instruments, we tested that each instrument was validly excluded from our second stage models. Finally, we tested for endogeneity of our treatment variable to

determine our preferred model (2SRI or logit). Because the 2SRI approach is similar to a variant of the Hausman Test, we tested for endogeneity using the residuals in the second stage models, where the null hypothesis is that the treatment variables are exogenous. If the treatment variables are exogenous, then the residuals should have no explanatory power and the non -IV logistic model is preferred because the standard errors are more precise.

While there are multiple factors related to the risk of readmission,[25,26] our approach was designed to emulate CMS work in this area.[20] For each treatment definition we ran 3 models: (1) an unadjusted model; (2) an approximation of a CMS risk adjusted model which included the 21 CMS risk adjustment variables, age and whether or not the discharge was from a surgical unit; and (3) a fully adjusted model that included covariates from model two plus race (white, black, other/ unknown), gender, risk status (moderate or high- risk) and insurance status (private, Medicaid, Medicare, other public, and no coverage/unknown). We did not adjust for patients' admission source or discharge disposition because these factors are associated with the structure of the health care system, and may reflect the quality of care delivered.

Figures and Tables

Figure 2.1 Rollout of the Care Transitions Program and study period

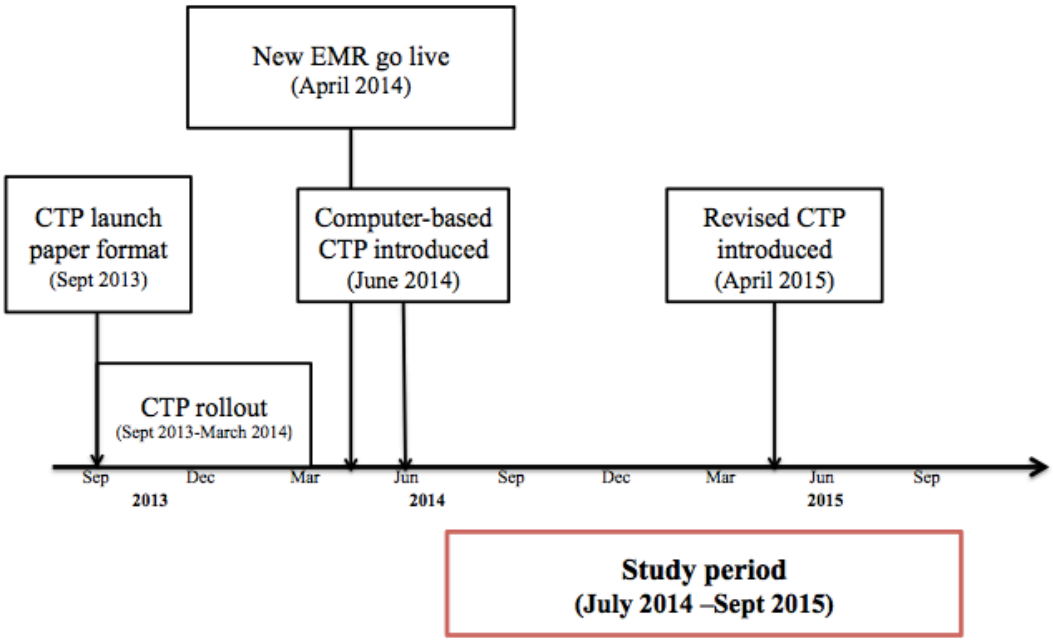


Figure 2.2 The Donabedian model to assess 30- day readmission

Antecedent Characteristics	Structure	Process	Outcome
Patient risk factors	Hospital unit and service line	Care Transitions Program components	Unplanned all-cause 30-day readmission

Table 2.1 CTP roles and responsibilities by provider type

Case Manager Checklist Responsibilities:

- Comprehensive assessment completed and post-acute care needs identified
- Complete handoff transitions note

Medication Transition Specialist (Pharmacy Technician) Checklist Responsibilities:

- Obtain medication history, contact home pharmacy, and update meds list; review with team pharmacist

Pharmacist Checklist Responsibilities:

- Admission medications list reconciled using medication history; issues discussed with medical team
- Discharge medications list reconciled, medical team notified
- Medication counseling/ teach back used with patient/ caregiver(s)
- Place notes/ concerns/ monitoring in handoff transitions note

Discharging Clinician Checklist Responsibilities:

- Notify service pharmacist when medication list is ready for discharge reconciliation
- Inpatient MD to outpatient MD communication completed (electronic, phone, or in person)

Bedside Nurse Checklist Responsibilities:

- Teach back used for red flags
- Discharge instructions reviewed with patient/ caregiver(s)
- Scheduled follow up appointment at bedside with patient / caregiver(s) within 7 -14 days of discharge from hospital
- Purposeful pause huddle to ensure patient readiness for discharge

Table 2.2 Risk strata

Risk Strata	Definition	Excepted Readmission Rate
High risk	• ≥3 inpatient admissions in the past year OR • ≥3 chronic conditions and 10 or more medications	30%
Moderate risk	Not high risk and had either: • 2 inpatient admissions in the past year OR • ≥ 2 chronic conditions	20%

Table 2.3 A consolidated framework for implementation research domains and constructs (Source: Damschroder et al., 2009)

Domain	Construct
Intervention Characteristics	• Intervention Source • Evidence Strength and Quality • Relative Advantage • Adaptability • Trialability • Complexity • Design Quality and Packaging • Cost
Outer Setting	• Patient Needs and Resources • Cosmopolitanism • Peer Pressure • External Policy and Incentives
Inner Setting	• Structural Characteristics • Networks and Communications • Culture • Implementation Climate • Readiness for Implementation
Characteristics of Individuals	• Knowledge and Beliefs About the Intervention • Self-Efficacy • Individual Stage of Change • Individual Identification with Organization • Other Personal Attributes
Process	• Planning • Engaging • Executing • Reflecting and Evaluating

Table 2.4 Study sample exclusion criteria and rationale

Criteria	Rationale
Admissions for rehabilitation care	• These admissions are not for acute care
Patients admitted for a condition category with high-competing mortality risk in the post-discharge period	• A high ratio of post –discharge deaths per readmission reduces the opportunity for readmissions and interferes with the quality signal
Died during hospitalization	• Patients who die during the initial hospitalization cannot be readmitted
Transferred to another acute care hospital	• In an episode of care in which the patient is transferred among hospitals, responsibility for the readmission is assigned to the final discharging hospital. Intermediate admissions within a single episode of care are not eligible for inclusion
Patients discharged against medical advice	• Hospital had limited time to implement high quality care
Patients with a residence zip code of greater than 150 miles from UNC Hospitals	• There may be a closer hospital for these patients, thus it is less likely that we will have good data on these patient's 30-day outcomes

1. Adapted from Yale New Haven Health Service Corporation / Center for Outcomes Research and Evaluation
2. See Appendix 1 for specific detail on condition categories that compromise the condition categories with a high-competing mortality risk in the post-discharge period

CHAPTER 3. FRONTLINE PERSPECTIVE ON THE IMPLEMENTATION AND DELIVERY OR INPATIENT SERVICES TO REDUCE 30-DAY READMISSIONS

Overview

Background: The Affordable Care Act created financial incentives for hospitals to reduce 30-day readmissions. In response, many healthcare systems sought to improve transitional care services. Research to date on transitional care is favorable, but significant gaps persist in our understanding of what makes program run smoothly when implemented in real world settings.

Objective: We sought to understand the context in which transitional care is delivered. Specifically, how features of the inner setting (e.g., competing demands, commitment and training) and intervention characteristics facilitate or hinder effective implementation and delivery.

Approach: Guided by the Consolidated Framework for Implementation Research, we conducted semi-structured interviews and used template analysis to code and classify fragments of text.

Participants: 25 providers (case managers, medication transition specialists, pharmacists, discharging clinicians, nurses) and managers (unit managers and department directors who oversaw frontline providers) were purposefully sampled from medical and surgical units where

the care transitions program was active. Participants were interviewed between March and July 2015.

Key Results: The implementation and delivery of the program was advanced by a shared belief in the importance of transitional care; however, providers' ability to work effectively as a team was hindered by gaps in the inner setting including: competing demands, limited training, and challenges with feedback and communication. In addition, providers' perceived flexibility in program design allowed for unit-specific tailoring; however, insufficient tools and procedures such as specified workflows or guidance regarding key components undermined respondents' confidence that the program offered something above usual discharge care or would achieve desired outcomes.

Conclusions: Healthcare systems could improve the implementation and delivery of similar transitional care programs by utilizing mid-level managers and champions to: communicate how the program aligns with existing priorities, clarify team roles and interdependencies among them, conduct trainings, and ensure tools are developed to support new workflows.

Introduction

Hospital readmissions within 30 days of discharge are common and costly and have long been used as an indicator of the quality of care.[1,27] The Affordable Care Act created financial incentives for hospitals to reduce 30-day readmissions; most notably, the Hospital Readmission Reduction Program penalizes hospitals with excess 30-day readmission rates for certain high volume, high cost conditions.[28] In response, many health care systems have sought to improve

transitional care services, which have been defined as *"a broad range of time-limited services designed to ensure health care continuity, avoid preventable poor outcomes among at-risk populations, and promote the safe and timely transfer of patients from one level of care to another or from one type of setting to another."*[6] Hallmarks of successful transitional care interventions include patient engagement and education by a nurse; referrals for community services and supports; communication between hospitals and primary care providers; and post-discharge calls and/or home visits.[6,7]

Research to date on transitional care from trials and administrative data is favorable,[7,8] but significant gaps persist in our understanding of how and why programs succeed or fail when implemented in real world settings. There is a growing recognition that to improve the quality of care, we need to evaluate not only summative, but also formative, outcomes (e.g., organizational factors, complexity of intervention components)[16,29] that are critical to understanding the context in which transitional care is delivered. To this end, we elicited perspectives of frontline personnel about factors affecting implementation of a multidisciplinary program designed to improve transitions from the hospital to the home. Guided by the Consolidated Framework for Implementation Research (CFIR) and its derivative Care Transitions Framework.[15,16] we focused on two domains: (a) inner setting, defined as the hospital's culture and structures that are important in forming a sense of team, and (b) intervention characteristics, defined as tools and procedures that make programs run smoothly and promote provider buy-in. We believed that these two domains would provide the greatest insight into features that facilitate or hinder effective implementation and delivery from the hospital's perspective.

Methods

Setting. This study was conducted at University of North Carolina (UNC) Hospitals, an 830-bed public academic medical center. UNC Hospitals admit more than 37,000 patients a year and its 30-day readmission rate is typical for its peers (12.24% in 2014).

Care Transitions Program (CTP). In the fall of 2013, UNC launched the hospital-wide CTP modeled after the Institute for Healthcare Improvement's strategy to reduce unnecessary readmissions.[14] UNC formed a transitions leadership team of providers and administrators from across the hospital. The leadership team developed a checklist of 13 services that were to be completed prior to patient discharge, including: (1) needs assessment by case managers, (2) medication history by medication transition specialists (pharmacy technicians), (3) medication reconciliation and counseling by pharmacists, (4) communication to outpatient provider by physicians, and (5) self-care education using teach-back and scheduling of timely follow up by bedside nurses (Table 3.1). The checklist was originally paper-based. After six months, UNC implemented a new commercial electronic medical record (EMR) system, and two months later, the checklist was fully integrated into the EMR.

Over a seven-month period, CTP was rolled out across the hospital (including medicine, heart and vascular, and surgery services), instead of specific diseases or payers. CTP targeted all moderate and high-risk patients identified with an algorithm based on the number of admissions in the past year, chronic conditions, and medications. It was estimated that the algorithm would identify nearly 40 discharges per day and that patients would have a 20-30% readmission risk. CTP was implemented without adding staff, though many staff roles were repurposed from previous quality improvement projects.

Participants. We used purposeful sampling to identify CTP *providers* (case managers, medication transition specialists, pharmacists, discharging clinicians, bedside nurses) and *managers* (unit managers and department directors who oversaw frontline providers) across medical and surgical care units. We sought to define and target high- and low-performing units based on recent checklist completion. This proved unfeasible due to the shifting nature of CTP teams. Most CTP providers (i.e., case managers, medication transition specialist, pharmacists, and physicians) were assigned to patients by service line (e.g. general medicine, cardiology, pulmonology). However, the bedside nurses were assigned based on acute care unit. Teams did not commonly work together for multiple patients. For example, the general medicine service might have patients located on 6 or 7 different units. Some pharmacists alternated services or would "float" to fill in where needed. Finally, residents rotated by service every few months. Given this challenge, we relied on the UNC Quality Improvement department to identify key informants. We then asked interviewees for recommendations so that alternative viewpoints would not considered. Respondents were offered $20 gift cards for participating. The UNC Institutional Review Board approved this study.

Interviews. Interview topics included: services provided through CTP and how they differed from regular discharge care; quality and quantity of communications with other CTP providers; appropriateness of targeted groups; and feedback and expectations around program performance. Semi-structured, 30-45 minute interviews were conducted by one author (RM). Interviews were digitally recorded, professionally transcribed, de-identified and transferred to Atlas.ti (Berlin, Germany) for analysis.

Data Analysis. We used template analysis, a procedure for coding and classifying fragments of interview transcripts that combines inductive and deductive approaches.[17] First, we developed a template of *a priori* codes based on CFIR. Second, two coders (RM, MCR) independently applied the initial coding template to five transcripts. Third, the initial coding template was revised and emergent thematic codes were added. Fourth, the revised template was used to code five *new* transcripts; consensus about the concepts and definitions in the template was reached to ensure inter-rater agreement. Fifth, the remaining transcripts were each coded in Atlas.ti by two coders. Finally, coded fragments were merged, sorted by construct, and analyzed. The full research team developed summaries by reviewing quotations and identifying main themes and exemplar quotes. Code summaries were discussed, combined, and modified until agreement was reached (Table 3.2).

Results

Between March and July 2015, we conducted 25 interviews with providers and managers who implemented CTP on six acute hospital units (Table 3.3). We organized our findings around inner setting and intervention characteristics (Table 3.2). Perspectives varied tremendously as one would expect when more than 200 providers are involved. Provider interviews focused on themes that were relevant to the provider. Given the variety of interview content, we did not provide counts of what percent of interviews agreed or didn't agree with a sentiment, but rather attempted to describe the range of views that were most common.

Inner Setting

We found that the transitions team came together through a shared vision, strong leadership, performance reports, and touch-base rounds; we also found that teamwork was

sometimes undermined by competing demands, limited training, challenges with feedback, and siloed communication across hospital departments.

Innovation Fit and Competing Demands. Reducing re-admissions was viewed as aligning with the hospital's mission. Many respondents spoke about the role of CTP in improving quality of care and reimbursement:

> *"I think the efforts to reduce readmissions is very important. It's crucial if we're going to maintain our financial viability as an institution" (Pharmacist)*

However, competing patient care demands were often viewed as more important:

> *"Spending a lot of extra time on one patient [to deliver CTP] … I have to weigh that against the needs of 15 to 20 other patients on the service." (Physician)*

Some respondents perceived a tension between CTP and discharging patients faster. For example, although nurses were supposed to lead a "purposeful pause" to ensure the patient is ready for discharge, physicians were often perceived as pressured to reduce length of stay:

> *"I had a patient last week that was being readmitted for pancreatitis. They [the doctors] were trying to... rush him out the door again. I kept telling them, "His pain is not under control…." and they really wanted to send him home that evening and I'm like, "He's a transition patient. He's readmitted with the same thing that you're trying to discharge him with and we don't have it resolved yet." (Nurse)*

Inadequate staffing frustrated some providers:

> *"I did my best to compassionately support that this [checklist] is added work without added FTEs*." *(Physician)*

Across provider types, CTP providers sought organizational cues that CTP was a priority and that sufficient resources were being allocated to its delivery and effective use**.** Lack of resources to deliver CTP on weekends may have undermined perceptions about its importance:

> "*I just think it's odd that if it's this important to prevent re-admissions, why aren't there resources to do it on seven days a week?" (Physician)*

Commitment. The CTP program was founded on the idea that diverse staff would collaborate. In some teams a "culture" around the checklist emerged that highlighted its importance; in others, provider roles were carried out in silos and the initiative was viewed as principally paperwork. Many providers looked to their managers to determine CTP's importance:

> *"In teams where leaders said, "This is a priority for us" it went really well. In teams where we didn't have that engagement, it just didn't*." *(Case Manager)*

Administrator commitment was usually perceived as high, though occasionally with skepticism. Some providers described CTP as the "flavor of the month" and wondered how long it would be sustained:

> *"I think it's the hot topic right now. I've been here long enough to know that there's always a hot topic. That topic frequently changes." (Case Manager)*

As before, providers were looking for organization cues that CTP was valued. Physician commitment was low; perhaps because they do not believe that what is required for their patients can be reduced to a series of checkboxes. However, many non-physician providers found low physician commitment discouraging:

> *"A lot of people feel like the nurses are getting a big push to do this and none of the other services are… Especially if the doctors aren't really participating in it and they're the ones making a lot of the big decisions." (Nurse)*

Teamwork disintegrated in units with poor participation from providers:

> *"Everybody kind of has this [attitude], "Well, nobody else does it, so why am I doing it?" (Nurse)*

Training and Rollout. For case managers, medication transition specialists, and pharmacists, training was facilitated by a relatively manageable number of close-knit staff. These staff discussed best practices and challenges in regular, all-staff meetings. Training for nurses and physicians, however, was more challenging due to the large number of providers and the influx of new residents:

"Nurses, there are thousands of them. My team… went to all these different nurse groups and did these trainings. For weeks it was all they did. There's no way they got all of them… I think we moved too quickly." (Supervisor)

Many nurses reported little formal training:

"We weren't educated on the entire process, what our role is, what everyone else's roles are, and that's where I think we struggle with that value part of it." (Nurse)

Limited training about CTP led to poor understanding of the new roles of case managers and pharmacists, who reported feeling underappreciated:

"I don't even think they [doctors] read our notes. I've had doctors … go, 'Wow I didn't realize that when you go in, you're assessing all these different things.' I don't think they have a clue that we actually work our tails off." (Case Manager)

Gaps in the initial training were compounded as the program was revised over time:

"They kind of changed the process as they went along. So people really just stayed confused about their role, what the expectations were and who was responsible for what." (Nurse)

Some units opted for a "second roll out" after a bumpy first roll out and found this effective:

"We took time at a couple of different staff meetings, created a PowerPoint and went over every single thing in the actual checklist, gave a little bit of background to what transitions was and our purpose in doing so. Since then, we rolled that out a few months ago. Our completion rate for nursing is greater than 90%. Before, it was not very good at all." (Nurse Manager)

<u>*Feedback and Expectations*</u>. Respondents indicated that monthly CTP performance reports promoted staff motivation and helped set goals:

"I feel we're very proud of our transitions work and our checklist completion. I just got our recent data back… and we've made significant improvements." (Nurse Manager)

Performance was established as a goal in the pharmacy department and was linked to performance reviews of staff; this helped emphasize its importance:

"I know when I sit in with my manager for my yearly evaluation that at least fifteen percent of my score at the end is going to be dependent on how I'm doing on transitions of care" (Pharmacist)

However, performance reports were limited for many providers, who wanted feedback on different outcomes or had concerns about the timeliness of reports:

> "*The big frustration for me has been not having any data for the last six months. I have no idea how I'm doing and it's been really hard for me to self-reflect.... It's hard to… learn from your mistakes or learn from your successes." (Pharmacist)*

Providers commonly voiced concerns with the accuracy of feedback or believed reports reflected other providers' poor performance:

> *"The problem is I'll do… [my part]; but if the case manager doesn't do her part or the pharmacist doesn't do hers or the nurse accidentally signs it before other people do it, then there's all these incompletes." (Nurse Practitioner)*

Others worried they weren't receiving credit appropriately:

> *"If you just miss one box then multiple things are counted against you even though you did them correctly" (Pharmacist)*

<u>*Communication*</u>. Increased communication and collaboration were widely viewed as essential to CTP but communication procedures lacked structure, and thus CTP didn't consistently result in a changed discharge process. What made communication better in some teams was a new "culture" around discharge planning:

> *"Once transitions came onboard, the whole communication process within our services for how we handled discharge planning and just interacted with each other totally changed." (Case Manager)*

In many cases, this was achieved by creating interdisciplinary touch-base rounds, in which team members met daily in small groups, to exchange findings about the needs of transitions patients:

> *"We talk about transitions patients first… Our pharmacist is there. Our case manager is there. Our provider is there. Everyone who's supposed to fill this out is sitting at the table" (Nurse Manager)*

Providers participating in touch-base rounds were enthusiastic about them; however, case managers and pharmacists, with patients on multiple services, often could not attend. As a result, many providers relied on informal communications to learn about patients' care need:

> *"As a case manager you have to be able to know what questions to ask of the doctors to pull out the information that you need to get. If you have a newer case manager or someone who has no experience doing that, or someone who's intimidated by their physician team, then they're going to have problems." (Case Manager)*

Some providers appreciated that informal communication allowed for relationships to form, others felt it caused information to fall through the cracks and didn't harness the potential of computer-based checklists. Without clearly specified procedures for communication, the team approach for delivering CTP weakened and many providers reported working alone:

> *"I do my part, they do their part, and nobody needs to discuss the other parts. You just do your part." (Nurse Practitioner)*

Intervention Characteristics.

Providers appreciated that CTP could be tailored to local settings and target appropriate groups, making the program run smoothly. However, gaps in CTP's tools and procedures resulted in inconsistent implementation and may have undermined respondent confidence that it offered something above usual discharge care.

Adaptability and Processes Standardization. Many units tailored CTP to match their unit workflows or to meet the unique needs of their patient population:

> "*This isn't a house-wide thing. It's just for our patient population…. we've been really working hard on creating an education tool … for our heart failure patients since they're a majority of our Transitions patients" (Nurse)*

For example, variation existed in whether patients were notified that they were part of CTP, who initiated the checklist in the EMR, and how follow- up appointments were made.

"There's still not a uniform standard process across all the services." (Physician manager)

While variation in implementation allowed best practices to be shared during team meetings, uncertainty existed around checklist expectations. Some providers felt that checklist items (for example the purposeful pause, or some of the teaching items) did not map to a specific course of action. A nurse manager remarked how this was a barrier to effective implementation. She said:

"People have to have something solid that matches what you're asking them to check off… if the case manager doesn't understand that it's her job to get a wheelchair, or the nurse doesn't understand that it's her job to see that the patient understands what their diagnosis is, what their medications are... If they don't understand or can some way quantify that that work has been done, then checking the box doesn't … make a better transitions process." (Nurse Manager)

There were many examples where providers made their own calls regarding what the checklist items required, or what patients should receive the service. For example, medication transition specialists and pharmacists reported not completing a full work-up for patients returning within ten days:

"Now, if the patient's been here within a two week period, we don't necessarily go back to interview the patient, we might just call just the pharmacy and see what their antibiotic is that was called in recently."(Medication Transition Specialist)

Pharmacist often considered a note to an outpatient pharmacist not applicable if no outpatient pharmacist was staffed in the clinic. Some aspects of CTP were supported or changed by other ongoing quality improvement initiatives (e.g. a new pilot program to streamline scheduling follow up appointments). These sometimes further confused providers as to what was and what was not a feature of the CTP initiative:

"Now, we're actually in a pilot as well or maybe it's no longer pilot where our [Health Unit Coordinator] makes all follow-up appointments for our patients… All of our patients now..." (Nurse Manager)

Eligible Patients. The algorithm to identify patient at moderate and high risk of readmission (and therefore for CTP) was for the most part sensitive but not specific. According to the hospital administration, this was the intention in order to create a unified standard for high-risk discharges. However, providers sometimes felt the algorithm-included patients for whom readmissions were planned or unavoidable:

> *"You have your diagnoses like Crohn's and colitis, your transplant patients, your cancer patients, people that will automatically come in for frequent readmits" (Case Manager)*

> *"People are being labeled Transitions inappropriately because they have a disease process… that's going to be frequently hospitalized regardless… Making someone like that Transitions ... There's nothing we can do." (Nurse)*

Managers reported this was a frustration for staff:

> *"I think doing the comprehensive assessment on patients that they don't think should meet a trigger, that can feel frustrating." (Case Manger Supervisor)*

There were also categories of patients whom the algorithm missed completely. The most common examples were patients with new diagnoses (because the algorithm relied on past healthcare use), and new patients (who often did not have the historical data to trigger the flag) and patients admitted for observation stays, who if admitted would suddenly become eligible for the program, but would be an inpatient for a very short time making it difficult to deliver the program:

> *"They'll be here a couple days and then be flipped to inpatient, and then they'll suddenly show up on the list. That's difficult, because if the patient's discharging that afternoon or early the next day, it gives you a very limited time to complete the tasks." (Pharmacist)*

Relative Advantage & Evidence Strength. Providers were split on whether the program offered something beyond usual discharge care.

> *"It made a huge difference. Our patient satisfaction scores on [our service lines], the HCAHPS scores for discharge planning were in the high 90s." (Case Manager)*

> *"I do know on one of my services… they have collected data and have seen a decrease in readmissions for the patients who attended their follow up appointments…. I think that's great." (Case Manager)*

However other providers viewed CTP as principally documentation:

> *"There's more nursing in terms of we fill out the paper but not more nursing in terms the care that we give to the patients." (Nurse)*

This was a barrier to implementation, because providers who could not distinguish between CTP and usual care were less likely to participate:

> *"I think we already do a lot of those things. We just don't document" (Nurse)*

Providers were eager to see evidence that CTP worked. Many had done their own research, with mixed conclusions:

> "*I've done some research, and it seems like a lot of other institutions have tried Transitions type programs and not had great success." (Nurse)*

Although providers wanted the best for their patients, not everyone shared the belief that the CTP would achieve desired results. Managers felt the more they could prove the relative advantage of CTP over usual discharge care and establish evidence strength, the more providers would commit time and resources to do it:

> *"The more we could demonstrate an added value, the more people would accept added work… "It's hard for us to see a benefit when I just discharged this guy last week and now he's back again." (Physician)*

Discussion

Multicomponent transitional care programs have been widely implemented in healthcare systems to reduce 30-day hospital readmissions;[30] however, little is known about what makes them succeed or fail. In interviews with frontline hospital personnel, we found that CTP was advanced by a shared belief in the importance of transitional care; however, respondents identified gaps in the inner setting that hindered the ability of CTP providers to work effectively

in teams, specifically: limited resources, competing demands, gaps in training about program goals or roles of other providers, and challenges with communication and feedback. In addition, while providers appreciated that flexibility in program design allowed for unit-specific tailoring, the lack of adequate tools and procedures (e.g., specified workflows, guidance regarding key CTP components) may have undermined providers' confidence that CTP offered more than usual discharge care or would achieve desired outcomes.

There are several limitations to our study. First, we were unable to match provider perspectives to high and low performing teams. In addition, given the variation in interview outcomes we did not feel it was honest to provide counts on the number of respondents who reported a similar sentiment. Our study took place at a single institution and we cannot necessarily generalize findings to other healthcare systems. However, the challenge UNC is facing is nearly universal among its peers. In the third year of the Hospital Readmission Reduction Program (FY 2015), 78% of eligible hospitals, up from 66% the year before, are receiving a penalty for their readmission rate.[31] Thus, implications from this implementation case study emerge for future practice.

Increasing organizational readiness for transitional care is important. Organizational readiness can be decomposed into two parts: change commitment and change efficacy.[32] We found providers' commitment to participating in CTP varied tremendously across provider types and units. Because CTP is team-based, problems arose when some felt committed to implementation and others did not. Our research suggests that shared resolve could be enhanced through systems of feedback that are timely and include measures providers consider important. Providers want to deliver good care to their patients', so demonstrating that CTP is achieving positive results could increase commitment to CTP. In addition, shared resolve might be

bolstered through better alignment of the program with other organizational priorities and structures for which providers already value change (e.g. patient education initiatives and team-based care). Having mid -level managers,[33] provider champions,[9] and/or transitions team-leads (possibly nurses)[13] communicate the rationale and success of CTP could reinforce its value for front-line staff.[34]

Change efficacy, the other part of organizational readiness, refers to providers' shared beliefs in their *collective* capabilities to implement CTP.[32] While providers nearly unanimously reported their own role in delivering CTP was straightforward, many thought, "the wheels would come off somewhere." Collective efficacy might be enhanced through interprofessional training; additional tools to standardize processes, especially those that involve hand-offs between providers (e.g., documented workflows); and clarification around program adaptability.[35] As described in CFIR, interventions are composed of 'core components' that are indispensable to the program and an 'adaptable periphery' that can be tailored to local settings.[16] We found that units often tailored CTP to match their existing workflows with little guidance, which contributed to ambiguous expectations and a lack of understanding about how the program differed from usual discharge care. Mid-level managers and provider champions could enhance change efficacy by clarifying roles and communicating interdependencies between roles. They could also assist with adapting program components, conducting trainings, and ensuring necessary tools are developed to support workflows.

Figures and Tables

Table 3.1 CTP roles and responsibilities by provider type

Case Manager Checklist Responsibilities:

- Comprehensive assessment completed and post-acute care needs identified
- Complete handoff transitions note

Medication Transition Specialist Checklist Responsibilities:

- Obtain medication history, contact home pharmacy, and update meds list; review with team pharmacist

Pharmacist Checklist Responsibilities:

- Admission medications list reconciled using medication history; issues discussed with medical team
- Discharge medications list reconciled, medical team notified
- Medication counseling/ teach back used with patient/ caregiver(s)
- Place notes/ concerns/ monitoring in handoff transitions note

Discharging Clinician Checklist Responsibilities:

- Notify service pharmacist when medication list is ready for discharge reconciliation
- Inpatient MD to outpatient MD communication completed (electronic, phone, or in person)

Bedside Nurse Checklist Responsibilities:

- Teach back used for red flags
- Discharge instructions reviewed with patient/ caregiver(s)
- Scheduled follow up appointment at bedside with patient / caregiver(s) within 7 -14 days of discharge from hospital
- Purposeful pause huddle to ensure patient readiness for discharge

Table 3.2 Operational definitions of key constructs among included domains

Inner Setting	
Innovation fit and competing demands	Perceptions of the importance of the intervention within the organization and the level of resources dedicated for intervention activities
Commitment	Shared receptivity of involved individuals to intervention
Training and rollout	Availability and usefulness of training and information about the intervention, at first and ongoing
Feedback and expectations	Feedback available to providers and managers on intervention performance/outcomes and statements about whether compliance is expected
Communication	The nature and quality of formal and informal communications and information exchange across relevant providers
Intervention Characteristics	
Adaptability and process standardization	Degree to which the intervention standardizes tasks and process that are the focus of the intervention and accounts of how intervention has been adapted, tailored or refined to meet local (unit) needs
Eligible patients	Perceptions about the appropriateness of targeted patient groups
Relative advantage and evidence strength	Perceptions of the advantage of implementing the intervention versus maintaining the status quo and the quality or strength of existing evidence supporting intervention use

Modified from Damschroder et al. 2009 and Rojas et al. 2014

Table 3.3 Respondent characteristics

	Frequency #
Respondent Total	25
Provider Type	
Case Managers	3
Medication Transition Specialists	2
Pharmacists	4
Discharging Clinicians	6
Nurses	8
Other Supporting Staff	2
Managers	6
Surgical	4

CHAPTER 4. CAN COMPUTER-BASED TRANSITIONAL CARE CHECKLISTS REDUCE 30-DAY HOSPITAL READMISSIONS?

Overview

Background: Several provisions in the Affordable Care Act incentivize healthcare systems to move from traditional fee–for-service payments towards global payments rewarding high-quality care. Notably, the Hospital Readmission Reduction Program (HRRP) penalizes hospitals with excess readmissions. Results of the HRRP's first three years suggest reducing readmissions remains a challenge.

Objectives: We evaluated the effect of a computer-based transitional care checklist on unplanned all-cause 30-day readmissions for at-risk patients.

Research design: A retrospective cohort analysis of patients discharged from University of North Carolina (UNC) Hospitals. The exposure of interest was a multidisciplinary pre-discharge checklist. Our main model used standard CMS risk adjustment variables. We considered an instrumental variable approach to control for potential selection bias. We found no evidence that unobservable factors predicted our exposure; thus, our preferred model was a logistic regression.

Subjects: Patients discharged from UNC Hospitals between July 2014 and September 2015 who were at high or moderate risk for readmission based on number of admissions in the past year, chronic conditions, and medications.

Results: We found a statistically non-significant but modest effect of the computer based transitional care checklist on odds of readmission (odds ratio= 0.92; 95% confidence interval, 0.81-1.04).

Conclusions: The computer based transitional care checklist studied did not reduce hospital readmissions. This may be related to measurement error, but more likely is a limitation of program design or implementation. New implementation procedures, such as making checklists simple and relevant to use and assuring appropriate use of "NA," may be needed to bolster program effectiveness.

Introduction

Several provisions in the Affordable Care Act incentivize healthcare systems to move from traditional fee–for-service payments towards global payments that reward high-value or high-quality care.[36] To increase value, many health care systems have targeted reducing 30-day hospital readmission rates. Notably, the Hospital Readmission Reduction Program (HRRP) penalizes hospitals with excess readmissions for certain high-volume, high-cost conditions. Initially these conditions were acute myocardial infarction, heart failure and pneumonia; chronic obstructive pulmonary disease and elective hip or knee replacement were added in 2015; and coronary artery bypass graft surgery is slated to begin in 2017. Hospital readmissions are also a metric for many new models of care including Accountable Care Organizations and bundled-payment initiatives.[3,4] In addition, Medicare now allows physicians or other qualifying non-physician practitioners to bill for "transitional care management" services at discharge.

Taken together, it comes as no surprise that nearly 90% of hospitals have a written objective of reducing readmissions for at-risk patients.[37] Strategies to reduce readmissions vary but often include a dedicated transitions provider, medication reconciliation, patient engagement, and communication with outpatient providers.[10,11] Research on the effectiveness of transitional care strategies is mixed. One review concluded that despite some studies with significant findings, "the strategies than an individual hospital can implement to improve transitional care remain largely undefined",[10] another found that only high-intensity interventions that included a home visit within three days of discharge were effective at reducing readmissions,[7] and a third stated: "the current evidence base may not be adequate to facilitate change even for highly incentivized hospitals."[8]

Hospitals today continue to struggle to respond to the HRRP. For example, more hospitals were penalized through the HRRP in 2015 (78%) than in 2013 (64%); and the total penalty increased from $290 million in 2013 to $428 million in 2015.[3] Moreover, major teaching hospitals and safety-net hospitals were more likely to incur financial penalties.[3] These results suggest that there is a gap in knowledge and/or implementation of effective strategies to lower readmission rates. Checklists are widely used to encourage key actions that are consistent with high-quality care.[38–40] We sought to evaluate the effect of a care transitions program that uses a computer-based checklist on 30-day readmissions for a broad group of at-risk patients at one large academic medical center.

Methods

Setting. This study was conducted at University of North Carolina (UNC) Hospitals and two of its affiliates, REX Healthcare and Chatham Hospitals. UNC Hospitals is an 830-bed public academic medical center. UNC admits more than 37,000 patients a year, and its 30-day

readmission rate was 12.24% in 2014, which is similar to its peer institutions. REX is a 660-bed not-for-profit private acute care facility located approximately 25 miles from UNC, and Chatham Hospital is a 25-bed community hospital located approximately 30 miles from UNC. All three are part of the UNC Health Care System and share a common electronic medical record (EMR).

Care Transitions Program (CTP). In the fall of 2013, UNC Hospitals launched the CTP in their medicine, heart and vascular, and surgery service units. CTP was modeled after the Institute for Healthcare Improvement's strategy to reduce unnecessary readmissions.[14] A leadership team developed a checklist of services that were to be completed prior to patient discharge. CTP was organized into five components according to provider roles (1) needs assessment by case managers, (2) medication history by medication transition specialists (pharmacy technicians), (3) medication reconciliation and counseling by pharmacists, (4) communication to outpatient provider by physicians, and (5) self-care education using teach-back and scheduling of timely follow up by bedside nurses (Table 4.1).

CTP targeted all moderate and high-risk patients identified with an algorithm based on the number of admissions in the past year, chronic conditions, and medications; it was estimated that the algorithm would identify 40 discharges a day with a 20-30% readmission risk. CTP was implemented without adding staff, though many staff roles were repurposed from previous quality improvement initiatives.

CTP was modified over time. Originally, the checklist was paper-based (September 2013 -June 2014). Seven months after the paper checklist was introduced, UNC implemented a new EMR (April 2014), and the checklist became computer-based two months later (June 2014). Ten months later, the original 19-item checklist was streamlined to 13 items based upon early

experience (April 2015). The five components remained the same; however, certain provider roles were simplified (e.g. the case manager items were condensed from four items to two items).

Data sources. Data came from the Carolina Data Warehouse (CDW), a central repository containing EMR and administrative data for UNC, REX, and Chatham Hospitals. In addition, CDW merged data from State vital statistics to provide records on patient death.

Study sample. Patient discharges were included if they met criteria for the CTP program: (1) ≥18 years, (2) discharged from a medicine, heart and vascular, or surgical unit at UNC Hospitals and (3) moderate or high-risk for readmission. We restricted the sample to patients admitted on or after July 1, 2014 and discharged before September 30, 2015. Our initial dataset included 11,966 discharges. Based on criteria developed by the Yale New Haven Health Service Corporation/ Center for Outcomes Research & Evaluation for CMS (Yale/CMS), we excluded discharges that: (1) had an admission for rehabilitation condition (n=480), (2) were admitted for a condition with high-competing mortality risk in the post-discharge period (n=1,103), (3) died during the hospitalization (n=99), (4) were transferred to another acute care facility (n=125) or (5) were discharged against medical advice (n=48).[20] In addition, we excluded discharges for patients who lived greater than 150 miles from UNC Hospitals as they were more likely to be readmitted to hospitals other than those in our study (n=376).

Key variables and measures. The primary outcome was unplanned all-cause 30-day readmission, defined as an admission to UNC, REX, or Chatham Hospitals within 30 days after discharge from an eligible index admission. Consistent with the Yale/CMS measure, we excluded planned readmissions, defined as those for maintenance chemotherapy or for any of 32 procedures that are typically planned and not coded for an acute diagnoses or complications of care.[20,21]

Our primary exposure was completion of CTP checklist items. We sought a measure that could be used across changes to the program over time. As previously described, the CTP checklist consisted of five components organized according to provider role. For each discharge, we calculated the number of components completed. A priori, we defined CTP exposure as ≥ 4 components complete; however, we conducted sensitivity analyses under all alternative definitions (i.e. ≥ 1 components complete, ≥ 2 components complete, ≥ 3 components complete, and 5 components complete).

To assess completion of individual items we used the following criteria. If no checklist was initiated for an eligible patient, each item for that patient was coded as incomplete. Among patients with a checklist, most providers electronically signed their name to signify completeness; however, some used free text. If a provider signed their name, marked an item "NA" (not applicable) or provided a rationale for why a task was not carried out that did not describe a coordination challenge with the program, we considered the item complete. Otherwise, the item was marked incomplete.

Risk adjustment. Following the Yale/CMS recommendation and consistent with previous CMS risk-standardization strategies, we used the CMS Hierarchical Condition Categories Model (CMS-HCCs) to group ICD-9 codes into risk adjustment variables that are clinically coherent and carry similar risks (e.g. severe infection, diabetes and end stage renal disease). CMC-HCCs were constructed using ICD codes related to the final discharge condition of the index admission, our final list include 21 risk variables. We also included age and whether or not the service line was surgical.

Instrumental variables. Because patients' severity level and unobservable factors might be correlated with both receipt of CTP and readmission risk, we considered an instrumental

variable approach**.** Valid instruments must: 1) explain variation in the endogenous treatment variable and 2) not predict the dependent variable except through the treatment variable. Based upon qualitative interviews and published literature, we tested the following possible instruments:

Weekend discharge. We hypothesized that discharges during the weekend would be less likely to receive CTP than discharges during the week. We knew from interviews that CTP providers (i.e., pharmacists and case managers) are staffed less on the weekend and thus CTP delivery, which typically occurs on the day of discharge, would be less common. A potential concern with this instrument is that it may be related to patient severity; however, we did not find support for this in our data. Weekend has also been used previously for a related set of analyses.[22]

Recent unit and service line performance on CTP. We hypothesized that acute care units and service lines that performed "well" for a previous set of patients on CTP items are likely to perform "well" for the next set of patients, independent of patients' readmission risk. To develop a measure of recent performance, we created variables representing the rate of CTP services delivered for the last ten patients discharged from the same unit and service line respectively. While some CTP providers (e.g. nurses) are assigned to patients based on their acute care units, others (e.g. discharging physicians) are assigned based on service line. Because there were changes to how patients were attributed to CTP providers during our study time period, this combination of instruments captures the concept of provider behavior, a commonly used instrument.[23]

Discharge caseload. Given that providers reported that time was sometimes a barrier to delivering CTP, we hypothesized that discharges that occurred on days with more CTP

discharges than average would be less likely to receive checklists than discharges that occurred on days with less CTP discharges than average. We calculated a mean discharge caseload for each unit by month, and then calculated the difference between that day's discharge rate and the mean.

Statistical analysis. We compared CTP exposure and clinical and demographic characteristics of discharges in our sample by whether or not they resulted in a 30-day readmission using t-tests for continuous variables and chi-squared statistics for categorical variables.

For our main analysis, we used logistic regression with and without an instrumental variable approach to correct for potential endogeneity of the treatment variable. In the latter case, a two-stage residual inclusion (2SRI) model was used as the more common two-stage least squares approach yields inconsistent estimates in non-linear models.[24] We conducted three types of IV specification tests. First, we used an F test to determine instrument strength. Second, because we had multiple instruments, we tested that each instrument was validly excluded from our second stage models. Finally, we tested for endogeneity of our treatment variable to determine our preferred model (2SRI or logit). Because the 2SRI approach is similar to a variant of the Hausman Test, we tested for endogeneity using the residuals in the second stage models, where the null hypothesis is that the treatment variables are exogenous. If the treatment variables are exogenous, then the residuals should have no explanatory power and the non -IV logistic model is preferred because the standard errors are more precise.

While there are multiple factors related to the risk of readmission,[25,26] our approach was designed to emulate CMS work in this area.[20] For each treatment definition (≥ 1 components complete, ≥ 2 components complete…) we ran 3 models: (1) an unadjusted model; (2) an

approximation of a CMS risk adjusted model which included the 21 CMS risk adjustment variables, age and whether or not the discharge was from a surgical unit; and (3) a fully adjusted model that included covariates from model two plus race (white, black, other/ unknown), gender, risk status (moderate or high- risk) and insurance status (private, Medicaid, Medicare, other public, and no coverage/unknown). We did not adjust for patients' admission source or discharge disposition because these factors are associated with the structure of the health care system, and may reflect the quality of care delivered. We conducted several sensitivity analyses post hoc including: an alternative treatment definition of number of components *started* (as opposed to number of component *completed*), an alternative outcome definition that was a composite measure of 30-day readmission and mortality, and the inclusion of a time trend.

For each treatment definition and model specification, we calculated odds ratios (OR) with 95% confidence intervals (CI). We calculated average marginal effects for our main treatment definition using bootstrapped standard errors. All analyses were performed in Stata 14 (College Station, TX).

Results

Our sample included 10,083 eligible hospital discharges among 6,094 patients. The mean age was 56.54, 31.6% were Black, and more than half had Medicare coverage. The overall unadjusted unplanned all-cause 30-day readmission rate in the sample was 25.9%. Discharges that were associated with a 30-day readmission had on average more CMS risk adjustment variables (1.77 verses 1.54, $p < 0.0001$), they were more likely to be Black ($p = 0.001$), and more likely to have Medicaid or Medicare insurance coverage ($p < 0.0001$, $p = 0.05$) (Table 4.2).

Figure 4.1 graphically depicts the trend in the unadjusted readmission rate, and the average components completed by month for the entire sample. The average monthly

readmission rate varied more than 10 percentage points during our study period; it peaked in September 2014 at 34.0% and dropped as low as 22.7% in July 2015. The distribution of our independent variable highlights some of the challenges the hospital had delivering CTP during the study time period. While our entire sample was qualified for the program, out of 5 possible components complete, on average patients had less than 2 complete (Figure 4.1). Simple statistics demonstrate a secular trend in both of these variables ($p=0.01$, $p <0.0001$).

Instrumental variable specification. Weekend discharge and recent unit and service-line performance were strong instruments ($F >10$) for all model specifications; discharge caseload was not ($F = 0.67$). Wooldridge and others warn that weak instrument can introduce biased results,[41] so we excluded discharge caseload as an IV. All included IVs were tested separately, and all passed the over-identification test ($p > 0.05$). Finally, the inclusion of the residual in our second stage models was non-significant across treatment definitions; thus we fail to reject the null hypothesis that the CTP is exogenous. This suggests randomness in the way CTP was delivered with respect to unobservable patient risk factors. In other words, variation in the degree to which the CTP was delivered, at least among this target population, seems largely idiosyncratic rather than systematically related to patient factors. Thus, our preferred model was a logistic regression.

Main results. For our primary outcome definition (≥ 4 components complete) with standard risk adjustment variables we saw a modest and statistically non-significant effect of CTP on readmission risk (OR= 0.92; 95% CI, 0.81-1.04) (Table 4.3). Put another way, having ≥4 components of the checklist complete was associated with a 1.6 percentage point reduction in all –cause 30-day readmissions (average marginal effect = 0.016; 95% CI, -0.040 – 0.0043)(Table

4). Inclusion of additional control variables (gender, race, risk and insurance status) had little effect on the dependent variable.

Across models using different thresholds for treatment exposure, we found a persistent but non-significant trend that as CTP dose went up, the odds of being readmitted in 30 days went down. Specifically, as we tightened our treatment definition from ≥1 components complete to ≥4 components complete odds ratios steadily declined (OR =1.02, OR= 0.99, OR = 0.96, and OR= 0.92, respectively). This trend did not hold for our most stringent treatment definition ≥5 components complete, which compares those who received the complete checklist to everyone who received anything less than the complete checklist and represents the smallest number exposed and the largest confidence interval (OR =1.02; 95% CI, 0.82-1.26) (Table 4.4). The 2SRI and logit models had similar and non-significant findings across model specifications (results not shown).

Several sensitivity analyses were conducted. We considered an alternative specification of our independent variable that modeled the number of CTP components *started*, as opposed to CTP components *completed*. We also considered a 30 –day readmission and mortality composite measure, and the inclusion of a time trend. Results remained similar and non-significant for all models.

Discussion

This study sought to determine the effect of a computer-based transitional care checklist on rates of unplanned all-cause 30-day readmissions among a broad group of patients. Overall we saw a statistically non-significant but protective effect of the CTP program on odds of being readmitted in 30 days. This finding was robust to the inclusion of additional control variables and various sensitivity analyses. Separate models under alternative treatment definitions found a

persistent, but non-significant, "dose response" relationship to higher levels of CTP exposure. This study is important, because it describes the potential of hospitals in real-world settings to reduce readmission using a pre-discharge checklist. Overall, however, the program did not demonstrate impressive reductions in readmissions. This may be in part related to measurement error, but more likely is either a limitation of program design or implementation.

Similar to national readmission rates during this time period, our data suggest a modest decline in readmissions among at-risk patients.[3] This evaluation of the computer-based transitional care checklist does not offer a clear explanation for the trend. It is possible, however, that there are spillover effects of the CTP program on "unexposed" participants. One possible benefit of the CTP program is that it helps to establish a new standard of care for discharge planning. Thus, it is possible patients received aspects of the intervention even when their EMR did not reflect those services. Though perhaps good for patients, these spillover effects create a measurement challenge for evaluation. Our primary exposure relied on documentation of services that may or may not have occurred.

Fidelity to program implementation suffered during the study period. High rates of incomplete checklists (95.3%), coupled with large number of items reported as "NA" suggests low fidelity to CTP procedures. This may, in part, explain aspects of our results, e.g., large confidence intervals and non-significant findings. To increase program fidelity, new implementation procedures may be needed, such as making checklists simple and relevant to use,[42] assuring appropriate use of "NA", and providing specific and actionable feedback to providers on program performance.[43,44]

Irrespective of program implementation or possible measurement error, we might have a problem with the underlying effectiveness of the program. Either program components are

ineffective at reducing readmissions or the program is being targeted to the wrong patients. If the former, then the hospitals' primary focus on improving fidelity to program, will continue to lack desired outcomes. It could be that additional strategies for improving 30-day outcomes are required (e.g. better linkages to outpatient providers and community based resources, or home visits for high risk patients) though such strategies may be outside of the scope of a checklist.

There are several important limitations to this study. First, while our IV specification tests suggested we could treat CTP exposure as an exogenous variable, it is possible our findings may be biased due to unobservable patient factors. We would expect the results to be biased toward the null if the CTP were effective but given disproportionately to patients with a higher underlying risk. In that case the effects could wash each other out. We attempted to minimize any potential bias by restricting our selection criteria and controlling for key covariates in our models. In general we followed criteria developed by Yale/CMS, however these were developed for a Medicare population, and may not adequately risk-adjust for a younger population. In addition, readmissions in this study were limited to those within the UNC system; however, internal research suggests that more than 80% of readmissions are captured by this measure. Finally, this study period captures a period of transition for UNC Hospitals. Implementation rates for the CTP dropped after implementation of the new EMR, and although we did not include the months just following this transition, rates continued to go up during our study period. Similarly, we were not able to look at how changes to checklist items altered program effectiveness. For this and other reasons findings of this study may not be generalizable to other institutions.

Figures and Tables

Figure 4.1 Mean readmission and component completion rate by month for study sample

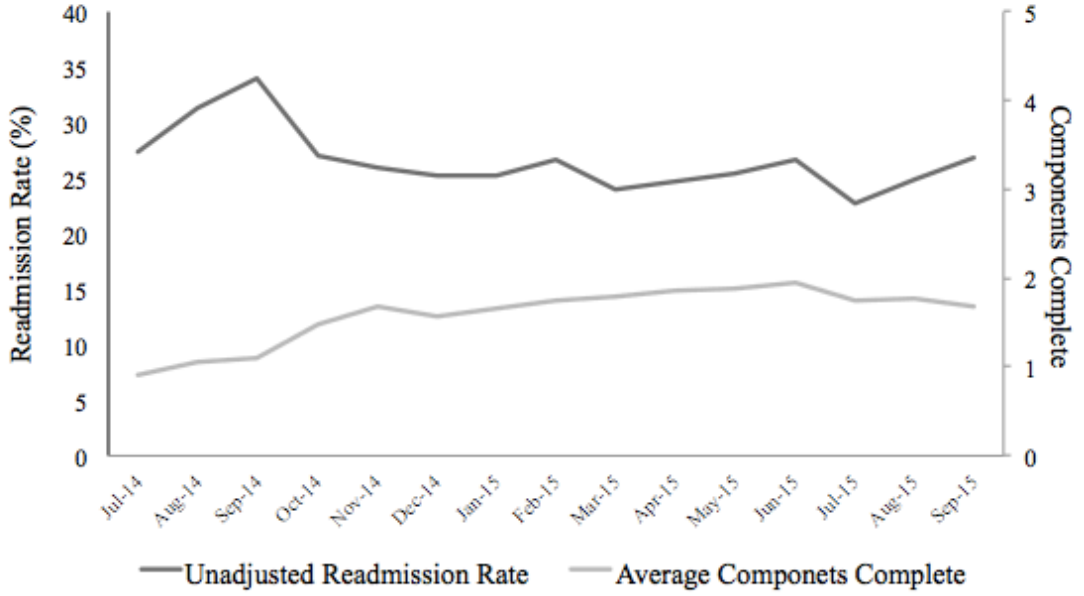


Table 4.1 Roles and responsibilities by provider type

Case Manager Checklist Responsibilities:
- Comprehensive assessment completed and post-acute care needs identified
- Complete handoff transitions note

Medication Transition Specialist Checklist Responsibilities:
- Obtain medication history, contact home pharmacy, and update meds list; review with team pharmacist

Pharmacist Checklist Responsibilities:
- Admission medications list reconciled using medication history; issues discussed with medical team
- Discharge medications list reconciled, medical team notified
- Medication counseling/ teach back used with patient/ caregiver(s)
- Place notes/ concerns/ monitoring in handoff transitions note

Discharging Clinician Checklist Responsibilities:
- Notify service pharmacist when medication list is ready for discharge reconciliation
- Inpatient MD to outpatient MD communication completed (electronic, phone, or in person)

Bedside Nurse Checklist Responsibilities:
- Teach back used for red flags
- Discharge instructions reviewed with patient/ caregiver(s)
- Scheduled follow up appointment at bedside with patient / caregiver(s) within 7 -14 days of discharge from hospital
- Purposeful pause huddle to ensure patient readiness for discharge

Table 4. 2 Discharge characteristics, overall and by readmission status

Variable	Overall Sample N = 10,083	Not Readmitted N = 7,468	Readmitted N = 2,615	*P*
	Mean (sd) or N (%)			
Unique patients	6,094	5,676	1,645	
Outcome				
30 – day readmission	2,615 (25.9%)			
30 – day readmission + mortality	2,672 (26.5%)			
Independent Variable				
≥ 1 components complete	6,111 (60.6%)	4,513 (60.4%)	1,598 (61.1%)	0.54
≥ 2 components complete	5,145 (51.0%)	3,813 (51.1%)	1,332 (50.9%)	0.92
≥ 3 components complete	3,504 (34.8%)	2,607 (34.9%)	897 (34.3%)	0.58
≥ 4 components complete	1,624 (16.1%)	1,220 (16.3%)	404 (15.5%)	0.29
5 components complete	453 (4.5%)	331 (4.4%)	122 (4.7%)	0.62
Risk Covariates				
Number of CMS- HCC risk variables	1.60 (1.22)	1.54(1.20)	1.77(1.24)	<0.0001
Age	56.54 (17.67)	56.69 (17.68)	56.08 (17.63)	0.12
Service Line– Surgical	3,088 (30.6%)	2,327 (31.2%)	761 (29.1%)	0.049
Additional Covariates				
Sex – Female	5,080 (50.4%)	3,778 (50.6%)	1,302 (49.8%)	0.48
Race – White	5,863 (58.2%)	4,383 (58.7%)	1,480 (56.6%)	0.06
Race – Black	3,181 (31.6%)	2,285 (30.6%)	896 (34.3%)	0.001
Race – Other/ Unknown	1,039 (10.3%)	800 (10.7%)	239 (9.1%)	0.02
Payer – Private	1,811 (18.0%)	1,384 (18.5%)	427 (16.3%)	0.01
Payer – Medicaid	2,547 (25.3%)	1,800 (24.1%)	747 (28.6%)	<0.0001
Payer – Medicare	5,801 (57.5%)	4,253 (56.9%)	1,548 (59.3%)	0.05
Payer – Other public	378 (3.8%)	295 (4.0%)	83 (3.2%)	0.07
Payer – No coverage/ none listed	302 (3.0%)	257 (3.4%)	45 (1.7%)	<0.0001
Instruments				
Weekend discharge	2,027 (20.1%)	1,496 (20.0%)	531 (20.3%)	0.76
Last 10 rate (unit)	0.34 (0.15)	0.34 (0.15)	0.33 (0.15)	0.84
Last 10 rate (service line)	0.34 (0.14)	0.34 (0.13)	0.33 (0.14)	0.19
Discharge caseload (days difference from units monthly discharge rate)	0.00 (1.33)	-0.01 (1.33)	0.02 (1.34)	0.33

Table 4.3 Odds of readmission under alternative treatment definitions and model specifications for logit models

Treatment definition	≥ 1 components complete	≥ 2 components complete	≥ 3 components complete	**≥ 4 components complete**	5 components complete
# In treatment group	6,111	5,145	3,504	**1,624**	453
	Odds Ratio (95% Confidence interval)				
M1. Unadjusted	1.03 (0.94- 1.13)	1.00 (0.91-1.09)	0.97 (0.89-1.07)	**0.94 (0.83-1.06)**	1.06 (0.85-1.31)
M2. Risk Adjusted[1]	1.02 (0.93-1.12)	0.99 (0.91-1.08)	0.96 (0.88-1.06)	**0.92 (0.81-1.04)**	1.04 (0.84-1.29)
M3. Fully adjusted[2]	1.01 (0.93-1.11)	0.97 (0.89-1.07)	0.94 (0.86-1.04)	**0.90 (0.80- 1.02)**	1.02 (0.82-1.26)

1. Risk adjusted models includes 21 CMS risk adjustment variables, age and whether or not discharge was from a surgical unit
2. Fully adjusted models include all the risk adjustment variables from model two plus indicators for gender, race, risk and insurance status
3. Bold indicates preferred model based on *a priori* outcome specification

Table 4.4 Average marginal effects of the Care Transitions Program on readmission

	M1. Unadjusted	M2. Risk Adjusted	M3. Fully adjusted
Average marginal effect of CTP (≥ 4 components complete)	-0.013	-0.016	-0.019
95% Confidence Interval	(-0.037, 0.011)	(-0.040, 0.0084)	(-0.043, 0.0043)

1. Risk adjusted models includes 21 CMS risk adjustment variables, age and whether or not discharge was from a surgical unit
2. Fully adjusted models include all the risk adjustment variables from model two plus indicators for gender, race, risk and insurance status
3. Confidence intervals were constructed using bootstrapped standard errors

CHAPTER 5. UNPACKING PROVIDER ROLES IN COMPUTER-BASED TRANSITIONAL CARE CHECKLISTS: WHAT COMPONENTS MATTER MOST?

Overview

Background: Reducing hospital readmissions are a national priority, but the role of different provider components of the transitional care process remains unclear.

Objectives: We evaluated the effect of 5 components organized by provider role of a computer-based transitional care checklist on unplanned all-cause 30-day hospital readmissions.

Research design: We conducted a retrospective cohort analysis of patients discharged from University of North Carolina (UNC) Hospitals. The independent variables were 5 components of a pre-discharge checklist organized by provider role: case managers, medication transition specialists, pharmacists, discharging physicians, and bedside nurses. We used a logistic regression approach, harnessing the natural variation in the program implementation to determine different component effectiveness: specifically, comparing individual with partial checklist to each other.

Subjects: Patients discharged from UNC Hospitals between July 2014 and September 2015 who were at high or moderate risk for readmission based on number of admissions in the past year, chronic conditions, and medications.

Results: Our sample included 10,083 eligible discharges with a 25.9% readmission rate. We found a not statistically significant but protective effect of most providers' checklist components on readmission risk. Odds ratio ranged from 0.87 for the discharging physician component (95% CI=0.75-1.00) to 0.95 for the case management component (95% CI= 0.83-1.09). We did not see evidence that individual components worked better when completed in tandem with each other. We predicted having all the components complete would produce a 5- 8percentage point decrease in readmission.

Conclusions: There was a modest but not statistically significant effect of most provider checklist components on readmission risk. To the extent that these results were due to wide confidence intervals around point estimates, there may be reason to be optimistic about computer-based transitional care checklists.

Introduction

The Affordable Care Act (ACA) has brought increased attention to hospital readmissions as an indicator of quality of care. Readmissions are the focus of the Hospital Readmission Reduction Program (HRRP), which penalizes hospitals with excess readmissions for a growing number of high-volume, high cost conditions,[3] but also serve as performance metrics for many new models of care, such as accountable care organizations or bundled payment initiatives. Transitional care, often viewed as a panacea to reduce readmissions, has been bolstered by several ACA demonstrations projects and new billing codes that allow physician and other qualifying non-physician providers to deliver face-to-face and non-face-to-face services to high-risk patients as they transition from the hospital to their community setting.[6]

As a result, a proliferation of transitional care models has emerged: the Care Transitions model,[45] Project Reengineering Design (RED),[46] and the State of Action on Avoidable Rehospitalizations (STAAR) among others.[47,48] Some are developed broadly for at-risk patients, whereas others target specific patient populations, such as those with heart failure.[49] Though not all hospitals have formal or branded interventions in place, research suggests that nearly 90% of hospitals have at least a written objective of reducing readmissions for at-risk patients.[37] Perhaps as a result, national readmission begun to decline significantly starting in 2012.[3,50]

Despite current enthusiasm for transitional care, many gaps exist in our understanding of its effectiveness and optimal design. Research to date is limited by small sample sizes and a narrow focus on specific diseases, payers, or populations.[8,51] We are evaluating the effects of the components of a hospital-based transition checklist program in a broad group of patients at moderate or high risk of readmission.

Methods

Setting. This study was conducted at University of North Carolina (UNC) Hospitals. UNC is a large public academic medical center. UNC admits more than 37,000 patients a year, and its 30-day unplanned readmission rate is 16.6% on the Medicare Hospital Compare website for the current reporting period (7/1/13-6/30/14), which is "worse than the national rate" of 15.2% (www.Medicare.gov/Hospitalcompare/). In addition this study includes outcome data from two of UNC Hospital's affiliates, REX Healthcare and Chatham Hospitals. REX is a 660-bed not-for-profit private acute care facility located approximately 25 miles from UNC, and Chatham Hospital is a 25-bed community hospital located approximately 30 miles from UNC. All three are part of the UNC Health Care System and share a common electronic medical record (EMR).

Care Transitions Program (CTP). In the fall of 2013, UNC Hospitals launched the CTP in their medicine, heart and vascular, and surgery service units. CTP was modeled after the Institute for Healthcare Improvement's strategy to reduce unnecessary readmissions.[14] A leadership team developed a checklist of services that were to be completed prior to patient discharge. CTP was organized into five components according to provider roles: (1) needs assessment by case managers, (2) medication history by medication transition specialists (pharmacy technicians), (3) medication reconciliation and counseling by pharmacists, (4) communication to outpatient provider by physicians, and (5) self-care education using teach-back and scheduling of timely follow up by bedside nurses (Table 5.1). CTP was implemented without adding staff, though many staff roles were repurposed from previous quality improvement initiatives.

CTP targeted all moderate and high-risk patients identified with an algorithm based on the number of admissions in the past year, chronic conditions, and medications. Specifically, high risk was defined as either 1) $\geq$ 3 inpatient admissions in the past year, OR 2) $\geq$ 3 chronic conditions and $\geq$ 10 medications. Moderate risk patients were those who were not high risk and had either 1) $\geq$2 inpatient admissions in the past year OR 2) $\geq$ 2 chronic conditions. It was estimated that the algorithm would identify approximately 40 discharges a day with a 20-30% readmission risk respectively.

Data sources. Data came from the Carolina Data Warehouse (CDW), a central repository containing EMR and administrative data for UNC, REX, and Chatham Hospitals. In addition, CDW merged data from State vital statistics to provide records on patient death.

Study Sample. Patient discharges were included if they met criteria for the CTP: (1) $\geq$18 years, (2) discharged from a medicine, heart and vascular, or surgical unit at UNC Hospitals, and

(3) moderate or high-risk for readmission. We restricted the sample to patients admitted on or after July 1, 2014 and discharged on or before September 30, 2015. Our initial dataset included 11,966 discharges. Based on criteria developed by the Yale New Haven Health Service Corporation/ Center for Outcomes Research & Evaluation for CMS (Yale/CMS), we excluded discharges that: (1) had an admission for rehabilitation condition (n=480), (2) were admitted for a condition with high-competing mortality risk in the post-discharge period (n=1,103), (3) died during the hospitalization (n=99), (4) were transferred to another acute care facility (n=125) or (5) were discharged against medical advice (n=48).[20] In addition, we excluded discharges for patients who lived > 150 miles from UNC Hospitals as they are more likely to be readmitted to hospital other than those in our study (n=376) (Figure 5.1).

Key variables and measures. The primary outcome was unplanned all-cause 30-day readmission, defined as an admission to UNC, REX, or Chatham Hospitals within 30 days after discharge from an eligible index admission. Consistent with the Yale/CMS measure, we excluded planned readmissions, defined as those for maintenance chemotherapy or for any of 32 procedures that are typically planned and not coded for an acute diagnoses or complications of care.[20,21]

Our primary exposure was completion of CTP provider components. For each component, we considered it complete if all the items under it were complete (e.g. the pharmacist indicated they had completed: an admission medication reconciliation, a discharge medication reconciliation, medication counseling with the patient, and a handoff transitions note) (Table 5.1). Among patients with a checklist, most providers electronically signed their name to signify completeness; however, some used free text. Providers were allowed to indicate not applicable (NA) at their discretion; we considered items marked as NA to be complete. If, however, no

checklist was started, or a provider left an item blank, the item was considered incomplete. Because checklist were integrated into the patients EMR, two or more providers could access the checklist at the same time, and checklists were not necessarily completed in order.

Risk adjustment. Following the Yale/CMS recommendation and consistent with previous CMS risk-standardization strategies, we used the CMS Hierarchical Condition Categories Model (CMS-HCCs) to group ICD-9 codes into risk adjustment variables that are clinically coherent and carry similar risks (e.g. severe infection, diabetes and end stage renal disease). CMC-HCCs were constructed using ICD codes related to the final discharge condition of the index admission, our final list include 21 risk variables (Appendix 3). We also included age and whether or not the service line was surgical.

Statistical analysis. We compared CTP exposure and clinical and demographic characteristics of discharges in our sample by readmission using t-tests for continuous variables and chi-squared statistics for categorical variables.

Due to variation in program implementation, many patients had partial checklists during our study period. We were concerned that selection bias might be a concern. Specifically that unobserved patient factors (e.g. patient frailty) might be related to delivery of CTP components and readmission risk. Previously analyses of this data proposed an instrumental variable (IV) approach to correct for endogeneity of the treatment variable, but found that an IV approach was not necessary and results were the same across two stage residual inclusion and logistic regression models. In other words, CTP delivery was idiosyncratic with respect to unobservable patient risk factors. This finding was bolstered by qualitative interviews, which suggested time and available resource were key drivers of implementation, as opposed to patient need or patient risk. Thus we used a logistic regression approach, harnessing the natural variation in the program

implementation to determine different component effectiveness: specifically, comparing individual with partial checklist to each other.

While there are multiple factors related to risk of readmission,[25,26] our approach was designed to emulate CMS work in this area.[20] We ran 3 models: (1) an unadjusted model, with indicator variables for individual CTP provider components (case management, medication transition specialist, pharmacist, bedside nurse, and discharging clinician) plus a control for the number of components initiated; (2) a risk adjusted model which included the 21 risk variables, age and whether or not the discharge was from a surgical unit; and (3) a fully adjusted model that includes covariates from model 2 plus indicators for race (white, black, other/ unknown), gender, insurance status (private, Medicaid, Medicare, other public, and no coverage/unknown) and whether or not the patient was classified as high or moderate risk. We did not adjust for patients' admission source or discharge disposition because these factors are associated with structure of the health care system, and may reflect the quality of care delivered. We calculated odds ratios (OR) for readmission and 95% confidence intervals (CI), as well as average marginal effects with bootstrapped standard errors.

Next, we examined whether there were synergies between related components. Specifically, because the first pharmacist item (Admission medications list reconciled using medication history; issues discussed with medical team) depends in part on the medication transition specialist completing the medication history, we wanted to see if the effect of the Pharmacist component varied by Medication Transition Specialist component completion. Similarly because the Bedside Nurse component required the teaching strategies outlined by the discharging clinician, we examined whether the effect of the Bedside Nurse component varied by the Discharge Physician component completion. We hypothesized that components would be

more effective when delivered in tandem, than if provided individually. We calculated an average marginal effect for each component with and without the other one, and determined whether the two predictions were statistically different from one another.

Finally, we calculated predicted probabilities (PP) for representative patient discharges in our sample using the method of recycled predictions. To do so, we ran our risk adjusted model with high risk- interacted with individual components. We calculated predicted probabilities for four relevant discharge categories –those that were labeled high risk and were set to receive all or none of the intervention components, and those that were labeled moderate risk and were set to receive all or none of the intervention components. We bootstrapped standard errors to produce confidence intervals. All analyses were performed in Stata 14 (College Station, TX).

Results

Our sample included 10,083 eligible hospital discharges among 6,094 patients. The overall unadjusted unplanned all-cause 30-day readmission rate was 25.9%. The average components completed ranged from 18.9% for the Discharging Physician component to 49.6% for the Case Management component. There was no significant relationship between individual components being complete and whether or not the discharge resulted in a readmission (Table 5.2).

In our primary risk –adjusted models, none of the provider components were statistically significant, though most of the provider components were protective against readmissions. Specifically, point estimates were less than one but confidence intervals were large: i.e., Case Management component (OR = 0.95; 95% CI = 0.83-1.11), the Pharmacist component (OR = 0.92; 95% CI = 0.82- 1.05), the Discharging Physician component (OR = 0.87; 95% CI = 0.75-1.00) and the Bedside Nurse component (OR = 0.92; 95% CI = 0.82- 1.05) (Table 5.3).

Presented another way, the average marginal effect of the components ranged from a 2.6 percentage point decrease in readmissions for the Discharging Physician component to an ~1.0 percentage point reduction for the Case Management component (Table5. 4). The point estimate for the Medication Transition Specialist component was non statistically significant but greater than one (OR = 1.05; 95% CI = 0.93-1.19: OR = 1.04; 95% CI =0.99-1.10).

The inclusion of additional covariates in our fully adjusted model (i.e., race, gender, insurance and risk status) did not substantially impact estimates, though the OR for the Discharging Physician component did cross the threshold for statistical significance at the p =0.05 level (OR = 0.86; 95% CI = 0.74-0.99) (Table 5.3). Its clinical interpretation remained the same. We did not see evidence that the effect of the pharmacist component varied by participation by the medication transition specialist (p=0.94). Similarly we did not see evidence that the effect of the Bedside Nurse component varied by the Discharge Clinician component completion (p = 0.63) (results not shown).

Finally, using the method of recycled predictions we estimated that being high risk and having the complete set of intervention components was associated with an 8 percentage point decrease in readmission for high risk patients (PP = 0.34; 95% CI 0.31-0.37 versus 0.26; 95% CI 0.21- 0.31). The effect was similar, but slightly smaller for moderate risk discharges. Specifically having the complete set of intervention components was associated with 5-percentage point decrease in predicted probability of being readmitted for moderate risk patients though as before confidence intervals were overlapping (PP=0.23; CI =0.20- 0.25 versus PP= 0.18 95% CI =0.14-0.22) (Figure 5.2).

Discussion

Given the increasing incentives to reduce 30-day hospital readmissions, many health care systems have implemented transitional care programs. We evaluated one such program: a multi-component, computer-based checklist to reduce readmissions. We found that four of the five components (case management, pharmacists, discharging clinicians and bedside nurse) were associated with a non statistically significant but protective reduction in readmissions. We found no evidence that the components were more effective when provided together, than provided separately. Finally, we predicted high-risk discharges that received the complete set of components could have an approximately 8-percentage point decrease in readmissions. These results, while lacking the strength of statistical significance, give us some reason to be optimistic about computer-based transitional care checklists.

One explanation for study's large confidence intervals is the variable implementation of checklist components. Where as for some providers a "check" might indicate a high-level of intervention, others might indicate much more limited intensity. For example, one pharmacist item entailed a handoff transitions note; however, the quality or the notes was not measured, and likely uneven. Furthermore, many providers indicated "NA" for items. There are many reasons why provider discretion was and should be encouraged; nonetheless it creates a challenge for evaluation. Understanding best practices for items that are especially prone to variable implementation is an important future step to ensure that these types of checklists achieve the best results.

Interestingly, the discharging physician component was the least likely to be completed, and had the biggest estimated effect on reducing readmissions. This finding is supported by a large evidence base showing that handoffs are a vulnerable time for patients and communication

with outpatient providers is a key aspect of the discharge process.[52–55] We know from interviews with providers, that physicians were skeptical about the effectiveness of transitional care checklists. This is something that healthcare systems can take back to their physicians to underscore the importance of their participation.

Contrary to our hypothesis, we did not find any evidence that components were more effective when provided together. While the checklist is designed to increase communication and collaboration across provider roles, it is equally possible that the checklist is primarily being filled out in an assembly – line like manner, with providers doing their individual parts without referring back to other provider contributions. Also it is possible some roles are duplicative as opposed to synergistic. This is an important role for future research.

There are several limitations to this study. First, while previously analyses indicated selection was not introducing biased estimates, we are limited in what we can conclude given the non-random nature of the study design. Nonetheless, we would expect the results to be biased toward the null if the CTP were effective but given disproportionately to patients with a higher underlying risk. We attempted to minimize any potential bias by restricting our selection criteria and controlling for key covariates in our models. In addition we may have some problems with the quality of the data. In addition, readmissions in this study were limited to those within the UNC system, however internal research suggests that more than 80% of readmissions are captured by this measure. Finally, this study period captures a period of transition for UNC hospital. Implementation rates for the CTP dropped after its transition to the electronic version, and have steadily increased after the adoption of a new EMR. Finally our primary exposure relied on documentation of services that may or may not have occurred. For these and other reasons findings of this study may not be generalizable to other institutions.

Figures and Tables

Figure 5.1 Sample construction

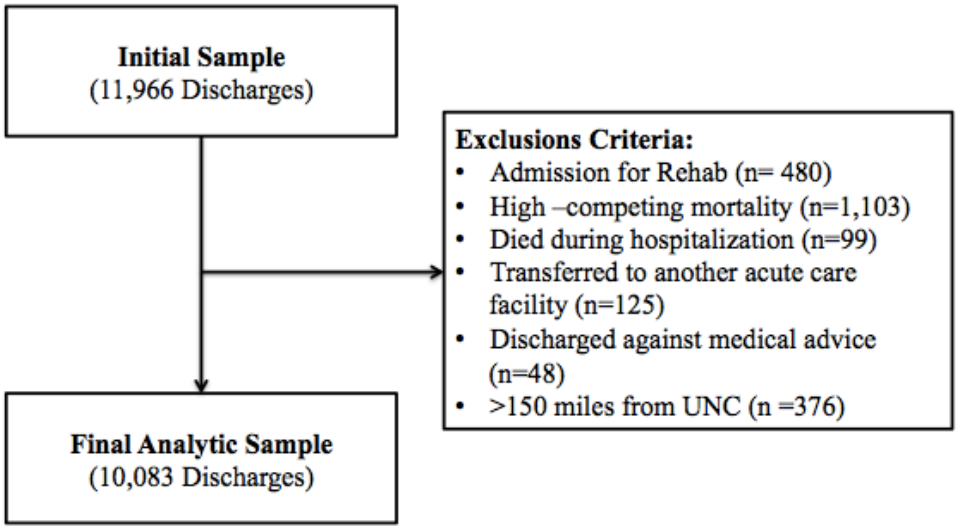
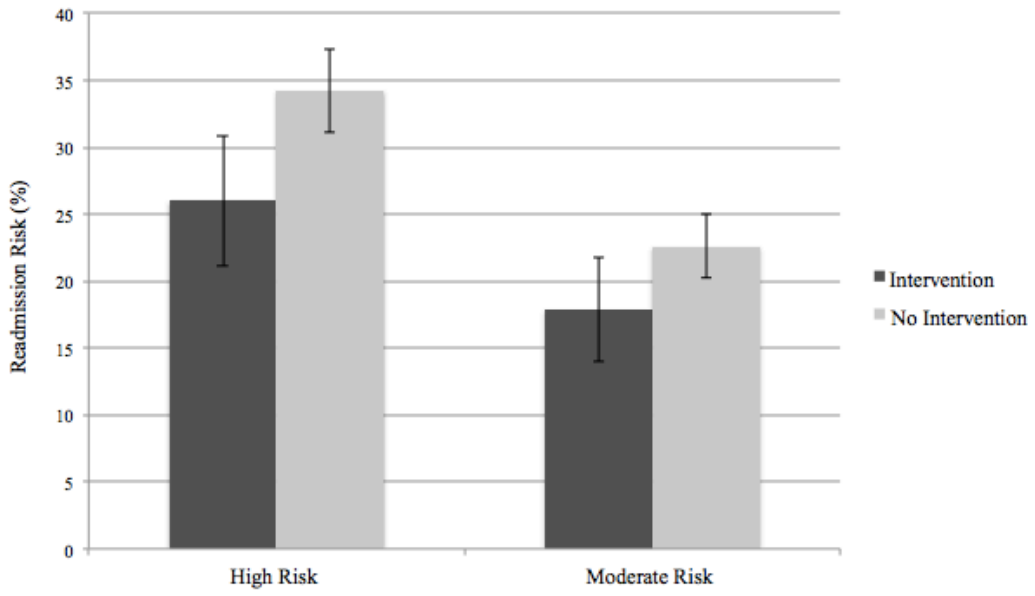


Figure 5.2 Predicted probability of readmission by risk and intervention status



1. Predicted probabilities are calculated using the method of recycled predictions
2. The high risk group includes 4,540 discharges, the moderate risk group includes 5,543 discharges
3. Confidence intervals were constructed using bootstrapped standard errors

Table 5.1 CTP roles and responsibilities by provider type

Case Manager Checklist Responsibilities:

- Comprehensive assessment completed and post-acute care needs identified
- Complete handoff transitions note

Medication Transition Specialist (Pharmacy Technician) Checklist Responsibilities:

- Obtain medication history, contact home pharmacy, and update meds list; review with team pharmacist

Pharmacist Checklist Responsibilities:

- Admission medications list reconciled using medication history; issues discussed with medical team
- Discharge medications list reconciled, medical team notified
- Medication counseling/ teach back used with patient/ caregiver(s)
- Place notes/ concerns/ monitoring in handoff transitions note

Discharging Clinician Checklist Responsibilities:

- Notify service pharmacist when medication list is ready for discharge reconciliation
- Inpatient MD to outpatient MD communication completed (electronic, phone, or in person)

Bedside Nurse Checklist Responsibilities:

- Teach back used for red flags
- Discharge instructions reviewed with patient/ caregiver(s)
- Scheduled follow up appointment at bedside with patient / caregiver(s) within 7 -14 days of discharge from hospital
- Purposeful pause huddle to ensure patient readiness for discharge

Table 5.2 Discharge characteristics, overall and by readmission status

Variable	Overall Sample N = 10,083	Not Readmitted N = 7,468	Readmitted N = 2,615	*P*
	Mean (sd) or N (%)			
Unique patients	6,094	5,676	1,645	
Outcome				
30 – day readmission	2,615 (25.9%)			
Independent Variables				
Case Management Component Complete	4,705 (46.7%)	3,484 (46.7%)	1,221 (46.7%)	0.97
Medication Transition Specialist Component Complete	3,624 (35.9%)	2,659 (35.6%)	965 (36.9%)	0.23
Pharmacist Component Complete	3,851 (38.2%)	2,863 (38.3%)	988 (37.8%)	0.62
Discharging Physician Complete	1,760 (17.5%)	1,317 (17.6%)	443 (16.6%)	0.42
Bedside nurse Component Complete	2,897 (28.7%)	2,161 (28.9%)	736 (28.2%)	0.44
Risk Covariates				
Number of CMS- HCC risk variables	1.60 (1.22)	1.54 (1.20)	1.77(1.24)	<0.0001
Age	56.54 (17.67)	56.69 (17.68)	56.08 (17.63)	0.12
Service Line– Surgical	3,088 (30.6%)	2,327 (31.2%)	761 (29.1%)	0.049
Risk Group				
High	4,540 (45.0%)	3,103 (41.6%)	1,437 (55.0%)	<0.0001
Additional Covariates				
Sex – Female	5,080 (50.4%)	3,778 (50.6%)	1,302 (49.8%)	0.43
Race – White	5,863 (58.2%)	4,383 (58.7%)	1,480 (56.6%)	0.06
Race – Black	3,181 (31.6%)	2,285 (30.6%)	896 (34.3%)	<0.001
Race – Other/ Unknown	1,039 (10.3%)	800 (10.7%)	239 (9.1%)	0.03
Payer – Private	1,811 (18.0%)	1,384 (18.5%)	427 (16.3%)	0.01
Payer – Medicaid	2,547 (25.3%)	1,800 (24.1%)	747 (28.6%)	<0.0001
Payer – Medicare	5,801 (57.5%)	4,253 (56.9%)	1,548 (59.3%)	0.04
Payer – Other public	378 (3.8%)	295 (4.0%)	83 (3.2%)	0.07
Payer – No coverage/ none listed	302 (3.0%)	257 (3.4%)	45 (1.7%)	<0.0001

Table 5.3 Odds of readmission for main CTP components

	Case Management	Medication Transition Specialist	Pharmacist	Discharging Physician	Bedside Nurse
	Odds Ratio (95% Confidence Interval)				
M1. Unadjusted	0.93 (0.82-1.06)	1.06 (0.94-1.20)	0.92 (0.81-1.04)	0.91 (079-1.04)	0.91 (0.80-1.02)
M2. Risk Adjusted[1]	0.95 (0.83-1.09)	1.05 (0.93-1.19)	0.92 (0.81-1.04)	0.87 (0.75-1.00)	0.92 (0.82-1.03)
M3. Fully adjusted[2]	0.95 (0.83-1.08)	1.03 (0.91-1.17)	0.91 (0.80-1.04)	0.86 (0.74-0.99)	0.91 (0.80-1.03)

1. Risk adjusted models includes 21 standard CMS risk variables, age and whether or not discharge was from a surgical unit
2. Fully adjusted models include all the risk adjustment variables from model 2 plus indicators for gender, race, risk and insurance status

Table 5.4 Average marginal effects of CTP components on readmission

	Average Marginal Effect	95% Confidence Intervals
Case Management	-0.0089	-0.035, 0.017
Medication Transition Specialist	0.0094	-0.013, 0.033
Pharmacist	-0.016	-0.039, 0.0068
Discharging Physician	-0.026	-0.054, 0.0015
Bedside Nurse	-0.017	-0.039, 0.0052

1. Average marginal effects were calculated for risk adjusted model which includes 21 standard CMS risk adjustment variables, age and whether or not discharge was from a surgical unit
2. Confidence intervals were constructed using bootstrapped standard errors

CHAPTER 6. CONCLUSIONS

We examined how a computer-based transitional care checklist initiative delivered as part of discharge planning affects unplanned all-cause 30-day readmissions. We also conducted interviews with frontline providers who completed the checklist to understand facilitators and barriers to the checklist's implementation and effective use. In general, and across model specifications, we found that the checklist reduced readmissions approximately 1-3 percentage points as currently implemented; however, our findings suggest that transitional care checklist *could* reduce readmissions approximately 5-8 percentage points if implemented with a high-degree of fidelity. If achieved, such a reduction would exceed UNC Healthcare's goal of a 5% relative reduction in readmissions. The qualitative interviews demonstrated program strengths, but also challenges, to more fully implementing the checklist into a team-based discharge planning process. Notably, our study was conducted in a large healthcare system that seeks to deal with the rapid change in the structure and incentives around health care delivery. Such research is critical because what is effective in randomized trials does not always work in real world practices.[16] It is imperative that healthcare systems use their own environment as "laboratories for quality improvement" when implementing and evaluating new initiatives.

Reducing readmissions. Ultimately, the CTP checklist was not a magic bullet to prevent readmissions (not that we thought it would be). Some of the necessary interventions to prevent readmissions might be beyond the scope of a checklist. For example, at least one systematic review found only programs that included a home visit by a nurse had evidence of effectiveness.[7]

Also better linkages to outpatient providers and more community based resources and services available in the patients home may be needed for especially high-risk patients.[6,7] Still, given our findings and the goals of UNC Hospitals, a checklist may be a reasonable strategy and bolstering implementation an appropriate next step.

CTP implementation. This work highlights the implementation challenges for UNC Hospitals. CTP was rolled out in approximately 28 nursing units to improve discharge care for 40 discharges per day. With more than 200 staff members involved in providing transitional care, it comes as no surprise that implementation was an onerous task. Fewer than 5% of discharges completed all 5 possible components, and another 11.6 % completed 4 components. Among provider components, completion rates ranged from 17.5% for the Discharging Physician component to 46.7% for the Case Management component. While some of these low completion rates can be attributed to the rollout of a new electronic medical record (EMR), qualitative interviews demonstrated the challenges of requesting additional tasks in an already resource-constrained and busy work environment. Although, providers wanted the best for their patients, not everyone shared the belief that the Care Transitions Program (CTP) was a good investment of his or her time. Providers had to weigh spending time on CTP against spending time on other patient care activities. Physicians, in particular, may have resisted checklists because they do not believe that what is required for their patients can be reduced to a series of checkboxes.[56] This is critical because many non-physicians viewed physician participation as a sign that the initiative was valued. Because CTP is team-based, morale disintegrated when team members were not evenly committed to implementation of the program.

Bolstering implementation is a complex task. Across provider types, team members sought organizational cues that CTP was a priority across units and that sufficient resources were

being allocated to its delivery and effective use. We found that providers valued systematic and timely feedback, including measures they considered important (often outcome measures). Providers were eager to see evidence that CTP was achieving positive results. Having mid -level managers,[33] provider champions,[9] and/or transitions team-leads (possibly nurses)[13] communicate the rationale and successes of CTP could reinforce its value for frontline staff.[34] This may be best accomplished in interprofessional settings.[57–59]

Checklists. What makes an effective checklist? Within the healthcare system, surgical teams have shown the more beneficial effects of checklist. For example, a checklists virtually eradicated central line infections in the intensive care unit at Johns Hopkins Hospital.[38,40] This 5-point checklist specified that doctors should: wash hands with soap; clean the patient's skin with antiseptic; cover the patient's body with sterile drapes; wear a mask, hat, sterile gown and gloves; and put a sterile dressing over the insertion site.

There are notable differences between the central line infection checklist and CTP. The central line infection checklist concerns a specified time period, location, and series of tasks. Compare that to the CTP checklist, which is completed throughout the patients' hospital stay and engages a diverse set of providers who may not have historically interacted with each other. In addition, the process of preventing central line infections is much better understood, applies to all patients, and has clear metrics. Compare that to preventing readmissions, where the outcome occurs up to 30 days later and the factors contributing to it often occur outside of the hospital.[26,60]

These differences do not mean checklists in the discharge process cannot be useful. In fact, these checklists have more in common then what may appear on the surface. In *The Checklist Manifesto*, Gawande distinguishes between errors of ignorance (mistakes we make because we don't know enough) and errors of ineptitude (mistakes we make because we don't

make proper use of what we know).[38] Failures in surgical rooms and in transitional care are usually the latter and occur because something is missed. In complex processes, like a discharge process, it's easy for a medication not to be reconciled or a discharge instruction not to be reviewed. Most importantly, both checklists are ultimately about getting healthcare teams on the same page about what is expected in a given encounter. While moving towards team-based care and focusing on outcomes that occur outside the hospital are large and sometimes abstruse challenges, work in this area is clearly the focus of twenty-first century healthcare.[6]

Qualitative interviews illuminated some of the challenges CTP faced because responsibilities included "nontraditional" checklist items. Specifically, checklist items did not necessarily map to a specific course of action. Unlike the surgical checklist item, "wash hands with soap," CTP items were sometimes vague, for example, the nurse should have a "purposeful pause." What does this item mean? What does it entail? One nurse manger shared:

> *"People have to have something solid that matches what you're asking them to check off… if the case manager doesn't understand that it's her job to get a wheelchair, or the nurse doesn't understand that it's her job to see that the patient understands what their diagnosis is, what their medications are... If they don't understand or can some way quantify that that work has been done, then checking the box doesn't … make a better transitions process."*

There are many reasons why checklist items lacked specification; the checklist was hospital-wide and it covered teams and patients that varied tremendously. While understandable, this presented some challenges for implementation.

In the Consolidated Framework for Implementation Research, interventions are described as having two parts: 'core components' that are indispensable to the program and an 'adaptable periphery' that can be tailored to local settings.[16] We found that units often tailored CTP to match their existing workflows with little guidance, which contributed to ambiguous expectations and a lack of understanding about how the program differed from usual discharge

care. To address this, it may be useful to develop tools to standardize processes, especially those that involve hand-offs between providers (e.g., documented workflows). Such clarification around program adaptability may help with implementation and effectiveness.[35]

Culture. Programs to improve quality must address culture, especially in the rapidly changing landscape in health care. This was highlighted by qualitative interviews that reported some teams developed a "culture" around the checklist that highlighted its importance, while others viewed them as principally paperwork. To change culture, it would be useful to define and learn from high versus low-performing teams. However, this was a challenge because team compositions often changed. Most care team members (i.e., case managers, medication transition specialist, pharmacists, and physicians) were assigned to patients by service line (e.g. general medicine, cardiology, pulmonology). However, the bedside nurses were assigned based on acute care unit. Teams did not commonly work together for multiple patients. For example, the general medicine service might have patients located on 6 or 7 different units. Some pharmacists were assigned to more than one service or "float" to fill in where needed and residents rotated by service every few months. These challenges are not unique to CTP, but underscores why building a sense of team and culture of teamwork is formidable in academic medical centers. While this questions needs to be better understood, it seems likely, that poor culture and lack of teamness in CTP may at least partially explain why we didn't find synergies in program components.

Limitations. The study is limited by its single site and non-random sample. In our process evaluation, we were unable to match provider perspectives to high and low performing teams. In addition given the variety of interview content, we were not able to provide a count of what percent of interviews agreed or didn't agree with a sentiment. Our impact evaluation had

several methodological challenges as well. Specifically, while our instrumental variable specification tests suggested we could treat CTP exposure as an exogenous variable, it is possible our findings may be biased due to unobservable patient factors. We would expect the results to be biased toward the null if the CTP was effective but given disproportionately to patients with a higher underlying risk for readmission. In that case the effects could wash each other out. In addition, readmissions in this study were limited to those within the UNC system; however, internal research suggests that more than 80% of readmissions are captured by this measure. Finally our primary exposure relied on documentation of services that may or may not have occurred. For these and other reasons findings of this study may not be generalizable to other institutions.

Future directions. Future research on computer based transitional care checklists should better understand how checklist items and specific features of checklist delivery (e.g. how its integrated into the EMR, when providers access it) alter program effectiveness. In addition, we need to learn more about how to build team culture around the discharge process in dynamic groups. Also we need to develop additional strategies for the highest risk patients, particularly those with mental health challenges or who are homeless. Readmissions as a quality measure have been criticized. Opponents argue that readmissions are associated with patient frailty and progression of chronic disease more than they indicate hospital quality.[27] Nonetheless, it seems likely that CMS and others will move forward with 30-day readmissions as a quality measure. Safety- net hospitals are disproportionately impacted by the HRRP.[3] Thus, we need policy solutions that balance incentives to prompt system change with measures to ensure access and resources for vulnerable populations.[61] These might include: ensuring that broader delivery system improvements (e.g. patient-centered medical homes) include or coordinate with safety-

net hospitals; and a more careful consideration about the role of socioeconomic risk factors in payments tied to quality.[62]

APPENDIX 1: STUDY SAMPLE EXCLUSION CRITERIA

Category	DX CCS Codes
Admissions for "rehabilitation care; fitting of prostheses and adjustment devices"	254
Admissions wth a high competing mortality risk condition category	
Malignant neoplasm without specification of site	43
*Melanomas of skin**	22
*Cancer of breast**	24
*Cancer of colon**	14
*Cancer of liver and intrahepatic bile duct**	16
*Cancer of pancreas**	17
*Secondary Malignancies**	42
*Cancer of bronchus, lung**	19
*Cancer of other male genital organs**	31
*Cancer; other and unspecified primary**	41
*Fracture of neck of femur (hip)**	226
*Cancer of ovary**	27

1. Condition categories with an asterisk (*) met these criteria only for the cancer and medicine cohorts (admissions in the surgical cohort with these conditions were not excluded)
2. Adapted from Horowitz et al. 2011

APPENDIX 2.1: READMISSION EXCLUSION CRITERIA: PLANNED PROCEDURE LIST

Procedure	Procedure CCS Codes
Percutaneous transluminal coronary angioplasty (PTCA)	45
Cholecystectomy and common duct exploration	84
Maintenance chemotherapy	DX CCS Code 45
Amputation of lower extremity	157
Endarterectomy; vessel of head and neck	51
Colorectal resection	78
Coronary artery bypass graft (CABG)	44
Arthroplasty knee	152
Transurethral resection of prostate (TURP)	113
Hip replacement; total and partial	153
Therapeutic radiology for cancer treatment	211
Spinal fusion	158
Insertion; revision; replacement; removal of cardiac pacemaker or cardioverter/defibrillator	48
Laminectomy; excision intervertebral disc	3
Lobectomy or pneumonectomy	36
Peripheral vascular bypass	55
Heart valve procedures	43
Aortic resection; replacement or anastomosis	52
Nephrectomy; partial or complete	104
Embolectomy and endarterectomy of lower limbs	60
Inguinal and femoral hernia repair	85
Hysterectomy; abdominal and vaginal	124
Mastectomy	167
Arthroplasty other than hip or knee	154
Gastrectomy; partial and total	74
Open prostatectomy	114
Oophorectomy; unilateral and bilateral	119
Thyroidectomy; partial or complete	10
Bone marrow transplant	64
Lumpectomy; quadrantectomy of breast	166
Kidney transplant	105
Other organ transplantation	176
Electroshock therapy	ICD-9 94.26, 94.27

1. Readmission are excluded if they are in Appendix 2.1 but not 2.2 (for an acute diagnoses or complications of care)
2. Adapted from Horowitz et al. 2011

APPENDIX 2.2 DISCHARGE CONDITIONS THAT ARE FOR AN ACUTE DIAGNOSIS OR COMPLICATION OF CARE

Discharge Condition	**AHRQ Condition CC**
Acute myocardial infarction	100
Complication of device; implant or graft	237
Cardiac dysrhythmias	106
Congestive heart failure; no hypertensive	108
Conduction disorders	105
Diverticulosis and diverticulitis	146
Septicemia (except in labor)	2
Complications of surgical procedures or medical care	238
Aortic and peripheral arterial embolism or thrombosis	116
Fracture	(207, 225, 226, 227, 229, 230, 231, 232)
Intestinal obstruction without hernia	145
Infective arthritis and osteomyelitis (except that caused by TB or sexually transmitted disease)	201
Acute cerebrovascular disease	109
Peri-; endo-; and myocarditis; cardiomyopathy	97
Pneumonia (except that caused by TB or sexually transmitted disease)	122
Syncope	245
Chronic obstructive pulmonary disease and bronchiectasis	127
Respiratory failure; insufficiency; arrest (adult)	131
Fluid and electrolyte disorders	55
Urinary tract infections	159
Pleurisy; pneumothorax; pulmonary collapse	130
Acute and unspecified renal failure	157
Gastroduodenal ulcer (except hemorrhage)	139
Gastrointestinal hemorrhage	153
Calculus of urinary tract	160
Transient cerebral ischemia	112

1. Readmission are excluded if they are in Appendix 2.1 but not 2.2 (for an acute diagnoses or complications of care)
2. Adapted from Horowitz et al. 2011

APPENDIX 3: FINAL RISK ADJUSTMENT VARIABLES

Name	Label	CMS- CCs
rf1	**Severe infection**	**1,3-5**
	HIV/AIDS	1
	Central nervous system infection Tuberculosis	3
	Tuberculosis	4
	Opportunistic infections	5
rf3	**Metastatic cancer/acute leukemia**	**7**
rf4	**Severe cancer**	**8,9**
	Lung, upper digestive tract, and other severe cancers	8
	Other major cancers	9
rf6	**Other major cancers**	**10,11,12**
	Breast, prostate, colorectal and other cancers and tumors	10
	Other respiratory and heart neoplasms	11
	Other digestive and urinary neoplasms	12
rf9	**Diabetes mellitus**	**15,16,18-20,119, 120**
	Diabetes with renal manifestation	15
	Diabetes with neurologic or peripheral circulatory manifestation	16
	Diabetes with ophthalmologic manifestation	18
	Diabetes with no or unspecified complications	19
	Type 1 diabetes mellitus	20
	Proliferative diabetic retinopathy and vitreous hemorrhage	119
	Diabetic and other vascular retinopathies	120
rf10	**Protein-calorie malnutrition**	**21**
rf11	**End-Stage liver disease**	**25,26**
	End-Stage liver disease	25
	Cirrhosis of liver	26
rf12	**Other hematological disorders**	**44**
rf14	**Drug and alcohol disorders**	**51,52**
	Drug / alcohol dependence	52
	Drug/ alcohol psychosis	51
rf15	**Psychiatric comorbidity**	**54-56, 58, 60**
	Schizophrenia	54
	Major depressive, bipolar, and paranoid disorders	55
	Reactive and unspecified psychosis	56
	Depression	58
	Other psychiatric disorders	60
rf18	**Hemiplegia, paraplegia, paralysis, functional disability**	**67-69,100-102,177,178**
	Quadriplegia, other extensive paralysis	67
	Paraplegia	68
	Spinal cord disorders/ injuries	69

	Hemiplegia/ hemiparesis	100
	Diplegia(upper), monoplegia, and other paralytic syndromes	101
	Speech, language, cognitive, perceptual	102
	Amputation status, lower limb/ amputation	177
	Amputation status, upper limb	178
rf19	**Seizure disorder and convulsions**	**74**
rf21	**Coronary atherosclerosis or angina, cerebrovascular disease**	**83, 84, 89, 98, 99, 103**
	Angina pectoris/ old myocardial infarction	83
	Coronary atherosclerosis/ other chronic ischemic heart disease	84
	Hypertensive heart and renal disease or encephalopathy	89
	Cerebral atherosclerosis and aneurysm	98
	Cerebrovascular disease, unspecified	99
	Cerebrovascular disease late effects, unspecified	103
rf24	**Specified arrhythmias**	**92,93**
	Specified hearth arrhythmias	92
	Other heart rhythm and conduction disorders	93
rf26	**Chronic obstructive pulmonary disease**	**108**
rf27	**Fibrosis of lung or other chronic lung disorders**	**109**
rf30	**Ulcers**	**149**
rf40	**Pancreatic disease**	**32**
rf41	**Rheumatoid arthritis and inflammatory connective tissue disease**	**38**
rf42	**Respirator dependence/ tracheostomy status**	**77**
rf43	**Transplants**	**128,174**
	Kidney Transplant status	128
	Major organ transplant status	174
rf44	**Coagulation defects and other specified hematological disorders**	**46**
rf45	**Hip fracture / dislocation**	**158**

1. There were no fibrosis of lung or other chronic lung disorders (CCs 109) or coagulation defects and other specified hematological disorders (CCs 46) in the sample
2. Adapted from Horowitz et al. 2011

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