Bridging the Discharge Gap Effectively (BRIDGE):

A Novel Approach to Transitional Care for Patients with Acute Coronary Syndrome

by

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BRIDGE

BRIDGING THE DISCHARGE GAP EFFECTIVELY

DEDICATION

I dedicate this dissertation first to my family. Without the love and support of my husband and the patience of my children, this would not have been possible. I also dedicate this to all of the healthcare professionals who cared for me during my events.

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I would like to acknowledge and thank all of the members of my doctoral committee for their support, encouragement, understanding and thoughtful input during my countless revisions. Each member has made unique contributions so much to the success of this project. Dr. Brush, always my champion, has challenged me to be a better writer. Dr. Pressler, an expert in cardiovascular nursing, has strengthened my methodologies. Dr. Eagle, the renowned cardiovascular expert with the vision for the BRIDGE Program, has offered me every resource he has at his disposal. Last, but not least, Dr. Wheeler, my expert in health care policy and finance, has lead me through the maze of understanding and completing cost analyses. Without each of these members and their collective talents, this project would not be complete or as rich.

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LIST OF ABBREVIATIONS

ACC	American College of Cardiology
ACE-inhibitors	Angiotensin Converting Enzyme Inhibitor
ACS	Acute Coronary Syndrome (Unstable Angina and Acute Myocardial Infarction)
AHA	American Heart Association
AHRQ	Agency for Healthcare Research and Quality
AMI	Acute Myocardial Infarction
ARB	Angiotensin Receptor Blocker
β-blockers	Beta-Adrenergic Blocking Agents
BRIDGE	Bridging the Discharge Gap Effectively
CCI	Charlson Comorbidity Index
CHD	Coronary Heart Disease
CVD	Cardiovascular Disease
GRACE	Global Registry for Acute Coronary Event
IMB	Information-Motivation-Behavioral Skills Model
MCORRP	Michigan Cardiovascular Outcomes Research and Reporting Program
MEDPAR	Medicare Provider Analysis and Review
NP	Nurse Practitioner
Statin	HMG-CoA reductase inhibitor
USA	Unstable Angina

ABSTRACT

Bridging the Discharge Gap Effectively (BRIDGE):

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Background: Bridging the Discharge Gap Effectively (BRIDGE) is a program that aims to provide patients with cardiovascular disease quality evidence-based care through their hospital-to-home transition. The BRIDGE nurse practitioners assess patients' clinical status, make adjustments in their therapeutic regimens as needed, educate patients and families about health promotive activities and refer when necessary. This study aimed to determine if the BRIDGE model was effective in improving six-month medication persistence rates (for secondary prevention medications), lowering 30-day hospital readmission rates, and reducing overall health care costs associated with readmission.

Methods: Data were collected retrospectively on all patients referred to the BRIDGE program. Medication persistence was analyzed using logistic regression, rates were calculated for hospital readmissions, and a cost model was developed to compare BRIDGE costs against avoided hospital readmission costs. All eligible patients referred to BRIDGE received an appointment within 14 days of discharge. Analyses compared attendees with non-attendees.
Results: Of 500 patients referred to the BRIDGE program, 74 were excluded due to early adverse events. Of those remaining, 25.2% (n=107) had a discharge diagnosis of acute coronary syndrome (ACS), and 72.2% (70) attended BRIDGE. The mean age of study participants was 62.4 years and the majority were female (59.8%) and white (85.6%). With the exception of dyslipidemia there were no baseline differences between groups.

Most patients were prescribed aspirin, β-blockers, ACE-inhibitors, statins, and clopidogrel at discharge (range 75.0% to 97.9%) and remained on therapy at six months (range 80.6% to 95.5%). There were no differences in persistence rates between groups. BRIDGE participants had lower readmission rates at 30 (9.7 vs. 27.8. p=.112), 60 (11.3 vs. 38.9, p=.012), 90 (16.1 vs. 38.9, p=.052), and 180 (27.4 vs. 50, p=0.72) days post-discharge. On average, the program saved $4,944 per-patient or $306,537 overall in avoided readmissions. **Conclusion:** Most ACS patients require early post-discharge follow-up. BRIDGE fulfills this need with demonstrated success in reducing 30-day readmissions at a cost value. The BRIDGE model is thus a novel and practical approach to addressing

transitional care and the vexing nation-wide problem of hospital readmissions for ACS patients.

CHAPTER I

INTRODUCTION

Nearly 20% of all patients discharged after an acute myocardial infarction (AMI) will have a rehospitalization within 30 days (Krumholz et al., 2009). Half of those rehospitalized patients will have had no contact with a healthcare provider since their discharge (Jencks, Williams, & Coleman, 2009). This rate of AMI readmissions exceeds the median rate for all disease readmissions in the United States (Jencks et al., 2009). Data from the Medicare Provider Analysis and Review (MEDPAR) database found that 34% of hospital discharged Medicare beneficiaries between 2003 and 2004 were rehospitalized within 60 days of discharge and 68.9% were either readmitted or dead within one year (Jencks et al., 2009; Krumholz et al., 2009). The cost of these unexpected readmissions exceeded 17 billion dollars in 2004 (Jencks et al., 2009; Krumholz et al., 2009), representing a significant burden for rising healthcare costs. In response to this trend, legislation has been proposed to reduce insurance reimbursement to hospitals for readmission services (Jencks et al., 2009).

Exactly what circumstances lead to readmissions following an AMI are unclear, although causal speculations include early discharge, insufficient discharge education, poor patient comprehension (Greenwald & Jack, 2009), a shortage of cardiologists (Fye, 2004), and lack of adherence to joint American

Heart Association/American College of Cardiology secondary prevention guidelines (Eagle, Kline-Rogers, et al., 2004; Mehta et al., 2002). Efforts to remedy these potential readmission contributors have looked at a variety of care models as possible mediators. The current focus is on the transitional phase of care between discharge and outpatient follow-up. These models have the potential to revolutionize our current care delivery system by elevating transitional care beyond conceptualization to an integral component in the continuum between acute and ambulatory care. Though most research in this area has focused on heart failure, a few studies have addressed acute coronary syndrome (ACS); the broader definition of coronary disease that includes AMI and unstable angina (see Appendix). To date however, no single intervention has been successful enough to be adopted by the greater healthcare industry (Jencks et al., 2009).

In 2007, the University of Michigan Health System (UMHS) responded to the problems identified in the hospital-to-home transition by developing the Bridging the Discharge Gap Effectively program (BRIDGE). The BRIDGE program was designed to provide seamless care to all patients discharged from the UMHS after experiencing an ACS event. The main goals of BRIDGE were aimed at promoting compliance with evidence based therapies, improving patient outcomes, and decreasing readmissions (Housholder & Norville, 2009). Now reaching its five-year anniversary, the BRIDGE program is poised to evaluate its efficacy in achieving its aims.

Gaps in the Literature

Although currently receiving much attention, transitional care models and their outcomes remain in an early stage of research development. A literature search of “transitional care” through MEDLINE and CINAHL 2006-2011, restricted to the English language and its care of individuals over 45 years of age, returned only 35 articles. After excluding articles that were not from the United States or related specifically to the hospital-to-home transition, 11 articles remained. Of these remaining articles, there was one randomized controlled trial, one cross-sectional study, one qualitative study, two literature reviews, two general articles, and four case studies. This type of distribution in the level of evidence is common in the early stages of concept development. Broadening the search criteria to span the last decade and including terms such as “discharge planning” and “care coordination,” returned a slightly larger number of studies and reviews, though not consistently specific to transitional care, and most reviews only cited a small number of studies including: Bodenheimer (2008), Brooten et al. (2002), Chiu and Newcomer (2007), Jacob and Poletick (2008), Naylor and Keating (2008), and Phillips et al. (2004).

Of the more broadened search for studies of transitional care, patients over 60 years of age were primarily targeted (Coleman, Parry, Chalmers, & Min, 2006; Naylor et al., 1994; Naylor et al., 1999; Phillips et al., 2004; Sinclair, Conroy, Davies, & Bayer, 2005) and these studies often failed to address racial or cultural variations in care outcomes. The majority of those using randomized controlled trials emphasized a limited number of chronic diagnoses such as stroke, heart failure and ACS (Coleman et al., 2006; Harrison et al., 2002; Kind, Smith, Frytak, & Finch, 2007; Naylor et al., 2004; Phillips et al., 2004; Sinclair et al., 2005). Indeed, only four trials included AMI (Naylor, et al., 1994; Naylor, et al., 1999; Stewart & Horowitz, 2002), and in only one of these (Sinclair et al., 2005) was it the primary focus. For the most part, heart failure is the leading diagnosis for research in this area. Several of the reviews discuss patient adherence to therapeutic regimens as part of the success in maintaining health and avoiding hospital readmission, but surprisingly few actually measure adherence (Peikes, Chen, Schore, & Brown, 2009). The primary outcome measure attributed to successful transitional care is the rate of hospital readmission (Coleman, Parry, Chalmers, & Min, 2006; Krumholz, et al., 2002; Naylor, et al., 2004; Naylor, et al., 1999; Peikes, et al., 2009; Sinclair, et al., 2005; Stewart, Pearson, Luke, & Horowitz, 1998). Thus, while these studies provide important data supporting transitional care as a potential mediator, there remain salient questions. For example, the concept of dose is lacking throughout the literature. That is, no study has evaluated the amount of transitional care interaction required to achieve any given outcome. Perhaps more important is that fewer than half of the studies in the last decade (and only one in the last five years) provide analyses of comprehensive cost data (Chiu & Newcomer, 2007). This is particularly relevant in an era of escalating health care costs and rising numbers of older adults who may need these services. Thus, this study aims to address the latter gap by assessing differences in six-month medication persistence rates (for secondary prevention medications), 30-day readmission rates, and to compare costs between patients who participated in the transitional care BRIDGE program and those who received usual care following hospital discharge for an acute coronary event. Each of these topics will be addressed separately in chapters 2, 3, and 4.

Specific Aims and Research Hypotheses

The specific aims and hypotheses of this study are:

1) To determine if there is a difference in six-month medication persistence rates (beta-adrenergic blocking agents [ß-blockers], angiotensin converting enzyme inhibitors [ACE-inhibitors] or angiotensin receptor blocking agents [ARBs] in patients intolerant to ACE-inhibitors, aspirin, HMG-CoA reductase inhibitors [statins], and clopidogrel) following discharge from the hospital for an ACS event between patients who participated in the nurse practitioner (NP)-delivered BRIDGE program and those who did not.

    H1.1: Compared with patients who had usual care, patients who participated in the BRIDGE program will have higher medication persistence rates six months after discharge.

2) To determine if there is a difference in hospital readmissions following discharge from the hospital for an ACS event between patients who participated in the NP-delivered BRIDGE program and those who did not.

    H2.1: Compared with patients who had usual care, patients who participate in the BRIDGE program will have a lower 30-day hospital readmission rate.

3) To determine costs associated with the BRIDGE model and the difference in costs associated with its use compared to nonuse (usual care) in hospital readmissions following discharge from the hospital for an ACS event.

    H 3.1: Compared with usual care, there will be a cost reduction for care associated with participation in the BRIDGE program.

These aims are addressed in 3 papers as follows: Aim 1 in Paper one (chapter 2); aim 2 in Paper two (chapter 3); and aim 3 in paper three (chapter 4).

Background and Significance

Acute Coronary Syndrome

Cardiovascular disease is the leading cause of death in the United States (U.S.). Indeed, more than a half million Americans die each year from coronary heart disease (CHD) alone, making deaths from CHD more prevalent than any other single illness (American Heart Association, 2009; Rosamond et al., 2007). Data from the American Heart Association (AHA) estimates that the incidence of acute myocardial infarctions in adults over 20 years of age will reach 785,000 this year and will cost an estimated 160 billion dollars in both direct and indirect expenses (AHA).

Despite the urgent nature of acute coronary syndrome (ACS), the event may be considered purely an exacerbation of underlying chronic CHD. There is a 53% likelihood that patients will experience more than one ACS event (AHA, 2009). However, with early treatment and adherence to evidence-based guidelines, both morbidity and mortality are reduced (Antman et al., 2004). As part of the IMPACT study, Ford et al. (2007) estimated that risk factor management alone (reducing lipids, glucose, and blood pressure; eliminating smoking; and, increasing physical activity) could reduce AMI mortality by as much as 44%.

American College of Cardiology/American Heart Association ACS Guidelines

Since 1980, the American College of Cardiology (ACC) and the American Heart Association (AHA) have collaboratively produced and revised guidelines for the prevention, diagnosis, and management of a variety of cardiovascular diseases (CVDs). The ACC/AHA Task Force consists of cardiology experts and representatives from other medical and specialty groups. Its intent is to give healthcare providers a tool to support evidence-based clinical decision-making. The guidelines offer a range of acceptable approaches from a consensus of experts, but should not replace the clinical judgment of the primary care provider (Antman et al., 2004)

The process of ACC/AHA guideline development involved a comprehensive literature review, weighing of the evidence, and estimation of outcomes based on patient modifiers (Antman et al., 2004). All evidence is graded according to the Classification and Recommendations and Level of Evidence rubric. This rubric first identifies the class of data according to the degree that the benefits outweigh the risks, or vice versa (Class I: Benefit >>> Risk and are recommended, Class IIa: Benefit >> Risk and are reasonable, Class IIb: Benefit $\geq$ Risk and may be useful, and Class III: Risk $\geq$ Benefit and are not recommended). Within each of the four classifications, the quality of the evidence is evaluated according to three possible rankings (Level A: data from multiple randomized clinical trials or meta-analyses; Level B: data from a single randomized trial or nonrandomized studies; Level C: consensus opinions of experts, case studies, or standard-of-care documents). This grading scheme enables estimations of the size and certainty of treatment effects when caring for patients with ACS (Antman et al., 2004).

The initial ACC/AHA Task Force guidelines for ACS were presented in 1990 and were focused solely on the early management of AMI. Since 1990, there have been nine revisions or updates to this original document. The most recent publications related to ACS are the "*2011 ACCF/AHA Focused Update Incorporated Into the ACC/AHA 2007 Guidelines for the Management of Patients With Unstable Angina/Non-ST-Elevation Myocardial Infarction*" (Anderson et al., 2011) and the "*AHA/ACC Guidelines for Secondary Prevention for Patients With Coronary and Other Atherosclerotic Vascular Disease: 2006 Update*" (Smith et al., 2011). This latter revision reflects the evolution of AMI management from acute management to preventative and long-term treatment strategies and makes secondary prevention recommendations including short-term discharge goals, medication considerations, and long-term lifestyle modification. The transition from hospital-to-home, medication management and discharge education are identified as key components in patients' successful recovery from AMI.

Discharge goals for ACS patients thus include increasing patient and family education about the disease and treatment, need for appropriate follow-up, timing of the proposed follow-up, and suggested lifestyle modifications (Antman et al., 2009). Patients must be educated about their diagnosis, prognosis, and management in order for them to understand their role in minimizing future events. Additional education is necessary to support lifestyle modifications related to diet, smoking cessation and increased physical activity. Because of the relationships between CHD and hyperlipidemia and between hypertension, and hypercoagulation, education about the use of aspirin, β-blockers, ACE-inhibitors and statins for secondary prevention of ACS events is critical. Lastly, patients must understand why follow-up is important, what occurs during follow-up, and with whom the follow-up should take place. Given that the average length of stay for an ACS event is under 6 days (Spencer, Lessard, Gore, Yarzebski, & Goldberg, 2004), it is little wonder that patients may not be able to absorb this tremendous amount of information during this short convalescent phase. Thus, these interventions should be assessed soon after discharge to improve guideline adherence rates for patients, clinicians, and institutions during the hospital-to-home transition (Ellerbeck et al., 1995; McLaughlin et al., 1996; Mehta et al., 2002).

Medication Adherence and Persistence

Medication adherence is a substantial and ongoing problem in healthcare (DiMatteo, 2004). Poor adherence is associated with increases in morbidity, mortality, rehospitalizations, and overall health care costs (Sokol, McGuigan, Verbrugge, & Epstein, 2005). Medication adherence, also known as compliance, is a measure of "the extent to which a patient acts in accordance with the prescribed interval and dose of a dosing regimen" over a period of time and is often reported as a percentage (Cramer, Roy, Burrell, & Fairchild, 2008, p. 46). In contrast, medication persistence is defined as "the duration of time from initiation to discontinuation of therapy. Continuing to take any amount of the medication is consistent with the definition of persistence" (Cramer et al., 2008, p. 46). Both medication adherence and persistence are essential for obtaining the therapeutic benefits observed in clinical trials (Choudhry & Winkelmayer, 2008). However, without persistence, adherence is moot. In fact, life-long persistence for many chronic conditions is essential for prevention of secondary events.

Medication persistence with a regimen of aspirin, ß-blockers, ACE-inhibitors, statins, and clopidogrel has proven essential for preventing reoccurrence and progression of coronary disease in ACS patients (Antman et al., 2009). Poor medication persistence is associated with an increased risk of mortality (Ho, Spertus, Masoudi, & Reid, 2006). The largest decline in persistence with cardioprotective therapies has been observed within the first month after discharge from an ACS event (Ho et al., 2006) and less than 50% of patients remain on therapy at two years (Akincigil et al., 2008; World Health Organization, 2010).

The economic impact of persistence (and rates of adherence) across a number of health conditions is well documented (Sokol et al., 2005; World Health Organization, 2010). Among diabetic and hypercholesterolemic patients, adherence with combination therapy is associated with lower healthcare costs (Sokol et al., 2005). In fact, medication costs are completely offset by the reduction in medical costs for these patients. Higher rates of adherence are also associated with lower hospitalization rates and lower costs for hospitalization among patients with hypertension, congestive heart failure, diabetes, dyslipidemia, and post-AMI (Choudhry, Patrick, Antman, Avorn, & Shrank, 2008; Sokol et al., 2005).

Hospital Readmissions

As noted earlier, hospital readmissions are a major problem in the United States. Almost one fifth (19.6%) of the 11,855,702 Medicare beneficiaries' (who constitute the largest number of AMI patients) discharged from hospitals in 2003-2004, were readmitted within 30 days (Jencks et al., 2009). According to Krumholz, et al. (2009), hospital readmission statistics reported for CVD up to five years later were even worse (ACS M=19.9%, range 15.3% to 29.4%; heart failure M=24.4%, range 15.9% to 34.4%).

Hospital readmissions are a problem when considered from multiple perspectives. From an individual or patient perspective, readmissions mean that the patient is sicker. Rehospitalized patients spend more time away from home and work than those who remain in the community; they consequently suffer more social isolation, lost wages, and increased expenses. From a social standpoint, readmissions affect families, communities, and the work force and are an added burden to the overall healthcare system. From an institutional or health systems perspective, hospital readmissions present a two-sided issue:

filling hospital beds generates revenue; however, filling those hospital beds with readmissions suggests a poor quality of care that from a marketing standpoint (to consumers and insurers) may outweigh the benefit of any financial remuneration from these readmissions.

The perspective of this dissertation, supported by several new policy initiatives, is that lower hospital readmissions are generally accepted as a positive and desirable outcome. In June 2009, Mary Naylor, PhD RN, Professor of Gerontology and Director of the New Courtland Center for Transitions and Health at the University of Pennsylvania, proposed the Transitional Care Reimbursement Bill (H.R. 2773 and S. 1295) with the aim of preventing or reducing hospital readmissions. Recognizing the potential impact of the recent trend toward decreased Medicare reimbursement for home care services, this bill provided reimbursement for services aimed at preventing readmissions through more comprehensive care during the hospital-to-home phase. Naylor's proposed bill followed Peter Orszag's (then Director of the Office of Management and Budget) March 3, 2009 testimony to the House of Representatives Committee on Budget for a proposed bundled payment policy that would create a single payment for hospitalization and post-acute care, with penalties in the form of reduced reimbursement for hospital readmissions in centers with higher rates. Orszag proposed that this would result in a $26 billion dollar savings to Medicare over a ten year span (*Orszag Testimony, President's Fiscal Year 2010 Budget*, 2009).

In response to the financial implications, quality concerns, and public reporting of discharge planning and readmission rates, many researchers and institutions have explored the phenomenon of hospital readmissions and why they occur (Arora & Farnan, 2008; Cumbler, Carter, & Kutner, 2008; Greenwald & Jack, 2009; Jacob & Poletick, 2008). Data show that rehospitalizations occur primarily because patients decompensate after discharge and that this progressive decline is the result of a multifaceted interaction between client, discharging hospital, and outpatient follow-up (Cumbler et al., 2008; Greenwald & Jack, 2009; Jacob & Poletick, 2008). Examining these three areas during patients' transition from hospital-to-home is thus critical if appropriate interventions are to be developed to decrease hospital readmissions.

One such intervention is the national Hospital to Home (H2H) program. Championed by the American College of Cardiology Foundation and the Institute for Healthcare Improvement, H2H is modeled after the successful Door to Balloon (D2B) program that aimed to reduce the amount of time patients with ST-segment elevated myocardial infarctions waited for intervention after arriving at the hospital. The goal of the H2H program is to reduce readmission rates among patients discharged with heart failure or acute myocardial infarction by 20% by 2012 (Brindis & Krumholz, 2010) using three guiding principles: that patients adhere to their medications; that patients receive early post-discharge follow-up; and, that patients understand when and who to call for help (Brindis & Krumholz, 2010). By elevating transitional care beyond conceptualization to an integral component in the care continuum between acute and ambulatory care, there is opportunity to improve health care delivery and patient care quality while achieving the national goal of reducing hospital readmission rates.

Cost and Cost Effectiveness Analyses in Acute Coronary Syndrome

While most experts may agree that transitional care is an essential component of providing high quality care, data to support the cost of providing transitional care and improving patient adherence to secondary prevention therapies to reduce adverse outcomes is still needed. How best to approach measures of cost and quality is also under study.

A traditional cost analysis describes the tangible costs of programs and their operating costs. These costs are often compared to a standard (i.e. usual care) as a means to justify or determine the utility of one program over another (Warner & Luce, 1982). To make such a comparison, it is essential that equivalent data be examined. For example, in accounting for provider salary in one program, one must determine whether this rate represents salary only or salary plus benefits. When considering overhead, one must be clear whether to include cleaning, maintenance and upkeep, or only rent. In the absence of such detail, it is impossible to accurately compare the costs or savings across different programs.

Across the literature reviewed, there was no consistent methodology for determining programmatic costs associated with transitional care (Coleman et al., 2006; Krumholz et al., 2002; Naylor et al., 2004; Naylor et al., 1994; Naylor et al., 1999; Stewart, Pearson, Luke, & Horowitz, 1998) . Regrettably, this prohibits cost comparisons across various study designs. Of the four studies that provided enough detailed methodology to enable comparisons (Krumholz, et al., 2002; Naylor, et al., 2004; Naylor, et al., 1994; Peikes, et al., 2009) all report a savings or the potential to lower cost over usual care. However, as a result this lack of standard approach, little is truly known about the cost or cost per dose of current transitional care models; there are no studies in the published literature that present data related to the cost effectiveness of transitional care. Those that do purport to analyze cost are not always rigorous or generalizable.

In an attempt to address patient readiness for discharge for example, Newby et al. (2000) assessed the cost effectiveness of adding an additional day to each hospital stay for AMI patients to allow further convalescence and permit time for more detailed education. The authors concluded that hospitalizations longer than three days were not economical. It should come as no surprise that keeping a patient in the hospital for rest and education lacks economic appeal. In addition, longer hospital stays potentially expose patients to iatrogenic problems such as hospital-acquired infections.

Post-discharge interventions, on the other hand, have been more successful in demonstrating benefit. Many of these interventions (Naylor et al., 2004; Sinclair et al., 2005; Stewart et al., 1998) employed nurse practitioners to do post-hospital discharge home visits ranging from 1-8 times over as much as a three month period and concluded that this level of care was beneficial and reduced costs. There is a wealth of evidence that supports the high quality of care and the cost effectiveness provided by advanced practice nurse models of care (Brown & Grimes, 1995; Horrocks, Anderson, & Sallisbury, 2002). These home-based nurse practitioner interventions provided the ideal level of care necessary for successful transitions. However, these programs are not always feasible and cannot easily be generalized because they are resource intensive. Nevertheless, the cost analysis provided by Naylor et al. offers strong support for the utilization of such advanced practice models in transitional care.

Theoretical Framework

Transitional Theory and Practice

Transitional theory was introduced as a concept in nursing by Chick and Meleis (1986) in their landmark paper "Transitions: A Nursing Concern." Defining transition as change over time and "periods in between stable states" (p. 238), the authors then linked transitions related to health or illness as areas of nursing concern. A more modern perspective suggests that when transitions are related to health, illness, or behavioral responses to either health or illness, they fall under the broader care of a health care team. These responses fall into four separate transition typologies: developmental, situational, health-illness, and organizational (Schumacher & Meleis, 1994).

Each of the four transitions has unique attributes that require different units of measurement and models. Developmental transitions are individual level transitions such as becoming a parent, going through adolescence, or reaching menopause. Situational transitions may be cognitive, such as a role or career change, or physical such as moving or becoming homeless. Health-illness related transitions might also be cognitive or physical, such as representing an individual's experience with development, living with a chronic disease, or movement within levels of a health care system (ICU to general medicine, or hospital-to-home). Organizational transitions are largely related to the overriding forces that dictate organizational change (i.e., economics, legislation, society). These transitions may occur in succession or simultaneously, adding to the complexity of the process.

Bridges (2004) describes a transition as an "ending, then a beginning, and an important empty or fallow time in between" (p. 17). This definition suitably defines the health-illness related transition from hospital-to-home. The acute hospitalization phase is ending, and a new at-home recovery phase is beginning. This transitional period can be broadly defined as the period between when a patient becomes aware that they will be discharged and when their care is successfully transferred to outpatient healthcare providers (Arora & Farnan, 2008). The empty time in between these points, however, is a time when many things can go wrong that may lead to hospital readmission or mortality (Arora & Farnan, 2008; Chiu & Newcomer, 2007; Cumbler et al., 2008; Greenwald & Jack, 2009; Jacob & Poletick, 2008; Naylor et al., 2004; Phillips et al., 2004; Sinclair et al., 2005; Stewart et al., 1998).

Greenwald and Jack (2009) identified pitfalls leading to hospital readmission or mortality during the hospital-to-home transition as system flaws, patient-related issues, and/or clinician-related issues. System problems include failures in communication, lack of patient education, medication errors, and poor follow-up planning such that patients may not learn the material they were taught, may not adhere to their medication regimen, or may not keep follow-up appointments. Patient-related issues pertain to the physical condition of the patient who may develop new problems or post-discharge complications. Clinician-specific errors include failing to order or follow-up laboratory tests, discharging patients inappropriately, failing to prescribe evidence-based medications, and/or neglecting to order supportive home care services. Intervening to ameliorate these pitfalls during this period has demonstrated a benefit in lowering readmission rates and improving health related quality measures (Chiu & Newcomer, 2007; Naylor et al., 2004).

Unfortunately, because of decreasing lengths of hospital stays, (Spencer et al., 2004), it is now increasingly difficult to ensure the quality of discharge education and the patients' ability to retain that information (Arora & Farnan, 2008). This is particularly notable given that high quality discharge education is the strongest predictor for discharge readiness and low quality discharge education for hospital readmissions (Weiss et al., 2007). Because there is often more than one individual responsible for overseeing this process, it is understandable that errors and omissions are made (Arora & Farnan, 2008). To make matters worse, ACS patients are often unable to be seen by their cardiologists within the recommended 2-4 week period after discharge (Housholder & Norville, 2009). As a result, common mistakes and decompensating patients are not captured in the system soon enough to correct and avoid further morbidity and readmission.

Transitional Care Models

As a result of the national focus on hospital readmissions, an abundance of transitional programs are now being piloted. According to the Agency for Healthcare Research and Quality (2010), between 250 and 400 hospitals are now engaged in some form of readmission-reducing effort. It should be noted however, that programs to reduce readmissions are not new. More than two decades ago, Brooten et al. (1988) introduced a model for transitioning low birth weight infants from the hospital to home. Naylor and colleagues (2004; 1994; 1999) expanded on this model and have devoted their careers to developing and testing a transitional care model for older adults with chronic disease. This model, the Transitional Care Model, is widely recognized and has even been adopted by such large care providers as Kaiser Permanente, Aetna, and the University of Pennsylvania Health System. Like Brooten's model before it, it is a comprehensive program that extends patient care from hospital discharge into the patient's home in an attempt to facilitate a healthy transition across the hospital-to-home continuum.

Unlike Brooten (1988) and Naylor's (1994;1999;2004) models, the vast majority of transitional models today tend to be more narrowly focused on pre-discharge inpatient education and post-discharge telephone follow-up or in-home visits (Coleman et al., 2006; Sinclair et al., 2005; Stewart et al., 1998). Trained nurses or nurse practitioners carry out many of these home-based interventions. In their review of various transitional care models, Phillips et al. (2004) concluded that programs offering both pre and post discharge support could lower hospital readmissions and costs, while Jacob and Poletick (2008) concluded that low levels of social-support and self-confidence in ability to manage ones' own care needs were the strongest predictors of readmission.

The hospital-to-home transition is a complex health-illness transition (Schumacher & Meleis, 1994) with a host of variables across multiple domains. In fact, a successful transition from hospital-to-home requires concurrent transitions in individuals and the system and how they intersect. The complexity of this transition is evidenced by the lack of a theoretical framework that depicts the simultaneous interaction between individuals, systems, and processes. Instead, we have relied on various models to piece together the complex phenomena of transitional care. The Quality Cost Model used in Naylor and Brooten's works (Brooten et al., 1988; Brooten et al., 2002; Naylor et al., 2004) and the Maintaining Hope in Transition Model proposed more recently by Davidson, Dracup, Phillips, Padilla, and Daly (2007), are examples of theoretical frameworks that incorporate multiple domains. The Quality Cost Model incorporates the domains of quality of care, patient satisfaction, and cost (Brooten et al., 2002). The main constructs of the Maintaining Hope in Transition model are the individual, social relationships, and organizational plus societal factors (Davidson et al., 2007). While both models are well grounded and can be operationalized, neither fully captures the dynamic relationships that exist between the system, the client, and the clinician. The Quality Cost Model lacks system accountability and patient variability, while the Maintaining Hope in Transition model fails to address clinician responsibility.

As a result of the overarching systems' influence on transitional care, other proposed models are largely Donabedian (1966) in nature or are more modern adaptations of this work from Holzemer and Reilly (1995) and Mitchell, Ferketich, and Jennings (1998). These models, along with the Dartmouth Clinical Compass (Speroff, Miles, & Mathews, 1998), are appealing because they integrate systems and process into the care equation. The Donabedian Quality Care Outcomes Model (Mitchell & Lang, 2004) and the Outcomes Model for Health Care Research (Holzemer & Reilly, 1995) are both well validated in the literature. Yet applying these models to transitional care sacrifices the behavioral attributes of the individual that are paramount to a successful transition from hospital to home.

If one combines all of the necessary components of a successful hospital-to-home transition, it becomes evident that there is no simple representation, and that possibly no single model can fully explain the entire course. First, any transitional care model must be dynamic with all constructs interrelated. Second, a transitional care model cannot exist in a time vacuum. That is, systems, processes, and even patients are affected by external influences that may alter the necessary constructs in today's model. Therefore, any transitional model must exhibit plasticity, or the ability to evolve as systems, clinicians, evidence-based practice, policies, economics, and individuals change over time. Finally, the model must incorporate both individual and organizational behaviors and structures. This dissertation offers the Integrated Client-Focused Transitional Care Model as one means to portray these constructs and their relationships.

The Integrated Client-Focused Transitional Care Model

Combining elements of Donabedian (1966), Mitchell, Ferketich, and Jennings (1998) and Meleis, Sawyer, Im, Hilfinger Messias, and Schumacher (2000), this study offers the Integrated Client-Focused Transitional Care Model (see *Figure 1*) as a framework for studying the hospital-to-home transition. This model represents the dynamic integration of individual behavior and systems theory as well as discussions from experts in the field. The major concepts work together to simultaneously influence health outcomes. The resulting outcomes reciprocally influence ongoing quality improvement efforts. The Integrated Client-Focused Transitional Care Model was synthesized using Walker and Avant's methods for theory development (2005). As seen in the following depiction of the model (Figure 1), the major concepts are system, clinician, client characteristics, and outcomes. These concepts are in a dynamic relationship in which specific system and clinician characteristics mediate client behavior and outcomes. The arrow depicts the trajectory of these interactions at work aimed toward a bullseye whose center reflects more desirable patient outcomes from the hospital-to-home transition. When the system, clinician and client are aligned, the arrow (trajectory) meets with positive outcomes; when one or more misalign, the arrow changes course to the outer-ring of the bullseye, with negative outcomes. One can easily appreciate, due to the multiple factors influencing each area, that any small deviation in the system, clinician, or client interaction may have potentially devastating outcomes. Maintaining balance is thus a critical element in each of the areas detailed below.

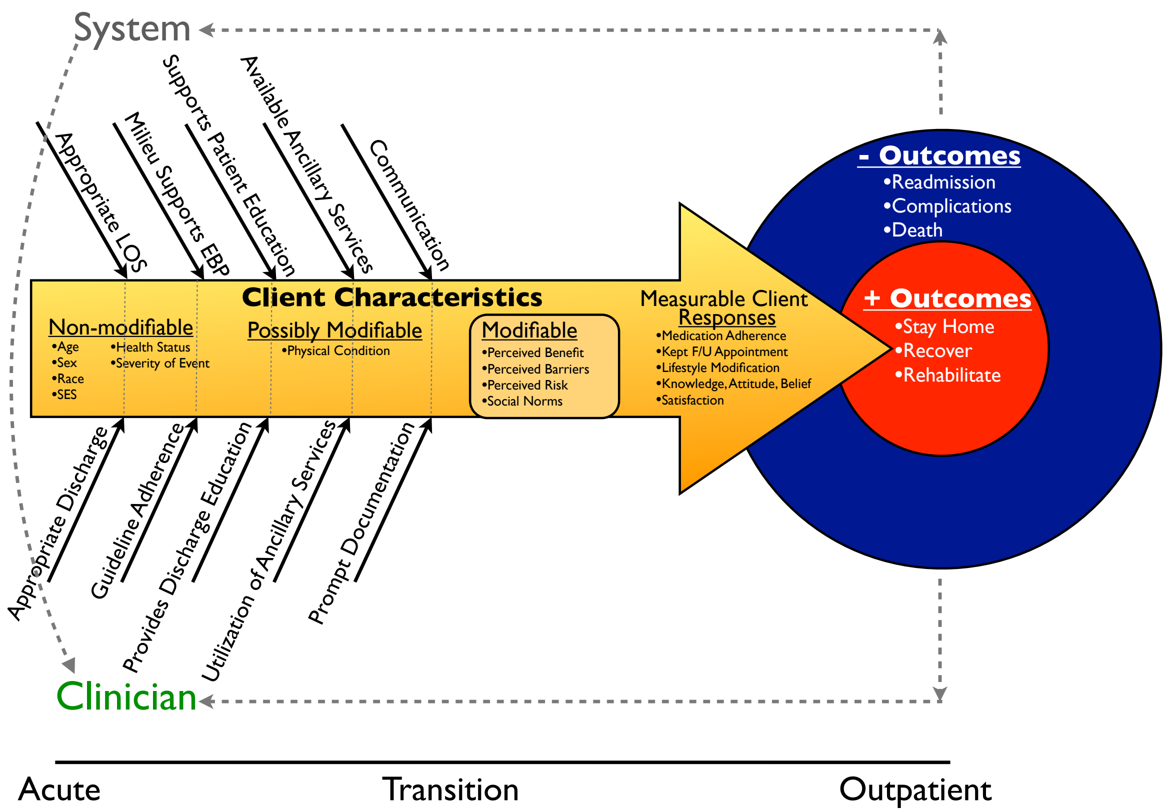

Figure 1. The Integrated Client-Focused Transitional Care Model, by Sherry M. Bumpus, 2012

System. System characteristics are traditionally structural and, as Mitchell, et al. (1998, p. 43) define, "have the right things" in place to promote system stability and function . Within the Integrated Client-Focused Transitional Care Model, using the BRIDGE model as an example, structural components include facilities, staff, instruments, technology, communication, and ancillary care services across the care continuum. Ancillary care services include inpatient consultations from specialists (i.e. cardiology) and outpatient primary and specialty care providers. While not all institutions participate in both inpatient and outpatient care (as UMHS does), all institutions must have an established network for providing post-discharge referrals and protocols for communicating with the outpatient providers. Less physical attributes of the system include the institution's policies, values, beliefs, and programs. For example, institutions promoting evidence-based practice (both as a policy and as a belief) should have a system for providing continuing education to their clinicians and for disseminating best-practice models throughout the facility. The "Get with the Guidelines" program is an example of a tool kit designed for institution-wide application and dissemination of the joint ACC/AHA ACS guidelines. Similarly, institutions supporting patient education must supply materials, information technology, and staff to deliver the education. Some structures are less obvious than others. For example, hospital lengths of stay may be shorter than necessary for optimal transition success due to the constrictions of economics, reimbursement, and/or external system policies that occur behind the scene.

Clinician. The clinician is ultimately responsible for providing direct care to the acute and recovering patient (depending on where one is in the continuum). The beliefs, knowledge, training, and skill of providers, together with their utilization of available tools and policies of the environment in which they practice, will mediate patient outcomes. The clinician in this regard represents processes. A skilled clinician utilizing evidence-based guidelines is responsible for treating a patient to the point of discharge and thus is capable of evaluating when discharge is appropriate. This assumes that the beliefs of the clinician are in agreement with standardized guidelines. As guidelines for many conditions, including ACS, specify discharge education, the clinician is responsible for ensuring that appropriate education has been delivered and received, whether he provides the education himself or delegates the task to others. However, simply caring for, educating and discharging the patient does not guarantee a successful transition. The clinician also has the added responsibility of ensuring that the patient has everything needed for a successful transition to home, including that secondary prevention medications have been prescribed, that the patient can obtain them, and that the medications are appropriate. It also requires that appropriate diagnostics have been ordered post-discharge, that prompt follow-up has been scheduled, and that the patient's capacity for self-care has been assessed. Prompt discharge follow-up requires an outpatient referral and assurance that this occurs within the recommended 2-week window for ACS patients. Making a referral requires that the clinician documents the stay in a timely manner and assures that the documentation is forwarded to outside providers.

Client characteristics. The single most important driver of the Integrated Client-Focused Transitional Care Model, as the name suggests, is the client, as certainly there would be no need for transitional care without a person in need. Indeed, it is the client and his/her non-modifiable and modifiable characteristics that create the greatest variance in meeting positive outcomes.

Non-modifiable client characteristics include demographic data such as age, sex, race, and socioeconomic status. The impact of the overall level of health of an individual and the severity of his event must also be taken under consideration. In a case where two patients have a similar ACS event, if Patient

A also has diabetes, high blood pressure, high cholesterol, depression, and osteoarthritis and Patient B has no other health conditions, then, as clinicians, we can predict that Patient A is at a higher risk for a secondary event. Alternatively, if both Patient A and Patient B were otherwise healthy with no comorbid conditions, but Patient A's ejection fraction was 20% and Patient B's was 55% after their events, we could predict that Patient A would do worse. The assessment of non-modifiable client factors must therefore include quantifiable measures of the client's overall level of health, comorbidities, and the severity of the event(s).

Modifiable characteristics represent the patient's variable response to treatment and include client adoption of attitudes, beliefs, behaviors, and lifestyle modification known to reduce secondary events. Given a client's overall health and the severity of his event, even under the ideal circumstances of a hypothetical world in which everything is done correctly every time, there will still be variability in treatment response.

Indeed, ensuring outcomes consistent with published results relies heavily on patient adherence behavior. Patients who believe in their treatment and their ability to adhere with the treatment over time are more likely to achieve the desired benefits of risk reduction and health promotion. A number of individual health behavior models such as the Health Belief Model (Rosenstock, 1974), Health Promotion Model (Pender, Murdaugh, & Parsons, 2006), Information-Motivation-Behavioral Skills Model (Fisher & Fisher, 2002), and Theory of

Reasoned Action/Planned Behavior (Fishbein & Ajzen, 1975) support the influence of clinicians in facilitating change in client health behaviors.

Each health behavior model uniquely defines its own operational variables and measurable outcomes. The particular variables relevant to the ACS population are perceived risk, perceived barriers, perceived benefit, social support, knowledge, attitudes, and beliefs. Examples of measurable outcomes are medication adherence, the percentage of follow-up appointments kept, and rates of adherence to specific lifestyle modifications (i.e. smoking cessation). More cognitive measures may include measures of knowledge, attitudes, and beliefs. Each disease state, population, and intervention may require conceptualization and operationalization specific to the area of study.

Outcomes. The primary outcome of the Integrated Client-Focused Transitional Care Model is a successful transition marked by a patient's ability to stay home, recover and rehabilitate. Readmission, morbidity, and mortality are typical (negative) measures of unsuccessful transitions reported in the transitional care literature. In fact, readmission rates following AMIs is one of the three conditions currently being monitored by the Hospital Quality Alliance as a measure of transitional success or failure (Jha, Orav, & Epstein, 2009).

Relationships between concepts. System and clinician concepts correspond to having the necessary resources and commitment to use resources in a prescribed manner consistent with standardized guidelines (i.e. AHA/ACC guidelines). For example, the system must provide a means for communicating and sharing information with providers. Clinicians must be able to utilize the system efficiently and effectively. Systems have policies and procedures that govern behavior of its employees and clinicians must work within these boundaries. It is insufficient to have the tools if they are not utilized, or to have the desire to act, if it is not permitted. The two are inextricably linked.

In the model depiction, the linkage between clinician and system is designated by the connecting dotted lines. These linkages are propositional statements about the relationship between the system and clinician behavior. The specific system and clinician concepts represented in this model correspond to the objectives identified by the Agency for Healthcare Research and Quality discharge goals as contributors to rehospitalization and other early adverse events described in the literature (Arora & Farnan, 2008; Chiu & Newcomer, 2007; Cumbler et al., 2008; Greenwald & Jack, 2009; Jacob & Poletick, 2008; Krumholz et al., 2002; Naylor et al., 2004; Phillips et al., 2004; Sinclair et al., 2005; Stewart & Horowitz, 2002; Stewart et al., 1998). It is also noted that the system may independently influence clinician behavior outside of the interactions with patients.

Both the institutional environment and the clinician have direct effects on the patient. The combined interaction of the clinician, the system, and the client translates to outcomes. If the system does not have all of the structural components, the actions of the clinician may counterbalance this, maintaining an even trajectory toward a positive outcome. Conversely, if a clinician's practice is below the expected standard, the system checks and balances may serve as a counterbalance. Patient-specific variables may cause imbalances as well. The patient may have a number of risks, but may be very compliant with secondary lifestyle modification under the proper influences of the clinician with the support of the system. The net effect results in the arrow remaining straight in its trajectory. To come full circle and enable ongoing quality improvement efforts, it is essential that outcomes be translated back to the system and the clinician, as depicted by the dotted unidirectional arrows.

BRIDGE Clinic Model of Care

The Integrated Client-Focused Transitional Care Model provides a framework for the overall hospital-to-home transition and is suitably broad to support a variety of transitional interventions. Like this model, Bridging the Discharge Gap Effectively (BRIDGE) is an intervention that aims to positively influence client behavior while simultaneously providing a check and balance of both the system and its clinicians. The nurse practitioner clinic is the cornerstone of the BRIDGE program. The clinic utilizes the joint ACC/AHA ACS guidelines as the best-practice model for secondary prevention of an ACS event. These guidelines emphasize discharge medications, lifestyle modifications, prompt follow up, and education about medication, therapeutics, lifestyle modification, signs and symptoms of danger, and when to call for help. The goals of the BRIDGE model are consistent with these guidelines.

BRIDGE Clinic Goals

1. Provide seamless care to individuals discharged from UMHS with ACS
2. Enhance compliance with evidence-based treatments
3. Improve clinical outcomes

4. Decrease readmissions
5. Decrease inappropriate use of acute care services (Housholder & Norville, 2009, p. 1)

In order to meet these goals, nurse practitioners (NPs) assess the clinical status of the patient and his/her treatment response and then make therapeutic adjustments as needed. The NPs also provide education about the client's condition, medications, and what happened during their hospitalization. Finally, they ensure that appropriate follow-up visits and referrals are in place (Housholder & Norville, 2009).

The underlying principles of the BRIDGE program are congruent with the Information-Motivation-Behavioral Skills Model (IMB), which stipulates that information, motivation, and behavioral skills are necessary determinants of health behavior. In other words, when individuals are appropriately informed, sufficiently motivated to act, and have the skills to do so, they are more likely to initiate and maintain health-promoting behavior (Fisher, Amico, Fisher, & Harman, 2008; Fisher & Fisher, 2002; Fisher & Fisher, 2003). This behavioral health model supports the investigation of hypothesis 1 (Patients seen in the BRIDGE clinic will have higher rates of persistence to secondary prevention medications at six-months than patients not followed in the BRIDGE clinic). The NPs provide information about the benefits of β-blockers, ACE-inhibitors, aspirin, statins and clopidogrel in preventing secondary events and managing current symptoms. The NPs discuss proper administration and access to these therapies. As part of this education, the NPs directly influence clients' individual attitudes and belief about their ability to take these medications and the positive benefits of doing so. When possible, the NPs include family members and support people in these discussions to enhance the social support and long-term encouragement toward adherence.

By helping patients develop the skills necessary to initiate and maintain adherence behaviors, it is expected that patients receiving this type of one-on-one follow-up will be more compliant than those who do not. While hypothesis 1 reflects overall patient persistence with secondary prevention therapies prescribed at discharge, other possible health outcomes could be measured as well. For example, because β-blockers lower heart rate, one possible measure would be to assess whether heart rates at 6-month post discharge are optimal. Similarly, lipid measurements reflect statin utilization. While these are client-specific health outcomes, the adherence to these specific measures is directly associated with lower morbidity and mortality and fewer rehospitalizations.

Application of the Integrated Client-Focused Transitional Care Model and BRIDGE. The BRIDGE Transitional Care program, operating under the IMB philosophy and couched within the Integrated Client-Focused Transitional Care Model, is unique. The overall BRIDGE concept begins at the system level. UMHS provides the type of teaching, learning, and evidence-based milieu essential for a successful transitional care program. UMHS has state-of-the-art communications and informational technology services that connect its vast inpatient and outpatient network. When patients are admitted with a diagnosis of ACS, for example, a critical pathway is immediately established and standardized admission orders prompt providers to make use of the joint ACC/AHA ACS guidelines during the course of the patient's stay. Similar protocols are in place at discharge for β-blockers, ACE-inhibitors, aspirin, statins and clopidogrel, and justification is required when they are not prescribed. A discharge prompt also alerts providers when patients do not have timely follow-up scheduled (within 2 weeks). Clinicians are able to utilize the enhanced informational technology and communication systems available to them at UMHS to rapidly transmit discharge information directly to cardiologists, primary care providers, and the BRIDGE clinic. This is an essential step in linking inpatient to outpatient care. Discharge education is provided by both nurses and physicians to ensure that patients and families understand and have access to prescribed medications and protocols and recommended lifestyle modifications (including immediate referrals to smoking cessation programs). Patients must be made cognizant of the signs and symptoms of danger in order to be safely discharged and to avoid future complications. Together these system and clinician measures provide clients with the necessary skills to successfully care for themselves after discharge.

Unfortunately, for a number of reasons, patients and families may not recall education imparted at discharge. Although written information on all medications is provided and serves to minimize some confusion, it does not mitigate other issues. For example, patients will sometimes receive prescriptions for medications in the same class as those they already have at home. Patients may take both or not know which to take. At times, prescriptions may have been forgotten at discharge, or patients may not have filled them. For a variety of reasons, patients may have discontinued their medications without informing anyone, or simply exhausted their supply before their next visit with another healthcare provider. In light of the IMB Model, patients are thus lacking both the knowledge and skill to adhere to their prescribed program. A successful transitional care model must address this issue and offer a means to correct it. BRIDGE does this in that the NPs assess the patient's response to treatment and reinforce the education that clients and families need to best adhere to a therapeutic regimen (medication or lifestyle modification). Doing so helps "bridge" the chasm between the system and clinician and empowers clients toward better self care management.

Indeed, the truly unique aspect of BRIDGE is its collaboration with the rest of the health care system. BRIDGE does not serve as an alternate cardiology follow-up or take patients away from outpatient providers. Rather, the BRIDGE NPs practice independently, but when concerns arise, they first collaborate with the discharging physician or team. The discharge team has the most recent experience with the patient and can direct interventions where necessary. This is a novel organizational structure, as often the discharging team is not involved in any outpatient management. When, for whatever reason, a member of the discharge team is not available, the NPs have collaborative practice agreements with onsite cardiologists who are always willing to intervene. This feedback loop enables quality controls on both what occurs at discharge and what transpires after the patient goes home.

Preliminary Studies

When the BRIDGE clinic began operation in 2007, a clinical database was established to track the types of patients being seen and the effectiveness of the overall model. An initial review of this data, for the period from July 2008 through February 2009 revealed interesting findings warranting further study. As seen in Table 1, the average time from discharge to follow up with a cardiologist for all patients (N=342), whether participants in the BRIDGE program or not, was an astonishing 70.6 days whereas the average length from discharge to BRIDGE clinic was 19.5 days. The 30-day readmission rate for patients seen in the BRIDGE clinic was 8.5%, far less than the percentage of readmissions for patients who chose not to attend (21.2%), and well below the estimated national rate of 19.9% (Krumholz et al., 2009). This data thus supported BRIDGE's early success in preventing hospital readmission among BRIDGE users when compared to those who had more traditional follow-up. Why this occurred and what its effects were more broadly to the client and system remains to be examined in this study.

Table 1

Preliminary Data from BRIDGE Registry

Characteristic/Outcome (n=342)	BRIDGE Participants (n=230)	Non-participants (n=112)	p-value
Age (mean yr ± SD)	64.1 ± 15.0	61.0 ± 14.8	0.075
Male (%)	128 (55.4)	62 (55.7)	0.959
Days to BRIDGE (mean yr ± SD)	19.5 ± 17.8	N/A	N/A
Days to Cardiologist (mean yr ± SD)	75.0 ± 54.9	53.0 ± 55.5	0.006
Days to any provider (mean yr ± SD)	38.2 ± 56.2	38.0 ± 61.0	0.985
30-day Readmission (%)	19 (8.5)	21 (21.2)	0.001

Research Design and Methodologies in the Current Study

Design

This study analyzes data from the observational BRIDGE Registry to investigate the outcomes and efficacy of the nurse practitioner-driven BRIDGE program as a model for delivering transitional care. As noted earlier, the study's three specific aims will be addressed in three separate but related papers (Chapters 2-4). First, the 6-month post-discharge medication persistence rates (for β-blockers, ACE-inhibitors, aspirin, statins and clopidogrel) will be compared between patients who participated in the BRIDGE program and those who did not. Second, the 30-day readmission rate for ACS patients will be compared between patients who participated in BRIDGE and those who did not. Third, the cost and effectiveness of the BRIDGE program will be compared to usual care and avoided rehospitalizations as a result of the program.

The Human Subjects Internal Review Board (IRB) of the University of Michigan Medical Center approved this study (HUM00035421). As there was no direct patient intervention in this study, and only minimal patient risk, therefore informed consent was waived. Because of the study design and restrictions on the IRB waiver, no socioeconomic data were collected.

Setting

The University of Michigan's approach to managing the transitional care gap for CV patients and their high rates of early readmissions is novel. Bridging the Discharge Gap Effectively (BRIDGE) is a program designed to ensure that patients who are discharged after an ACS event have support through the hospital-to-home transition. The ambulatory clinic is staffed by independent, specialized, cardiovascular nurse practitioners, who function in collaboration with on-site cardiologists and who act as an extension of the in-hospital care team (Housholder & Norville, 2009).

The five expert cardiology nurse practitioners delivering the BRIDGE program each have a minimum of 25 years of cardiovascular nursing experience. They are all certified by the American Nurses Credentialing Center as either acute care or adult nurse practitioners. The NPs have monthly training, lectures, and seminars, provided by national experts in the field, to maintain currency and stay abreast of evidence-based changes to the care of ACS patients.

Sample

The BRIDGE registry contains data on all patients referred to the cardiovascular BRIDGE Clinic. Patients are enrolled in the registry if they received a BRIDGE referral at the time of discharge (refer to the patient flow diagram, *Figure 2*). Referrals are made to the BRIDGE program based on whether or not a patient has a follow-up appointment scheduled with their cardiologist or primary care provider within 14 days of discharge. The discharging physician is prompted to make this referral if no follow-up is documented. The Health System tracks all BRIDGE referrals. Each scheduled appointment, regardless of patients' participation, constitutes a unique entry into the BRIDGE registry.

Data from March 30, 2008 through March 30, 2009 were analyzed to address the differences between subjects who attended BRIDGE and those who did not. Thus, patients discharged between March 30, 2008 and March 30, 2009 were divided into two cohorts: an intervention group consisting of all patients who participated in the BRIDGE program during that period and a control group consisting of patients who were referred but did not participate in the program during the same period. Determinations of six-month medication continuation rates were calculated through six-months after the discharge date. Patients were excluded from the medication continuation portion of the study if they lacked follow-up data at six-months, had contraindications to medications for secondary prevention of events, or died. Patients were also excluded from the full study if they were pregnant, followed-up outside of the health system, or were readmitted or died prior to their initial BRIDGE clinic appointment. The Social Security Death Index was queried at the time of data abstraction for patients lacking follow up to determine if they died within the study period.

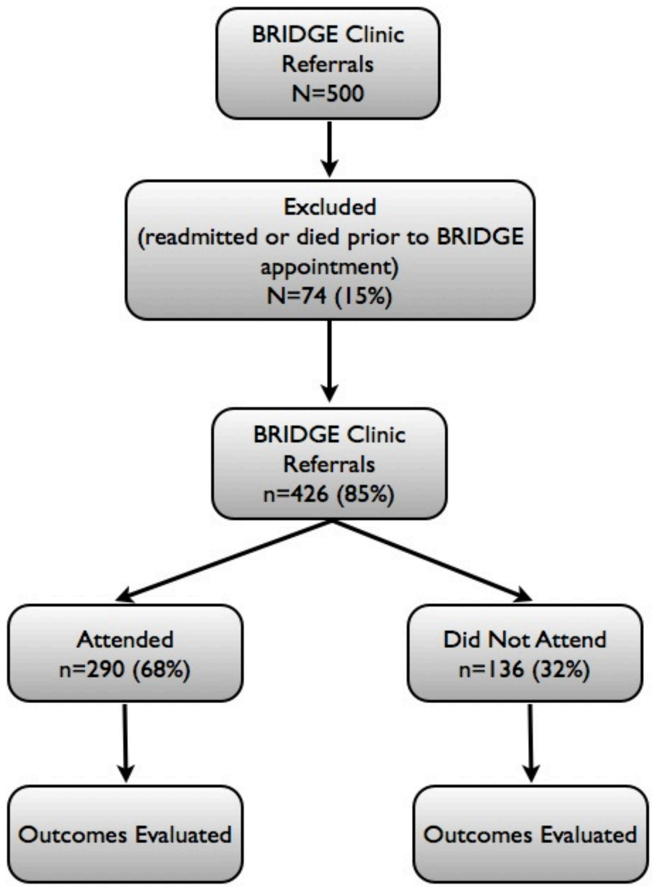

Figure 2. Patient flow diagram of the full BRIDGE Registry

Intervention

Client participation in the BRIDGE clinic was the intervention in this study. As noted earlier, five specially trained cardiology nurse practitioners (NPs) independently provide care in the BRIDGE clinic with medical collaboration and support as an extension of the discharge team. In a one-time visit with each patient, the NP does a comprehensive review of the hospital course and discharge plan and performs a thorough history and physical exam. The NP then evaluates the patient's knowledge and understanding of his/her diagnosis and treatment while reviewing each ordered test and medication. All NPs ensure that the American College of Cardiology/American Heart Association guidelines for secondary prevention medications have been prescribed and adjust medications and dosages depending on the patient's responses and/or side effects. The NPs also verify that all future tests and appointments have been scheduled and that proper referrals have been made. The combination of a comprehensive history and physical appraisal with education, resources, and proper follow-up aim to minimize the gaps in care during the hospital-to-home transition.

Instruments

Two major instruments were employed to gather data across all three papers.

Charlson Comorbidity Index (CCI). The CCI is a tool designed to quantify the combined effects and severity of 19 comorbid conditions on mortality. Each condition is weighted by its adjusted relative risk of mortality at 1 year to accommodate for the significant prognostic differences among the conditions (Charlson, Pompei, Ales, & MacKenzie, 1987). The chart tool is simple to use and requires only knowledge of the patient's comorbid conditions and their assigned weights. The sum (a continuous measure) of the individual weights classifies the level of comorbidity. One year and ten year mortality rates can be calculated for four distinct CCI score groups; 0, 1-2, 3-4, > 5, with higher

CCI scores associated with higher mortality (Charlson et al., 1987; Charlson, Szatrowski, Peterson, & Gold, 1994).

The CCI was developed in 1987 and modified to include age in 1994. For the purpose of this study, the original measure was used, as age is an independent risk for CVD (Wilson et al., 1998). Both tools have been tested in a variety of populations and settings and were consistently found to be valid tools for predicting mortality and adjusting risk (Needham, Scales, Laupacis, & Pronovost, 2005). The CCI served as a proxy for an individual's overall severity of illness.

GRACE risk score. The GRACE risk score for discharge is a tool to predict the risk of death in patients with acute coronary syndrome from hospital discharge to six months out. In this model, nine items were found to be multivariate predictors of mortality, with a c-statistic between 0.70 and 0.80, for all ACS patients (Eagle, Lim, et al., 2004). The variables included were age, heart rate, systolic blood pressure, creatinine level, and the presence or history of congestive heart failure, in-hospital percutaneous intervention, in-hospital coronary artery bypass graft surgery, past history of an AMI, ST-segment depression, and/or elevated cardiac enzymes (Eagle, Lim, et al., 2004). The tool assigns point values for levels of each variable. The sum (a continuous measure) of the points is then cross-referenced with the probability of in-hospital death (Granger et al., 2003). The discriminatory and predictive validity of this tool has been widely published (Elbarouni et al., 2009; Ramsay, Podogrodzka, McClure, & Fox, 2007). The GRACE score was used in this study to adjust for the severity of the patient's ACS event.

Data Collection

BRIDGE. Consecutive data for all patients referred to the BRIDGE program were collected into a de-identified, online, clinical database. Patients who did not show or who cancelled their appointments received a follow up phone call to determine the cause. The BRIDGE registry is maintained by The Michigan Cardiovascular Outcomes Research and Reporting Program (M-CORRP), a division of Cardiovascular Medicine specifically charged with developing and maintaining clinical registries for the purpose of advancing the science of cardiovascular medicine and improving the quality of care received by all patients in the UMHS system.

Recording of the registry population occurred in two phases. First, data were collected by direct chart audit. Second, data were manually entered into the online registry. The data abstraction form (see *Figure 3*) shows the variables included in this registry. Basic demographic, admission, discharge data, and 6-month follow-up data were collected. Additionally, detailed information pertaining to medications and the components necessary to calculate the CCI score and the GRACE Risk Score were incorporated. The tool has been refined since the preliminary clinical data collection in November of 2008 and has undergone extensive pilot testing for face validity.

BRIDGE CLINIC DATA FORM

Last Updated: 6/7/2010
Version 2.5.3

[1] PATIENT INFORMATION

Registration # ☐☐☐☐☐☐☐☐ Age ☐

Bridge Study # ☐☐☐☐☐☐☐☐ ◯ Male ◯ Female

Race: ◯ N/A
◯ White ◯ Black ◯ Asian ◯ Hisp. ◯ Nat. Amer. ◯ Other

[2] BRIDGE APPOINTMENT

1. Date of Bridge Clinic Appt (M M D D Y Y Y Y)
2. Appointment Cancelled? ◯ Yes ◯ No — If yes, select reason for cancellation below:
   - ◯ Got appt with cardiologist
   - ◯ Got appt with other HCP
   - ◯ Did not want appointment
   - ◯ Did not want location
   - ◯ Schedule conflict ◯ Death
   - ◯ Rehospitalized ◯ Unknown
   - ◯ Rescheduled (If yes, record date below): (M M D D Y Y Y Y)
   - ◯ Other
3. Bridge Clinic Type?
   - ◯ General Cardiology Clinic
   - ◯ Heart Failure Clinic
4. Path to Bridge Appt:
   - ◯ Home ◯ Unknown
   - ◯ Extended Care Facility ◯ N/A
   - ◯ Rehabilitation Facility
5. Provider: ◯ Housholder, Susan
   - General Cardiology: ◯ Bord, Cheryl ◯ Merz, Julie ◯ Walthall, Susan ◯ Mollo, Lynette ◯ Kline-Rogers, Eva ◯ Unknown
   - Heart Failure: ◯ Aaronson ◯ Matthews ◯ Dardas ◯ Nicklas ◯ Dyke ◯ Stein ◯ Hummel ◯ Wu ◯ Koelling ◯ Unknown

[3] BRIDGE SUMMARY

1. Adherence/Management Issues: ☐ N/A ☐ None
   - ☐ Education Provided
     - ☐ Disease process
     - ☐ Symptoms
     - ☐ When to seek care
     - ☐ Smoking cessation
     - ☐ Fluid Restriction
   - ☐ Diet
     - ☐ Na Restriction
     - ☐ Low Fat/Cholesterol
     - ☐ Calorie Restriction
   - ☐ Physical Activity
     - ☐ Encourage
     - ☐ Restriction
   - ☐ Weight Management
     - ☐ Daily Weight
     - ☐ Weight Loss
     - ☐ Weight Gain
   - ☐ Management
     - ☐ Monitors not applied
     - ☐ Tests not scheduled
   - ☐ Referrals
     - ☐ Anti-Coag Services
     - ☐ Cardiologist
     - ☐ Other
   - ☐ Medications
     - ☐ Not understand how to take
     - ☐ Stopped w/o consult from MD
     - ☐ 2 in same drug class
     - ☐ Never received script
     - ☐ Never filled script
       - ☐ Why
2. Referral to ED from Bridge Clinic? (cardiac) ◯ Yes ◯ No ◯ N/A
   Reason: ☐ Chest Pain ☐ Infection ☐ CHF exacerbation ☐ Unknown
   ☐ Other
3. Admitted from Bridge Clinic? ◯ Yes ◯ No ◯ N/A
4. Rehab Entry combined w/ Bridge? ◯ Yes ◯ No ◯ N/A

[4] DISCHARGE SUMMARY

1. Date of Admission (M M D D Y Y Y Y)
2. Date of Discharge (or Date of HFT referral)
   D/C Physician (Attending) — Physician ID # ◯ Heart Failure Telemanagement
3. Diagnosis from Primary Discharge:
   (select one) ◯ Unknown
   - ◯ Acute Coronary Syndrome (ACS)
     - ◯ STEMI
     - ◯ NSTEMI
     - ◯ Unstable Angina (USA)
   - ◯ Chest Pain (CP)
   - ◯ Afib/Flutter (AFIB)
   - ◯ Cardiomyopathy (CM)
   - ◯ Congestive Heart Failure (CHF)
     - ☐ Acute ☐ Systolic
     - ☐ Chronic ☐ Diastolic
   - ◯ Coronary Artery Disease (CAD)
     - ☐ CABG ☐ PCI
     - ☐ Cath ☐ Rx Therapy Only
   - ◯ Malignancy
   - ◯ Pericarditis (PeriC)
   - ◯ Other

   If Other, Indicate Reason for Bridge Referral: ◯ ACS ◯ CP ◯ AFIB ◯ CM ◯ CHF ◯ CAD ◯ Malignancy ◯ PeriC ◯ Cardiac (specify):
4. PMH / Comorbidities:
   (Including Primary. Select all that apply.)
   - ☐ Afib/Flutter (AFIB)
   - ☐ AIDS
   - ☐ Anemia (Any)
   - ☐ Aortic Stenosis
   - ☐ Arthritis
   - ☐ Arrhythmia
   - ☐ Atherosclerosis - Chronic
   - ☐ Cardiomyopathy (Any)
   - ☐ Cerebro Vascular Disease (CVD)
     - ☐ Trans Ischemic Attack (TIA)
     - ☐ Cerebrovascular Accident (CVA)
     - ☐ Carotid Stenosis
   - ☐ Congestive Heart Failure (CHF)
   - ☐ Connective Tissue Disorder
   - ☐ Coronary Artery Disease (CAD)
     - ☐ CABG ☐ MI
     - ☐ Cath ☐ PCI
   - ☐ Current Cigarette Smoker
   - ☐ Diabetes Mellitus (Any)
     - ☐ End Organ Damage
   - ☐ Dyslipidemia (Any)
   - ☐ Fluid/Electrolyte/pH Disorder
   - ☐ GERD
   - ☐ Hematologic Disorder - Severe
   - ☐ Hypertension (HTN)
   - ☐ Hypothyroidism
   - ☐ ICD/Pacemaker
   - ☐ Liver Disease
     - ◯ Mild ◯ Severe
     - ◯ Moderate
   - ☐ Malignancy
     - ☐ Leukemia ☐ Metastatic
     - ☐ Lymphoma
   - ☐ Obesity
   - ☐ Physical Disability - Functional
     - ☐ Hemiplegia
   - ☐ Protein-Calorie Malnutrition
   - ☐ Psychiatric Disorder (Major)
     - ☐ Anxiety ☐ Depression
     - ☐ Dementia ☐ Substance
   - ☐ Renal Disease
     - ◯ Acute ---> ◯ Dialysis?
     - ◯ Chronic ---> ◯ Mild ◯ Moderate ◯ Severe
   - ☐ Shock/Cardiorespiratory Failure
   - ☐ Pulmonary Disease
     - ☐ Mild ☐ Severe
     - ☐ Moderate ☐ OSA
   - ☐ Ulcer Disease
   - ☐ Urinary Tract Disorder
   - ☐ Valvular & Rheumatic Heart Disease
   - ☐ Vascular Disease
     - ☐ Deep Vein Thrombosis (DVT)
     - ☐ Peripheral Artery Disease (PAD)
     - ☐ Peripheral Venous Disease (PVD)
     - ☐ Pulmonary Emboli (PE)
   - ☐ Other (list below)

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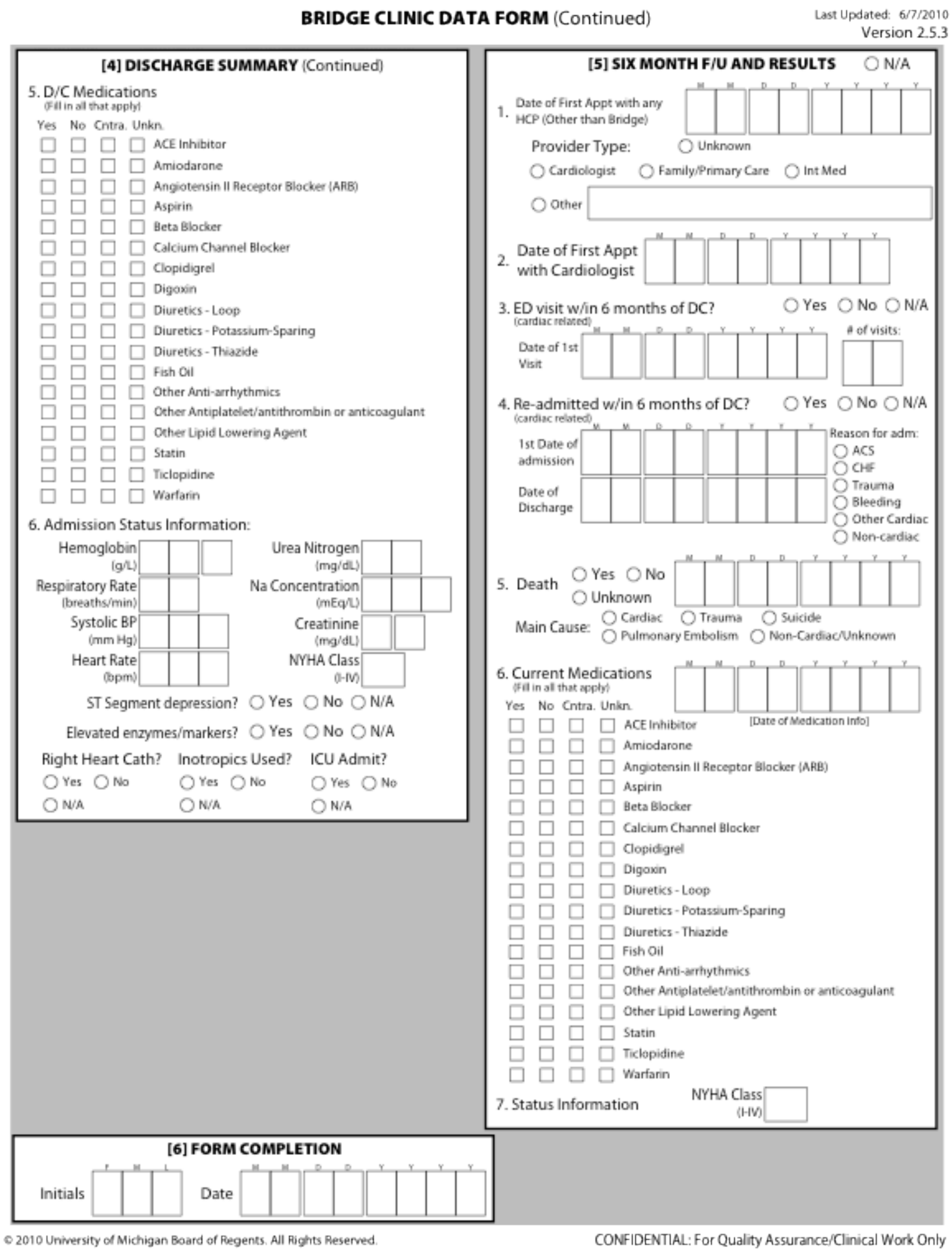

BRIDGE CLINIC DATA FORM (Continued)

Last Updated: 6/7/2010
Version 2.5.3

[4] DISCHARGE SUMMARY (Continued)

5. D/C Medications (Fill in all that apply)

Yes	No	Cntra.	Unkn.	
☐	☐	☐	☐	ACE Inhibitor
☐	☐	☐	☐	Amiodarone
☐	☐	☐	☐	Angiotensin II Receptor Blocker (ARB)
☐	☐	☐	☐	Aspirin
☐	☐	☐	☐	Beta Blocker
☐	☐	☐	☐	Calcium Channel Blocker
☐	☐	☐	☐	Clopidigrel
☐	☐	☐	☐	Digoxin
☐	☐	☐	☐	Diuretics - Loop
☐	☐	☐	☐	Diuretics - Potassium-Sparing
☐	☐	☐	☐	Diuretics - Thiazide
☐	☐	☐	☐	Fish Oil
☐	☐	☐	☐	Other Anti-arrhythmics
☐	☐	☐	☐	Other Antiplatelet/antithrombin or anticoagulant
☐	☐	☐	☐	Other Lipid Lowering Agent
☐	☐	☐	☐	Statin
☐	☐	☐	☐	Ticlopidine
☐	☐	☐	☐	Warfarin

6. Admission Status Information:

Hemoglobin (g/L) — Urea Nitrogen (mg/dL)
Respiratory Rate (breaths/min) — Na Concentration (mEq/L)
Systolic BP (mm Hg) — Creatinine (mg/dL)
Heart Rate (bpm) — NYHA Class (I-IV)

ST Segment depression? ◯ Yes ◯ No ◯ N/A
Elevated enzymes/markers? ◯ Yes ◯ No ◯ N/A

Right Heart Cath? ◯ Yes ◯ No ◯ N/A
Inotropics Used? ◯ Yes ◯ No ◯ N/A
ICU Admit? ◯ Yes ◯ No ◯ N/A

[5] SIX MONTH F/U AND RESULTS ◯ N/A

1. Date of First Appt with any HCP (Other than Bridge) M M D D Y Y Y Y
Provider Type: ◯ Unknown ◯ Cardiologist ◯ Family/Primary Care ◯ Int Med ◯ Other

2. Date of First Appt with Cardiologist M M D D Y Y Y Y

3. ED visit w/in 6 months of DC? (cardiac related) ◯ Yes ◯ No ◯ N/A
Date of 1st Visit M M D D Y Y Y Y — # of visits:

4. Re-admitted w/in 6 months of DC? (cardiac related) ◯ Yes ◯ No ◯ N/A
1st Date of admission M M D D Y Y Y Y
Date of Discharge
Reason for adm: ◯ ACS ◯ CHF ◯ Trauma ◯ Bleeding ◯ Other Cardiac ◯ Non-cardiac

5. Death ◯ Yes ◯ No ◯ Unknown M M D D Y Y Y Y
Main Cause: ◯ Cardiac ◯ Trauma ◯ Suicide ◯ Pulmonary Embolism ◯ Non-Cardiac/Unknown

6. Current Medications (Fill in all that apply) M M D D Y Y Y Y [Date of Medication Info]

Yes	No	Cntra.	Unkn.	
☐	☐	☐	☐	ACE Inhibitor
☐	☐	☐	☐	Amiodarone
☐	☐	☐	☐	Angiotensin II Receptor Blocker (ARB)
☐	☐	☐	☐	Aspirin
☐	☐	☐	☐	Beta Blocker
☐	☐	☐	☐	Calcium Channel Blocker
☐	☐	☐	☐	Clopidigrel
☐	☐	☐	☐	Digoxin
☐	☐	☐	☐	Diuretics - Loop
☐	☐	☐	☐	Diuretics - Potassium-Sparing
☐	☐	☐	☐	Diuretics - Thiazide
☐	☐	☐	☐	Fish Oil
☐	☐	☐	☐	Other Anti-arrhythmics
☐	☐	☐	☐	Other Antiplatelet/antithrombin or anticoagulant
☐	☐	☐	☐	Other Lipid Lowering Agent
☐	☐	☐	☐	Statin
☐	☐	☐	☐	Ticlopidine
☐	☐	☐	☐	Warfarin

7. Status Information — NYHA Class (I-IV)

[6] FORM COMPLETION

Initials F M L — Date M M D D Y Y Y Y

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Figure 3. Data collection tool. Reprinted with permission from M-CORRP

Data collection was done retrospectively by trained BRIDGE staff through M-CORRP. The study team included research trainees, medical students, residents, and nursing students, who all worked under the direct supervision of M-CORRP faculty and the PI. To ensure reliability and consistency in the process, all data abstractors attended a 10 week series of seminars on cardiovascular disease and UMHS policies and procedures. Further, all team members received training on variable definitions, how to abstract and record data on the BRIDGE case report form, and how to operate the Drupal interface for online data collection. This study design allowed 6-month follow-up data to be collected simultaneously.

The patient registration number was the only personal health identification variable collected. To minimize patient risk, a subject identifier was generated when each patient was entered into the database. As the registration number was inputted into the database, a two-way encryption method known as Mcrypt_AES_256 transformed the registration number into unusable information. The only retrieval mechanism was to input a decryption key. Only the study investigators had authority to approve this procedure and the PI supervised its use throughout the process. The Social Security Death Index was queried at the time of data abstraction for patients lost to follow-up. No Social Security numbers were written down or kept electronically; only the result of the query (i.e. death) was recorded.

Four separate measures ensured the quality of data recorded within this registry. First, the first five cases for all trainees were dually abstracted. Second, a designated data entry person, who was not the data abstractor, entered data and confirmed the absence of omissions or nonsense responses (i.e. a date of readmission before a date of discharge). Third, a 10% sample of all cases was flagged for review and verification by the principal investigator (PI). Lastly, diagnostics were run on the dataset to identify duplicate or unrealistic entries (i.e length of stay greater that 1 year). The PI and M-CORRP Research Manager resolved any discrepancies by reviewing original chart documentation.

Data Analysis

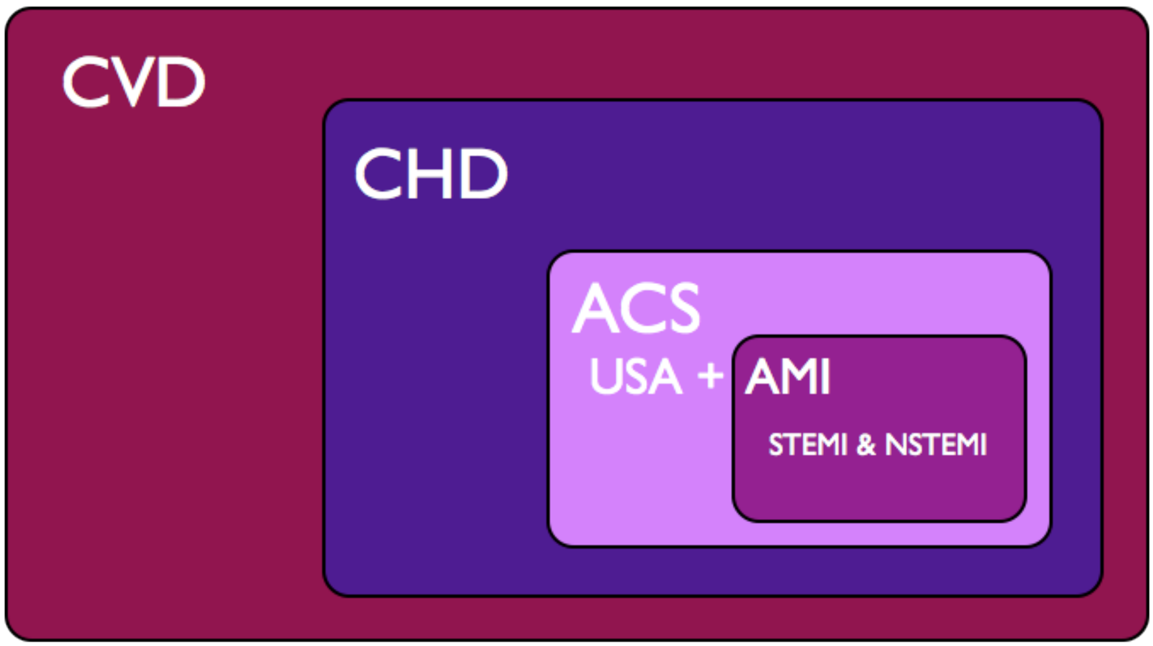
In order to address the three specific aims, three different analyses were performed. In chapter 2, a logistic regression analysis was used to explore how both patient and clinical factors explain medication persistence behavior. In chapter 3, rates were calculated to determine differences in hospital readmission between BRIDGE participants and usual care. Finally in chapter 4, a cost model was developed to compare costs associated with hospital readmission.

Summary

Each of the three following papers explore a single component of the Integrated Client-Focused Transitional Care Model. In chapter 2, the client-specific characteristic of medication persistence is examined. In chapter 3, readmission rates are measured as an outcome. In chapter 4, the system influence of cost is investigated. Though three separate and unique issues, as a result of the three-manuscript format of this dissertation, there is necessary redundancy within the background and significance and methods sections of the first four chapters. The overarching theme of transitional care is revisited in each manuscript, and similarly, methodology is presented in each paper despite only the data analyses varying between papers.

Appendix

A Visual Representation of Coronary Disease Classifications



Cardiovascular Disease (CVD)

Coronary Heart Disease (CHD)

Acute Coronary Syndrome (ACS)
Unstable Angina (USA)

Acute Myocardial Infarction (AMI)
ST Elevated Myocardial Infarction (STEMI)
Non-ST Elevated Myocardial Infarction (NSTEMI)

CHAPTER II

THE BRIDGE PROGRAM IMPROVES MEDICATION PERSISTENCE

Introduction

It is estimated that 785,000 Americans will suffer a first coronary event this year and that another 470,000 will experience some recurrent cardiac event (Roger et al., 2011). These trends have given rise to the need for evidenced-based guidelines that focus on secondary prevention across all aspects of acute coronary syndrome (ACS). One of the leading efforts in secondary prevention is the American Heart Associations' (AHA) *Get with the Guidelines*, which when adhered to by patients, providers and health systems, demonstrates significant reductions in both morbidity and mortality among ACS patients (Mehta et al., 2004). These guidelines encourage education on diet, exercise, weight management, smoking cessation, comorbid disease management, stress reduction, and strict and ongoing adherence to a medical regimen of β-adrenergic blockers (β-blockers), angiotensin-converting enzyme inhibitors (ACE-inhibitors; or angiotensin receptor blockers [ARBs] if ACE-inhibitor intolerant), aspirin, and statins, along with clopidogrel for up to one year following an event (Anderson et al., 2011; Antman et al., 2004; Antman et al., 2009). β-blockers reduce cardiac workload and are potent anti-ischemic agents offering both cardio-protection and pain relief. ACE-inhibitors or ARBs provide additional protection against cardiac muscle damage and decrease ventricular dilation over time to decrease the incidence of future ACS events and comorbid consequences (Antman et al., 2004). Antiplatelet agents reduce thrombus formation in atherosclerotic vessels. There is overwhelming evidence that platelet inhibition via aspirin is highly effective at reducing ACS events (Antithrombotic Trialists' Collaboration, 2002). Statin therapy reduces atherogenic circulating lipids to prevent arteriosclerosis known to increase risk for both fatal and nonfatal AMIs (National Cholesterol Education Program, 2002). The synergistic effects of these four drug classes have been widely documented (Hippisley-Cox & Coupland, 2005; Mukherjee et al., 2004; Wald & Law, 2003) yet full compliance remains lower than desired (Choudhry, Avorn, Antman, Schneeweiss, & Shrank, 2007). Clopidogrel is the newest agent added to this secondary prevention regimen. Initially recommended only in aspirin intolerant patients or in patients post percutaneous interventions for at least 2 weeks in combination with aspirin (Antman et al., 2004), clopidogrel is now recommended in all patients for a full year after an ACS event (Anderson et al., 2011; Smith Jr et al., 2006). Antiplatelet therapy in general reduces mortality and morbidity due to vascular causes in patients with ACS (Antithrombotic Trialists' Collaboration, 2002). In the Clopidogrel in Unstable Angina to Prevent Recurrent Events (CURE) trial (Yusuf et al., 2001) and the Clopidogrel versus aspirin in Patients at Risk of Ischemic Events (CAPRIE) trial (CAPRIE Steering Committee, 1996) further reductions in adverse events were noted with the combination of aspirin and clopidogrel.

The consequences of discontinuing any one of these medications are well established. Patients who stop aspirin or beta-blocker therapy are at nearly twice the risk of death as patients who continue therapy. Patients who discontinue their statin are almost three times more likely to die than are persistent users. Patients who discontinue all three of these agents have a five-fold increased mortality over patients who continue on at least one or two agents (Ho et al., 2006). Aside from decreased mortality risk, patients who adhere to evidence-based medication regimens have lower hospitalization rates; the costs incurred by their medications are then offset by reductions in healthcare utilization (Choudhry et al., 2008; Sokol et al., 2005).

Despite abundant evidence supporting the importance of medication for secondary prevention, numerous studies report poor rates of medication persistence among patients at high risk for secondary events. Ackincigil et al. (2008) found that 18% and 22% of patients respectively discontinued their ß-blockers and ACE-inhibitors at 6 months (Akincigil et al., 2008), while Benner et al. (2002) reported even lower continuation rates for statins (56%). Examining ACS patients over one year, Newby, LaPointe, Nancy and Chen (2006) found that only 71% of patients remained on aspirin. According to Ramsay et al. (2006), less than 20% of all AMI patients continue on their 4-drug regimen as recommended. Those who remained on at least a 4-drug regimen reduced their risk of death by 87%.

There are many reasons why patients do not take their medications. Exorbitant medication costs, the patient's lack of knowledge about his condition and/or understanding of how the medication benefits his condition, medication side effects, and religious beliefs are just a few. As patients' lengths of hospital stay decrease, moreover, so do opportunities for inpatient education that may moderate these factors. Even under ideal circumstances where patient education has been accomplished, for example, patients may not have the capacity to retain such knowledge after hospital discharge. Education alone may not prepare patients for common errors such as duplicate medication classes (with medications they have at home), non-formulary substitutions, inadequate therapeutic responses, and untoward side effects that occur after discharge. Even when patients are motivated to seek early follow-up care, appointments with a cardiologist may not be available for months. Many patients do seek follow-up with their primary care provider, only to be referred back to their hospital specialist. Delays in follow-up visits are missed opportunities for medication reconciliation, assessment of the patient's response to treatment, and reinforcement of discharge teaching that help prevent early adverse events that lead to ED visits, rehospitalization, and even death.

Transitional care models utilizing nurse practitioners (NPs) may be the answer to the follow-up dilemma and its consequences. NP models stress the importance of developing trusting relationships with patients and physicians, providing individualized education to patients and their supporters, offering known social services, simplifying drug regimens, and addressing side effects (Albert, 2008).

This is no truer than with NPs providing care in the Bridging the Discharge Gap Effectively (BRIDGE) program. Well versed in the ACC/AHA guidelines for secondary prevention of cardiac complications, they assess patients for medication side effects, drug interactions, duplications, omissions, and response, and make adjustments or changes to medication regimens when warranted. In addition to medical management, the NPs provide essential education to patients and their families about their condition, how each medication works to help prevent future events, and the proper administration of each prescribed medication. The NPs communicate as part of an interdisciplinary team to both the hospital and outpatient care support teams, and when necessary, work with community resources should patients have trouble paying for their prescriptions. Although these activities are aimed toward increasing patient persistence on care regimens, there has been no evidence to date that supports whether patients seen in BRIDGE are more likely to stay on their prescribed regimens over individuals who follow a more traditional follow-up pathway after hospital discharge.

To explicate whether patients seen in the BRIDGE program are more likely to adhere to their prescribed regimen for secondary prevention, this study compared the six-month medication persistence rates with β-blockers, ACE-inhibitors (or ARBs), aspirin, statins, and clopidogrel following discharge from the hospital after an ACS event between patients who participated in the BRIDGE program and those who had usual care. Given the breadth of literature suggesting that transitional care models with NPs fill a critical gap in care delivery to effect outcomes, the hypothesis was that compared with patients who received usual care, patients who participated in the BRIDGE program would have higher medication persistence rates at 6-months over individuals who did not participate (usual care).

Methods

Design

This retrospective quasi-experimental study aimed to investigate the efficacy and outcomes of the NP-driven, BRIDGE program as a model for transitional care by comparing the 6-month post-discharge medication continuation rates (for β-blockers, ACE-inhibitors, aspirin, statins and clopidogrel) between patients who participated in the BRIDGE program and those who did not.

Setting

The University of Michigan's Bridging the Discharge Gap Effectively (BRIDGE) is a program designed to ensure that patients who are discharged after a cardiovascular (CV) event have support throughout the hospital-to-home transition. The clinic is staffed by five independent, specialized, cardiovascular nurse practitioners, who function in collaboration as an extension of the in-hospital care team and, when needed, with onsite cardiologists.

Each of the NPs delivering the BRIDGE program has a minimum of 25 years of cardiovascular nursing experience. They are all nationally certified by the American Nurses Credentialing Center as either acute care or adult nurse practitioners. As such, they have had, and continue to have, monthly training, lectures, and seminars provided by national experts in the field in order to maintain their clinical competence and currency, particularly as it pertains to and the care of CV patients.

Sample

All patients over 18 years of age discharged from the University of Michigan Health System (UMHS) between March 30, 2008 and March 30, 2009 who were admitted either for a CV event or required a cardiology consultation during their stay were eligible for this study. Patients were enrolled in the study if they received a BRIDGE referral at the time of discharge. Referrals were made to the BRIDGE program based on whether or not a patient had a follow-up appointment scheduled with their cardiologist or primary care provider within 14 days of discharge. The discharging physician was prompted to make this referral if no follow-up appointments existed. The Health System tracked all BRIDGE referrals. Each scheduled appointment, regardless of patients' participation, constituted a unique entry into the BRIDGE registry.

Patients discharged were then divided into two cohorts: an intervention group consisting of all patients who participated in the BRIDGE program during that period, and a control group consisting of patients who were referred to but did not participate in the program during the same period. Determination of six-month medication continuation rates between the 2 groups was analyzed through six-months after the discharge date. Patients were excluded from the medication continuation portion of the study if they lacked follow-up data at six-months, had contraindications to medications for secondary prevention of events, or expired.

Patients were also excluded from the full study if they became pregnant, sought follow-up outside of the University of Michigan health system, or expired within 30 days of discharge. The Social Security Death Index was queried for patients lost to follow-up.

The study cohort included 424 patients referred to the general medicine cardiology BRIDGE program between March 30, 2008 and March 30, 2009. All patients who met the inclusion criteria and did not have follow-up scheduled within 14 days of discharge were referred. The subset of patients with ACS comprised 25.7% (n=109) of these referrals. Patients were excluded if they died or were rehospitalized prior to their initial BRIDGE appointment (n=11, 10.3%), The final study sample included 97 patients after excluding patients with missing variables (n=1, 1.0%). See the patient flow (see *Figure 4*).

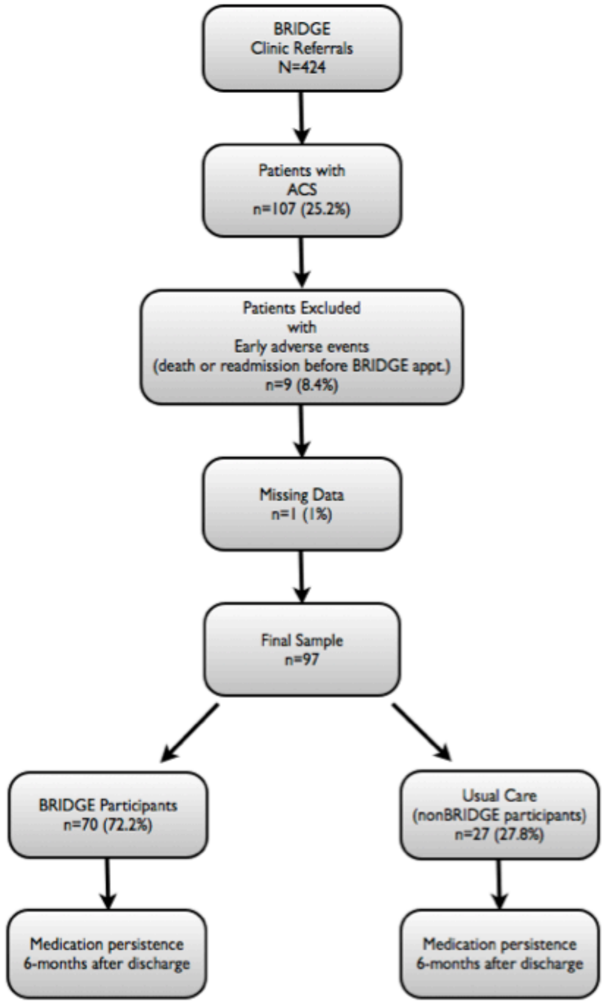


Figure 4. Patient flow diagram for analysis of medication persistence.

Measures

Two principal measures were used to extrapolate and analyze data to answer the study specific aims.

Charlson Comorbidity Index (CCI). The CCI is a tool designed to quantify the combined effects and severity of 19 comorbid conditions on mortality. Each condition is weighted by its adjusted relative risk of mortality at 1 year to accommodate for the significant prognostic differences among the conditions (Charlson et al., 1987). The chart tool is simple to use and requires only knowledge of the patient's comorbid conditions and the assigned weights. The sum (a continuous measure) of the individual weights classifies the level of comorbidity. One year and ten year mortality rates can be calculated. The range of possible scores depends on the number and severity of comorbid conditions within the study population. Higher CCI scores are associated with higher mortality (Charlson et al., 1987; Charlson et al., 1994).

Developed in 1987, the CCI has been tested across a variety of populations and settings and has consistently proven valid for predicting mortality and for risk adjusting (Needham et al., 2005). Given that greater numbers of comorbid conditions and the severity of those conditions is associated with poorer long-term outcomes, the CCI served as a proxy for overall severity of illness in this study.

GRACE Risk Score. The GRACE Risk Model for discharge was used to predict the risk of death in patients with acute coronary syndrome from discharge to six months after hospital discharge. The tool is simple and can be used in general clinical practice. Nine items were found to be multivariate predictors of mortality, with a *c*-statistic between 0.70 and 0.80 for all ACS patients (Eagle, Lim, et al., 2004). The nine variables were age, heart rate, systolic blood pressure, creatinine level, the presence or history of congestive heart failure, in-hospital percutaneous intervention, in-hospital coronary artery bypass graft surgery, past history of an AMI, ST-segment depression, and elevated cardiac enzymes (Eagle, Lim, et al., 2004). The tool assigned point values for levels of each variable such that individuals with higher risks had greater point value (possible range 70 to 210). The sum (a continuous measure) of the points was then cross referenced with the probability of in-hospital death (Granger et al., 2003). The discriminatory and predictive validity of this tool has been widely published (Elbarouni et al., 2009; Ramsay et al., 2007).

Approach

BRIDGE. The Michigan Cardiovascular Outcomes Research and Reporting Program (M-CORRP) maintains the BRIDGE registry. M-CORRP is a division of cardiovascular medicine specifically charged with developing and maintaining clinical registries for the purpose of advancing the science of cardiovascular medicine and improving the quality of care received by all patients. Data collection was performed retrospectively. Designated study research trainees (medical and research students working under the direction of M-CORRP and the PI) abstracted and entered data.

Three separate measures were in place to ensure the quality of data recorded within the registry. The first five cases for all trainees were separately abstracted and entered in the database and compared to the original case entry. Random 10% samples of all cases were flagged for repeat abstraction and data re-entry verification. The PI and M-CORRP Research Manager resolved any discrepancies.

Consecutive data for all patients referred to the BRIDGE program were collected into a de-identified, online, clinical database using a data abstraction form specific to this registry (see *Figure 3*, chapter 1). Data collected on each participant included basic demographics, admission data, discharge data, and 6-

month follow-up data, as well as detailed information pertaining to medications and the components necessary to calculate the CCI and GRACE Risk Scores. The latter items, as noted earlier, were critical in order to adjust for an individual's overall severity of illness (CCI) and the severity of the patient's ACS event (Grace Risk Score). Prior to its use, the data abstraction tool underwent extensive piloting and face validity testing. Patients who did not present for their appointment or who cancelled their appointments received a follow-up phone call to determine the cause. This data was also coded and contained in the database.

Data Analysis

Outcome. The main outcome for this analysis was medication persistence at six-months among ACS patients discharged on any combination of β-blockers, ACE-inhibitors (or ARBs), aspirin, statins, and clopidogrel. Persistence was defined as self-reported continued use of the medication six-months after discharge. Six-month persistence rates were determined by comparing self-reported medication regimens from the most complete cardiology or primary care follow-up notes six-months after discharge (no more than two weeks before and no more than one month beyond the six month discharge date) to the medication regimen prescribed at discharge. The methodology described here to calculate persistence with evidence-based medication therapies after discharge is consistent with the methodology employed to determine medication adherence from the GRACE Registry (Eagle, Kline-Rogers, et al., 2004).

Statistical Analysis. Six-month medication persistence rates for β-blockers, ACE-inhibitors (or ARBs), aspirin, statins, clopidogrel, and the combination of 3, 4, and 5 drug regimens were compared between BRIDGE attendees and non-attendees using the chi square test. Pearson's chi-square test for significance is reported except in cases where the expected count would violate an underlying assumption; in these cases, Fisher's Exact test is reported. Patients with known contraindications or hypersensitivity reactions to certain medications, such that they could not be prescribed or continue medication usage, were excluded. Data were analyzed using PASW 18.0. Baseline equivalencies were assessed for all demographic variables, comorbidities, and CCI and GRACE Risk scores. All variables were assessed for compliance with statistical assumptions including normal distribution. Missing data were excluded from the sample.

Hierarchical logistic regression models were used for each class of medication to evaluate the first hypothesis that BRIDGE attendance would influence medication persistence after adjusting for comorbidities (CCI) and severity of events (GRACE). A significance level was set at 0.05 for all analyses. Odds ratios (ORs) and 95% confidence intervals (CIs) were reported for all independent variables.

Results

Sample

Of 107 individuals discharged from UMHS after an ACS event, 97 were included in this analysis (refer back to *Figure 4*). Although patients with early adverse events (EAE) resulting in death or readmission before their scheduled

BRIDGE appointment were excluded from the analysis, in view of the fact that they neither received the intervention nor had the opportunity to attend if they had chosen to do so, those who were excluded were compared to those who were included to ensure that there was no significant variation between groups. There were no significant baseline differences between groups in either demographics or the types of comorbid conditions present (see Table 2). There were however, significant differences in both CCI and GRACE Risk scores. Patients who experienced an EAE had higher CCI and GRACE Risk scores, suggesting that these patients had more comorbid conditions or a more serious event, or both.

Table 2

Differences Between Sample and Those Excluded with an EAEs[a] No. (%)

Variable **n=107**	**EAEs** **n=9 (8.4%)**	**All Others** **n=98 (91.6%)**	**p-value**
Age (mean ±SD)	66.09 (14.96)	62.4 (13.9)	.409
Gender (% Female)	4 (44.4)	59 (60.2)	.483
Race			
White	7 (77.8)	83 (85.6)	.622
Non-white (Black, Asian, Native American, Hispanic)	2 (22.2)	15 (14.4)	.622
Comorbidities			
Afib	1 (11.1)	7 (7.1)	.517
CVD	0	6 (6.1)	1.00
Hx TIA	0	2 (2.0)	1.00
Hx CVA	0	2 (2.0)	1.00
CHF	2 (22.2)	12 (12.2)	.334
CAD	9 (100)	91 (92.9)	1.00
Current Smoker	2 (22.2)	24 (24.5)	1.00
Diabetes	3 (33.3)	30 (30.6)	1.00
Dyslipidemia	5 (55.6)	71 (72.4)	.279
HTN	7 (77.8)	63 (64.3)	.493
Obesity	1 (11.1)	18 (18.4)	1.00
Peripheral Vascular	1 (11.1)	12 (12.2)	1.00
Psychiatric Disorder n=35 (32.7%)	**n=4 (44.4%)**	**n=31 (31.6%)**	
Anxiety	1 (25.0)	16 (51.6)	.603
Dementia	1 (25.0)	5 (16.1)	.546
Depression	3 (75.0)	24 (77.4)	1.00
Substance	0	8 (25.8)	.553
Charlson Comorbidity	5.43+-2.30	3.98 +-1.79	.015
GRACE Risk Score	123.00+-37.53	99.69+-30.79	.022

[a]Early adverse events (hospital readmission or death before BRIDGE appointment).

The mean age of all study participants was 62.4 years. The majority (59.8%) were female, and white (85.6%) with a median length of initial hospital stay ranging from 2-4 days. Table 3 shows a comparison of patients who attended BRIDGE versus those who did not. With the exception of a higher percentage of dyslipidemia among BRIDGE users and slightly elevated rates of depression among non-attenders, there were no significant differences between the two groups.

Table 3

Demographic Differences Between BRIDGE and Usual Care Participants No. (%)

Variable n=97	**Attend n=70, (27.8%)**	**Did Not Attend n=27, (72.2%)**	**p-value**
Age (mean ±SD)	62.3±13.5	62.6±14.8	0.928
Gender (% Female)	42 (60.0)	16 (59.3)	0.947
Race			
White	59 (84.3)	24 (88.9)	0.751
Non-white (Black, Asian, Native American, Hispanic)	11 (15.7)	3 (11.1)	0.751
Comorbidities			
Afib	6 (8.6)	1 (3.7)	0.669
CVD	4 (5.7)	2 (7.4)	0.669
Hx TIA	2 (2.9)	0	1.00
Hx CVA	1 (1.4)	1 (3.7)	0.481
CHF	8 (11.4)	4 (14.8)	0.733
CAD	65 (92.9)	26 (96.3)	.670
Current Smoker	19 (27.1)	5 (18.5)	0.378
Diabetes	23 (32.9)	7 (25.9)	0.508
Dyslipidemia	57 (81.4)	14 (51.9)	0.003
HTN	47 (67.1)	16 (59.3)	0.466
Obesity	15 (21.4)	3 (11.1)	0.241
Peripheral Vascular	7 (10.0)	5 (18.5)	0.305
Psychiatric Disorder n=31(31.9%)	**n=17 (24.5%)**	**n=14 (51.9%)**	
Anxiety	9 (52.9)	7 (50.0)	0.870
Dementia	3 (17.6)	2 (14.3)	1.000
Depression	12 (70.6)	12 (85.7)	0.412
Substance	4 (23.5)	4 (28.6)	1.000
Charlson Comorbidity	3.98±1.75	4.11 ±1.96	0.765
GRACE Risk Score	99.63±30.8	103.44±30.8	0.585

Attendance

Overall, 77% (n=60) of referred patients attended their scheduled BRIDGE appointment. The median time from discharge to follow-up in the BRIDGE clinic was 15 days. There were differences between usual care (UC) and BRIDGE participants in median number of days from discharge to follow-up with any provider (UC median=15 days, BRIDGE median=20 days, $p=.587$) and with cardiology (UC median=31 days, BRIDGE median=59 days, $p=.006$). The most common reason for not attending BRIDGE was obtaining an earlier appointment with one's cardiologist or primary care provider (n=20/58 contacted by phone, 34.5%).

Medication Persistence

Overall rates of medication prescribing for secondary prevention in the population of study exceeded the rates in the literature for aspirin, β-blockers, and statins (Margulis, Choudhry, Dormuth, & Schneeweiss, 2011; Simpson, Beck, Richard, Eisenberg, & Pilote, 2003). Therefore, to show statistical significance over usual care in this institution is to show an improvement over care that is already above average. The following results (see Table 4) describe patterns of attendance by medications prescribed at discharge and patterns of persistence on the prescribed medications 6-months after discharge.

Table 4

Rates of Medication Persistence by BRIDGE Attendance No. (%)

Variable	n	Overall	Attend n=70 (72.2)	NonAttend n=27 (27.8)	p-value	OR	95% CI
Prescribed at discharge							
Aspirin	97	95 (97.9)	69 (98.6)	26 (96.3)	.481	2.654	[.160,44.004]
β-blockers	97	86 (88.7)	62 (88.6)	24 (88.9)	1.00	.969	[.237,3.960]
ACE-inhibitor/ARB	97	73 (75.3)	57 (81.4)	16 (59.8)	.023	3.014	[1.136,7.998]
Statin	97	92 (94.8)	68 (97.1)	24 (88.9)	.130	4.250	[.669,26.995]
Clopidogrel	97	72(75.5)	53 (75.7)	19 (73.1)	.791	1.149	[.412,3.199]
4 Drug Combination[a]	97	59 (60.8)	47 (67.1)	12 (44.4)	.040	2.554	[1.030,6.335]
5 Drug Combination[b]	97	46 (47.4)	36 (51.4)	10 (37.0)	.203	1.800	[.724,4.476]
Persistence at 6 months							
Aspirin	44	42 (95.5)	33 (97.1)	9 (90.0)	.407	3.667	[.208,65.548]
β-blockers	40	36 (90.0)	29 (93.5)	7 (77.8)	.213	4.143	[.494,34.746]
ACE-inhibitor/ARB	31	25 (80.6)	20 (80.0)	5 (83.3)	1.00	.800	[.076,8.474]
Statin	44	40 (90.9)	31 (91.2)	9 (90.0)	1.00	1.148	[.106,12.427]
Clopidogrel	35	30 (85.7)	22 (81.5)	8 (100.0)	.315	--	--
Of patients Prescribed 4 agents							
Still on 0 agents	27	--	--	--	--	--	--
Still on 1-2 agents	32	8 (25.0)	1 (16.7)	7 (26.9)	1.00	1.842	[.182,18.65]
Still on 3-4 agents	27	24 (88.9)	19 (86.4)	5 (100.0)	1.00	--	--
Of patients Prescribed 5 agents							
Still on 0 agents	21	--	--	--	--	--	--
Still on 1-2 agents	23	4 (17.4)	3 (16.7)	1 (20.0)	1.00	.800	[.065,9.919]
Still on 3-4 agents	34	20 (58.8)	14 (53.8)	6 (75.0)	.422	.389	[.112,2.024]
Still on 5 agents	21	12 (57.1)	10 (58.8)	2 (50.0)	1.00	1.429	[.161,12.701]

[a]Aspirin, β-blockers, ACE-inhibitor/ARB, statin. [b]Four agents plus clopidogrel.

As can be seen, nearly all patients discharged with ACS were prescribed aspirin (97.9%). Again, small numbers prohibit finding significance, but the trend here is also more difficult to interpret. Most subjects remained on aspirin (95.5%) six months after discharge. There were no differences between BRIDGE participants or participants receiving usual care and aspirin persistence 6 months after discharge.

Of those patients discharged with ACS, 88.7% were prescribed β-blockers. Being prescribed β-blockers had no impact on BRIDGE attendance (p=1.000*) and six months after discharge, 90% of the patients remained on β-blocker therapy regardless of BRIDGE participation (p=.123*).

Only 75.3% of all patients were discharged on ACE-inhibitors (or ARBs if ACE-inhibitor intolerant). A higher percentage of patients treated with ACE-inhibitors attended their scheduled BRIDGE appointment (p=.023) and six months after discharge ACE-inhibitor persistence increased for patients receiving usual care but remained 80.6% for all patients.

A high percentage of patients received prescriptions for statins at discharge (94.8%). Statin therapy did not influence BRIDGE participation (p=.130). Six-months after discharge a similarly high percentage of patients remained on their statins (90.9%) regardless of BRIDGE participation.

Of patients meeting the criteria for clopidogrel, 75.0% received a prescription at discharge. Being prescribed clopidogrel did not impact BRIDGE attendance (p=. 791). Six-months after discharge, 85.7% of patients remained on their clopidogrel and there were no differences between those who attended or those who received usual care.

Logistic regression was used to predict the likelihood of medication persistence six-months after hospital discharge. The analysis was limited by the number of patients for which there was medication persistence data available. Because of the small sample size, it was necessary to test a series of models rather than a single model. Also, because the CCI and GRACE Risk Scores had significant multicollinearilty ($r=.81$, $p< .000$) they could not be combined in any models. Three series of analyses were performed. Each series tested the likelihood of medication persistence to aspirin, ß-blockers, ACE-inhibitors, statins, and clopidogrel individually and to the four and five drug combined pharmacotherapy regimens of aspirin, ß-blockers, ACE-inhibitors, statins (4 drug regimen) plus clopidogrel (5 drug regimen). The first series of models tested only BRIDGE attendance. The second series tested attendance after adjustment for CCI, by entering it in first. Similarly, the third series tested attendance after adjustment for the GRACE Risk Score. As shown in Table 5, only 4 of the 21 models were predictive of medication persistence at six-months: ß-blockers or ACE-inhibitors adjusted for either the CCI or GRACE Risk Score. For ß-blockers, the addition of the CCI to attendance explained between 22.9% (Cox and Snell R squared) and 47.8% (Nagelkerke R squared) of the variance in persistence six-months after hospital discharge. Likewise testing attendance with the GRACE Risk Score explained between 25.4% (Cox and Snell R squared) and 53.1% (Nagelkerke R squared) of the variance in six-months persistence. The ACE-inhibitor model adjusted for the CCI explained between 25.0% (Cox and Snell R squared) and 39.0% (Nagelkerke R squared) of the variance in persistence; and in combination with the GRACE Risk Score explained between 31.7% (Cox and Snell R squared) and 49.5% (Nagelkerke R squared) of the variance. Further, the only independent variables to demonstrate significance were the CCI and GRACE Risk Scores.

Table 5

Logistic Regression Models Predicting Likelihood of Medication Persistence Six-Months after Hospital Discharge by BRIDGE Attendance

	Unadjusted Models		
Medication	***ß***	**Odds Ratio**	**95% CI**
Aspirin			
Constant	2.197	9.000	
Attend	1.269	3.556	.202, 62.63
-2 Log Likelihood	15.464		
Chi-Square (*df)*	.714 (1)		
% Correct classification	95.3		
Beta Blockers			
Constant	1.253	3.500	
Attend	1.421	4.143	.494, 34.746
-2 Log Likelihood	24.366		
Chi-Square (*df)*	1.640 (1)		
Correct classification	90.0		
ACE-I/ARBs			
Constant	1.609	5.000	
Attend	-.329	.720	.068, 7.661
-2 Log Likelihood	29.492		
Chi-Square (*df)*	.078 (1)		
Correct classification	79.3		
Statins			
Constant	2.197*	9.000	
Attend	.105	1.111	.103, 12.037
-2 Log Likelihood	26.608		
Chi-Square (*df)*	.007 (1)		
Correct classification	90.7		

Medications	ß	Odds Ratio	95% CI
	Unadjusted Models Continued		
Clopidogrel			
Constant	21.203	-	
Attend	-19.768	-	
-2 Log Likelihood	25.457		
Chi-Square (*df)*	2.938 (1)		
Correct classification	85.3		
4 Agents			
Constant	.405	1.500	
Attend	.773	2.167	.262, 17.892
-2 Log Likelihood	25.280		
Chi-Square (*df)*	.502 (1)		
Correct classification	72.7		
5 Agents			
Constant	.000	1.000	
Attend	.916	2.500	.256, 24.375
-2 Log Likelihood	22.297		
Chi-Square (*df)*	.618 (1)		
Correct classification	66.7		
	Models Adjusted for Charlson Comorbidity Index		
Aspirin			
Constant	1.303	3.681	
Charlson	.249	1.282	.053, .254
Attend	1.253	3.500	.196, 62.65
-2 Log Likelihood	15.159		
Chi-Square (*df)*	1.018 (2)		
% Correct classification	95.3		
Beta Blockers			
Constant	-3.720	.024	
Charlson	1.702*	5.482	1.189, 25.272
Attend	1.447	4.250	.285, 63.385

Medications	Models Adjusted for Charlson Comorbidity Index *ß*	Odds Ratio	95% CI
-2 Log Likelihood	15.619		
Chi-Square (*df*)	10.388 (2)**		
Correct classification	92.5		
ACE-I/ARBs			
Constant	5.913*	369.69	
Charlson	-.927*	.396	.185, .848
Attend	-.280	.756	.036, 15.844
-2 Log Likelihood	21.241		
Chi-Square (*df*)	8.329 (2)*		
Correct classification	86.2		
Statins			
Constant	.887	2.428	
Charlson	.409	1.505	.696, 3.257
Attend	-.088	.916	.078, 10.746
-2 Log Likelihood	25.324		
Chi-Square (*df*)	1.291 (2)		
Correct classification	90.7		
Clopidogrel			
Constant	-	-	
Charlson	-	-	-
Attend	-	-	-
-2 Log Likelihood	-		
Chi-Square (*df*)	-		
Correct classification	-		
4 Agents			
Constant	3.302	27.168	
Charlson	-.728	.483	.204, 1.141
Attend	.843	2.324	.199, 27.183

Medications	Models Adjusted for Charlson Comorbidity Index		
	ß	**Odds Ratio**	**95% CI**
-2 Log Likelihood	21.572		
Chi-Square (*df*)	4.210 (2)		
Correct classification	81.8		
5 Agents			
Constant	2.7000	14.881	
Charlson	-.692	.501	.207, 1.212
Attend	1.013	2.754	.189, 40.146
-2 Log Likelihood	19.056		
Chi-Square (*df*)	3.859 (2)		
Correct classification	72.2		
	Models Adjusted for GRACE Risk Score		
Aspirin			
Constant	2.452	11.610	
GRACE	-.003	.997	.949-1.049
Attend	1.281	3.600	.202, 64.03
-2 Log Likelihood	15.454		
Chi-Square (*df*)	.724 (2)		
% Correct classification	95.3		
Beta Blockers			
Constant	-9.395	-	
GRACE	.138*	1.147	1.006, 1.309
Attend	.904	2.469	.151, 40.485
-2 Log Likelihood	14.298		
Chi-Square (*df*)	11.708** (2)		
Correct classification	95.0		
ACE-I/ARBs			
Constant	9.979*	-	
GRACE	-.077**	.929	.874, .981
Attend	-.357	.700	.014, 33.970

Medications	Models Adjusted for Charlson Comorbidity Index ß	Odds Ratio	95% CI
-2 Log Likelihood	18.529		
Chi-Square (*df*)	11.040 (2)**		
Correct classification	89.7		
Statins			
Constant	.759	2.135	
GRACE	.016	1.016	.971, 1.064
Attend	-.045	.956	.082, 11.103
-2 Log Likelihood	26.065		
Chi-Square (*df*)	.550 (2)		
Correct classification	90.7		
Clopidogrel			
Constant	-	-	
GRACE	-	-	-
Attend	-	-	-
-2 Log Likelihood	-		
Chi-Square (*df*)	-		
Correct classification	-		
	Models Adjusted for GRACE Risk Score		
4 Agents			
Constant	5.450	232.733	
GRACE	-.056	.946	.888, 1.007
Attend	1.576	4.838	.260, 89.891
-2 Log Likelihood	20.610		
Chi-Square (*df*)	5.172 (2)		
Correct classification	86.4		
5 Agents			
Constant	5.054	156.651	
GRACE	-.055	.947	.877, 1.021
Attend	1.293	3.644	.191, 69.442

	Models Adjusted for Charlson Comorbidity Index		
Medications	***ß***	**Odds Ratio**	**95% CI**
-2 Log Likelihood	18.964		
Chi-Square (*df*)	3.951 (2)		
Correct classification	77.8		

*$p < .05$, ** $p < .01$

In summary, there were no significant differences in six-month medication persistence for any individual medication (aspirin, β-blocker, ACE-inhibitor, statin, clopidogrel). There were however, higher percentages of patients remaining on these therapies at 6-months after discharge who attended the BRIDGE program. Despite this finding, the small sample size and high rates of overall compliance may prevent observable significance. There were also no differences in rates of adherence to 4 or 5-drug combinations. Again, small numbers prohibit finding significance, but the trend here is also more difficult to interpret. The trend suggests greater persistence for non-attendees in all categories except for those prescribed the full 5-drug regimen, where patients who attended BRIDGE demonstrate greater persistence. However, with the exception of the β-blocker and ACE-inhibitor models combined with either the CCI or the GRACE Risk score, no models were predictive of medication persistence six-months after discharge. Of note, all patients, whether BRIDGE attendees or non-attendees, remained on at least one medication to the six month period of evaluation.

Discussion

This study measured differences in 6-month medication persistence rates of five secondary prevention agents between patients who received usual care and those who attended the NP-driven, transitional care BRIDGE program. Patients discharged on aspirin, β-blockers, statins, or clopidogrel had no impact on their follow-up BRIDGE appointment. However, more patients discharged on ACE-Is attended their BRIDGE appointment. This result is unclear given that there were no apparent demographic differences or disease severity differences between the 2 groups. One possible explanation may be that these patients received a stronger message from the discharge team regarding the need for early follow-up. Further analyses will be necessary to determine if this finding is clinically relevant.

There were no differences in 6-month persistence rates between usual care and BRIDGE participants on any single drug class. In fact, 6-month persistence for any single agent was high for all study participants; ranging from 80.65% for ACE-Is to 95.5% for aspirin. There was also no difference in persistence for ACE or statin use between BRIDGE participants and usual care. Higher proportions of patients who attended BRIDGE remained on aspirin and β-blockers, but lower proportions stayed on clopidogrel. It is unknown whether this reflects patient self-discontinuation or provider discontinuation. Significantly more patients prescribed either the 4 or 5 drug regimens attended their BRIDGE appointments. One possible explanation for this is that patients discharged on more medications may be more motivated to see a health care provider sooner due to side effects, questions, or confusion about their therapeutic regimen.

Given the small sample size, little can be concluded about the persistence habits of patients prescribed 4 or 5-drug regimens of combined pharmacotherapy. A larger sample is needed to more fully explore this question. However, despite there being no significant differences in persistence rates for patients prescribed combined pharmacotherapy, a higher percentage of patients who attended BRIDGE did remain on a 5-drug regimen six months after discharge and more patients under usual care reported continuing only 1-2 drugs of a 4 or 5-drug regimen. Notably, there were no cases where patients were taking zero medications. With the exception of the β-blocker and ACE-inhibitor models combined with either the CCI or the GRACE Risk score, no logistic regression models were predictive of medication persistence six-months after discharge. Further research and a larger sample is needed to not only determine if the intervention group has higher persistence, but also to determine if lower persistence is the result of patient or provider discontinuation. It is possible that the NPs of the BRIDGE clinic, or providers from subsequent visits over the six-month follow-up period, may have discontinued medications.

Limitations

This study adds to the growing body of literature on NP-delivered transitional care models. It also provides further understanding of how patients take their prescribed medications. It is also the first study to compare medication persistence after receiving usual care to participation in a transitional care program. However, there are limitations that should be considered. First, this study was conducted using an observational registry without randomization. Thus, this reduces the generalizability of the results as patients made their own decision whether or not to participate and therefore the groups were not likely to be equivalent. Still it has been argued that results from well done observational studies may more closely approximate usual care (Avorn, 2007). This study does compare a therapeutic intervention to usual care as a measure of success and thus its findings can be viewed as more rigorous. A second limitation pertains to the fact that the study institution has a high rate of compliance with evidence-based therapies, as is evidenced by the high discharge prescribing rates for cardio protective agents. Comparison of medication prescription rates at the UMHS with those reported in the GRACE Registry revealed that β-blocker prescribing rates at discharge were 2.1% higher at UMHS than those reported in the GRACE registry, aspirin prescribing rates were 7.0% higher at UMHS and statins 14.4% higher at U of M. (Eagle, Kline-Rogers, et al., 2004). Six-month continuation rates for both usual care and BRIDGE were 0.6% to 3.9% higher as well. The success of the BRIDGE transitional care program should be viewed not only as providing benefit beyond usual care, but also as providing benefit beyond usual care in a setting where usual care is highly consistent with national guidelines.

Because data were collected retrospectively, causality should not be assumed. Missing data or confounding variables may exist that were not taken into consideration. To calculate drug persistence for example, patients who had contraindications to medications were excluded from the analysis. Patients may have been misclassified if they had a troublesome effect or a contraindication to a drug prior to the index hospitalization that was not explicitly documented during this hospitalization. This error may have resulted in an overestimation of

BRIDGE's potential to improve medication persistence in participants (Mukherjee et al., 2004).

The sample size for this study, after exclusions and loss to follow-up, was also relatively small. Due to the small sample size, differences between groups were small and statistical analyses were limited as were the development of more comprehensive logistic models. A larger cohort is necessary to more fully explore these findings.

The observation period for this study was 6-months. Typically, data is reported for continuation at 1-year. In this study, patients only received the intervention once and were followed thereafter by primary care or cardiology. Measuring continuation even at 6-months may be reflective of the care patients received at some point after participating in BRIDGE. The median number of days from discharge to seeing any provider or cardiology ranged between 15 and 59 days.

A further limitation of this study was the use of self-report data for medication adherence. Discharge prescribing rates were obtained directly from the discharge note on the patient's electronic medical record. However, persistence data were obtained from clinic notes and reflected what the patient reported when interviewed. No pharmacy data or pill counts were done. For those who discontinued their medication, information as to whether this was a patient or provider decision was generally not documented. Self-report was a practical means of collecting this retrospective data. Even with IRB approval and resources, contacting patients for a more formal recollection of their persistence in the past would not have provided accurate data. It has been shown that self-report adherence correlates with pill counts and blood pressure control (Haynes et al., 1980; Yiannakopoulou, Papadopulos, Cokkinos, & Mountokalakis, 2005) and is most accurate over the short term rather than the long term (Jerant, DiMatteo, Arnsten, Moore-Hill, & Franks, 2008). Moreover, self-reported medication non-adherence with cardiovascular agents is strongly associated with adverse cardiac events (Gehi, Ali, Na, & Whooley, 2007). It is not possible to determine whether use of this methodology over or underestimates the potential benefits of BRIDGE. A more formal study is warranted to investigate these findings as well as influences of racial, ethnic, gender, and socioeconomic diversity.

Conclusion

These findings suggest that attendance in a one-time, ambulatory, NP-based transitional care program may improve medication persistence. Demographic variables, comorbidities, health status (CCI) and severity of event (GRACE Risk Score) were all examined and did not explain these findings, although some studies have shown that education and support from healthcare providers has a positive effect on medication behavior (Burke, Dunbar-Jacob, & Hill, 1997; Eagle, Kline-Rogers, et al., 2004; Haynes, McKibbon, & Kanani, 1996). Nurse practitioners are well suited to provide the type of high-level, high-quality care that ACS patients require (Albert, 2008).

The BRIDGE program was developed from a medical model utilizing NPs. Differences in NP and medical training may account for variations in practice and in how information is obtained and delivered during a visit (Albert, 2008; Horrocks et al., 2002). NPs of the BRIDGE program deliver high quality, cost effective care in a manner consistent with the Information, Motivation, Behavior Model. (Fisher et al., 2008; Fisher & Fisher, 2002; Fisher & Fisher, 2003).

This theoretical framework suggests that patients seen in the BRIDGE clinic should have higher rates of persistence on combined pharmacotherapy six-months after discharge. Through education, NPs influence patients' attitudes and beliefs related to their ability to take preventative medications and the positive benefits of doing so. By enabling patients to develop the skills necessary to initiate and maintain positive behavior, it is expected that patients receiving this type of one-on-one follow-up will be more persistent with their medications than those who do not.

As evidence to BRIDGE's success, participants had greater combined pharmacotherapy persistence at 6-months than usual care. Given the overwhelming evidence that combined pharmacotherapy is life-saving and that medication persistence is a significant issue in ACS patients, further investigation is necessary to document how transitional care influences this behavior. These results support the growing body of research demonstrating that transitional care not only helps patients navigate an overburdened healthcare system, but also has a direct impact on patient behavior and successful outcomes.

CHAPTER III

THE BRIDGE PROGRAM REDUCES HOSPITAL READMISSIONS

Introduction

Hospital readmissions place a considerable burden on an already stressed U.S. healthcare system and are a subject of great concern (Jencks et al., 2009). Although there are justifiable reasons for readmissions, many are avoidable. The Centers for Medicare and Medicaid Services monitor and record hospital readmission rates for a number of high-risk conditions as these rates are considered by many to be a marker of care quality. Hospital readmissions after an acute myocardial infarction (AMI) are among the conditions monitored.

It is estimated that 16.3 million Americans already suffer from coronary heart disease with a disproportionate number represented by ethnic minorities. It is also estimated that approximately 785,000 Americans will have a new coronary event this year from which approximately one-third will die (Roger et al., 2011). Of the more than 518,000 who survive, 470,000 (90%) will have a recurrent event (Roger et al., 2011). Despite these sobering statistics, little is known about the circumstances surrounding readmissions following an acute coronary event (ACS), although there is speculation that contributors to readmissions among those patients may include premature discharge, lack of prompt access to cardiology follow-up after hospital discharge (Fye, 2004), insufficient discharge education, lack of patient understanding of education provided, and poor provider adherence to American Heart Association/American College of Cardiology guidelines (AHA/ACC). Many of these contributors appear to be problematic during the patient's transition from hospital to home and the imminent shift from direct care to self-care that occurs during this period.

The hospital-to-home, or transitional care, phase of the patient care continuum begins prior to discharge and terminates once the outpatient care team has seen the patient and assumes responsibility for his/her care. This differs from coordinated care, which is a means to ensure that appropriate follow-up is being planned and carried out. Transitional care, on the other hand, is an actual clinical phase between acute care and ambulatory care with direct patient contact. Both transitional care and coordination of care aim to fluidly move patients from the acute care setting to the outpatient setting by facilitating communication, discharge education, medication management, resolution of outstanding diagnostics, and instruction on when to seek care (Hernandez et al., 2010). Coordination of care achieves all of these but lacks direct patient evaluation during the intermediate period before ambulatory care providers assume responsibility. Most models of transitional care are built around direct patient assessment, diagnosis, treatment, and education during this interim phase (Coleman et al., 2006; Naylor et al., 2004; Sinclair et al., 2005; Stewart et al., 1998).

Transitional care is not a new concept but certainly one that, driven by today's public scrutiny of health policy and finance, has become recently elevated as a key component along the patient care continuum. Health care providers have long recognized the consequences of poor patient follow-up, but lack of provider accountability between discharge and ambulatory acceptance has allowed the hospital-to-home problem to go largely unchecked until now. Since hospital readmissions became a publicized quality indicator of hospital performance, transitional care has gained a new following. Before 2005, research and publications on transitional models of care were scarce. Today, there is a national organization (H2H, Hospital-to-Home) working with the collaborative input of all levels of health care providers to design and structure solutions using this approach.

Initially, the aim of reporting hospital readmission rates was aimed to draw attention to the dilemma and allow patients to make informed choices about where to seek care. Later, readmission rates became part of a pay-for-performance program tied to specific conditions such as AMI, heart failure, and pneumonia (Conrad & Christianson, 2004). Now, the Patient Protection and Affordable Care Act (ACA) of 2010 is making lower hospital readmission rates an expectation. If this expectation is unmet, hospitals may suffer substantial penalties in the form of reductions in reimbursement. According to the policy, a percentage of the institution's aggregate Medicare payments, not just charges for the diagnosis-related group (DRG) where the readmission rate is in "excess," can be withheld by the Centers for Medicare and Medicaid Services (Foster, 2010). Initial fines will be imposed in 2013 and will be levied against 2012 readmission rates. In year one of this program, the penalty is 1% of the aggregate Medicare payments. In year two, 2014, the penalty will increase to 2% and in 2015 to 3% (ACA, 2010; refer to the Appendix for an example of how much this will potentially cost hospitals). This timeline has prompted a sense of urgency for hospitals and payers to work together toward resolving inherent problems associated with increased readmission.

The “Bridging the Discharge Gap Effectively” (BRIDGE) program is a novel care model that recognizes the growing concern regarding hospital readmissions and the need for care during the critical hospital-to-home transition. Now nearing its fifth year of operation, BRIDGE is a nurse practitioner (NP)-driven model that provides a one-time ambulatory transitional care visit within 14 days of discharge for patients discharged from a cardiology service or who required a cardiology consult during their hospitalization.

During that visit, NPs aim to eliminate many of the aforementioned contributors to hospital readmissions by providing thorough examinations and evaluating each patient’s response to treatment, performing medication reconciliation, and making therapeutic adjustments when necessary. The NPs also provide tailored education about the individual’s event, condition, and disease process and when to seek follow-up. Serving more broadly as care managers, BRIDGE NPs also review all diagnostic tests from discharge and ensure that appropriate diagnostics and follow-up are scheduled for the future. The NPs act as an extension of the hospital discharge team, contacting the team when necessary. Still, despite its purpose and five-year history, the efficacy of BRIDGE in reducing hospital readmissions for ACS patients is unknown.

The purpose of this study is to determine if there is a difference in hospital readmissions following discharge from the hospital for an ACS event, between patients who participated in the NP-delivered BRIDGE transitional care program and those who had usual care (follow-up post-hospital discharge with primary care or cardiology). It is hypothesized that when compared with patients who had usual care, patients who participate in the BRIDGE program will have lower rates of hospital readmissions.

Methods

Design

This retrospective, quasi-experimental study assesses the efficacy of the NP-driven BRIDGE program as a model for transitional care. The 30-day readmission rates for ACS patients who participated in the BRIDGE program were compared to patients who chose not to participate and received usual care.

Setting

The University of Michigan Health System's (UMHS) Bridging the Discharge Gap Effectively (BRIDGE), as described more thoroughly in chapter 2, is a program designed to provide transitional care for patients discharged after an ACS event. The clinic is staffed by five specialty-certified cardiovascular nurse practitioners who function in collaboration with onsite cardiologists. Within the BRIDGE clinic, the NPs perform physical assessments, assess patient status, make medication adjustments, provide education and make appropriate follow-up referrals .

Sample

As previously described, all patients over 18 years of age discharged from the UMHS with a diagnosis of ACS were eligible for this study. Referrals were made to the BRIDGE program based on whether or not a patient had a follow-up appointment scheduled with their cardiologist or primary care provider within 14 days of discharge. Patients included were discharged between March 30, 2008 and March 30, 2009 and were divided into two cohorts: those who were referred and attended the program and those who were referred and did not attend. Patients were excluded from the study if they became pregnant, sought follow-up outside of the UMHS, or expired within 30 days of discharge. The Social Security Death Index was queried for patients lost to follow-up.

The study cohort included 424 registry eligible patients referred to the BRIDGE program. Acute coronary syndrome (ACS) comprised 25.2% (n=107) of the diagnoses of those referred. Patients were excluded if they died or were rehospitalized prior to their initial BRIDGE appointment (n=9, 8.4%). The final study sample included 80 patients after excluding patients with missing variables (n=18, 18.4%). See patient flow (*Figure 5*).

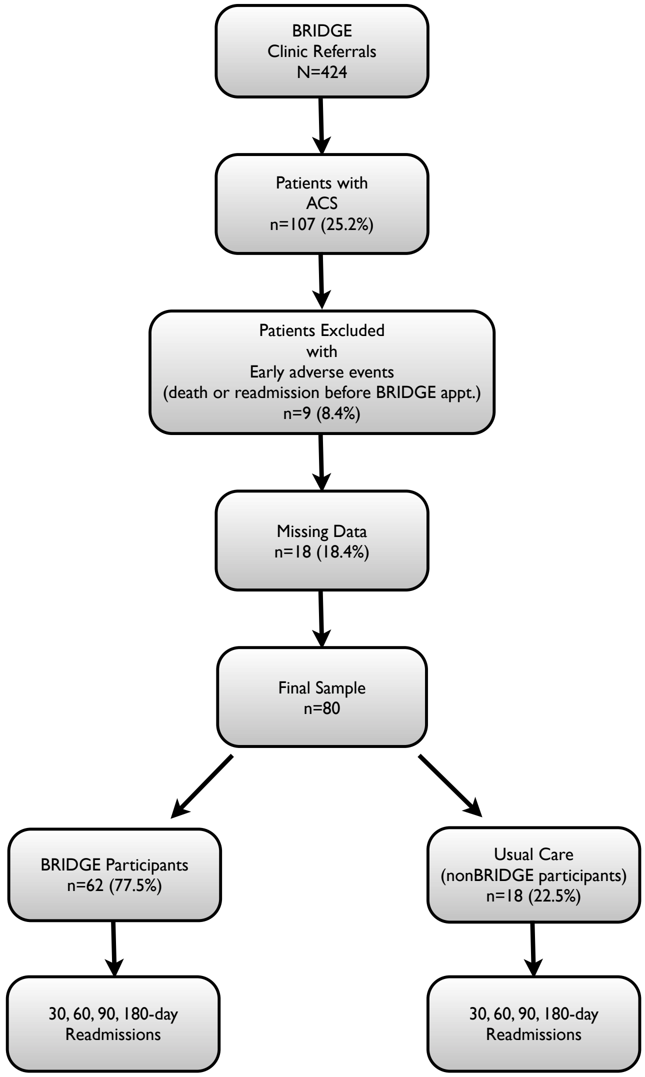


Figure 5. Patient flow diagram of analysis of hospital readmissions.

Measures

As in the prior study examining medication persistence, two separate measures were used to describe patient characteristics: the Charlson Comorbidity Index (CCI) and the GRACE Risk Score. The CCI serves as a proxy for an individual's overall state of health or illness. It has been tested across a variety of populations and settings and has been consistently in predicting mortality (Needham et al., 2005). The tool quantifies the combined effect of 19 comorbid conditions on mortality, where higher scores are associated with higher mortality (Charlson et al., 1987; Charlson et al., 1994). The GRACE Risk Model for discharge predicts the risk of death in patients with ACS from hospital discharge to six months out. In this study, the GRACE Risk score is indicative of the severity of the individual's event. Nine items are included in this multivariate prediction model and have demonstrated a *c*-statistic between 0.70 and 0.80 (Eagle, Lim, et al., 2004). The discriminatory and predictive validity of this tool has been widely published (Elbarouni et al., 2009; Ramsay et al., 2007).

Approach

Specifics of the design and maintenance of the BRIDGE registry were presented in chapters 1 and 2. Briefly, consecutive data for all patients referred to the BRIDGE program was collected into a de-identified, online, clinical database maintained by the Michigan Cardiovascular Outcomes Research and Reporting Program (M-CORRP).

Data were collected using the abstraction form shown in chapter 1, *Figure 3*. The variables included basic demographics, admission data, discharge data, and 6-month follow-up data. Detailed information pertaining to medications and items necessary to calculate the CCI score and GRACE Risk Score were also incorporated.

Data Analysis

General. Data were analyzed using PASW 18.0. All variables were assessed for compliance with statistical assumptions including normal distribution. Skewed data were transformed as necessary before inclusion into any model. Missing data were excluded from the sample.

Univariate and bivariate analyses. Baseline equivalencies were assessed for all demographic variables, comorbidities, CCI scores and GRACE Risk Scores. Associations between variables were assessed with Pearson's correlation coefficient. Independent student t-tests (continuous variables) and Chi Square (categorical variables) were used to compare the BRIDGE intervention group and the control group. Pearson's Chi-square test for significance was reported except in cases where the expected count would violate an underlying assumption; in these cases, Fisher's Exact test was reported. The significance level was set at 0.05 for all analyses.

Readmission rate. The hospital readmission rate was calculated as the number of patients discharged from the hospital with a diagnosis of an ACS event and readmitted to UMHS within 30 days, divided by the total number of people who were discharged alive with the same diagnosis (Jencks, et al., 2009). In order to isolate the BRIDGE effect, patients who were readmitted or died prior to their initial BRIDGE appointment date were excluded. The BRIDGE and non-BRIDGE specific rates of readmission were calculated as the total number of readmissions for the BRIDGE and non-BRIDGE groups divided by the total number of subjects in each group. Only the first readmission following discharge for an ACS event was counted. The patient was the unit of analysis.

Results

Sample

Of 107 ACS patients discharged from UMHS and referred for follow-up with BRIDGE, 80 were included in the final sample. Patients who died or were readmitted prior to their BRIDGE appointment were excluded, as were patients with missing data (n=27, refer back to *Figure 5*). Excluded patients were compared to patients remaining in the study (see Table 6). The patients excluded from the sample were noted to have higher CCI and GRACE Risk scores, suggesting that these patients either had more comorbid conditions, worse events, or both.

Table 6

Differences Between Sample and Those Excluded with an EAEs[a] No. (%)

Variable **n=107**	**EAEs** **n=9 (8.4%)**	**All Others** **n=98 (91.6%)**	**p-value**
Age (mean ±SD)	66.09 (14.96)	62.4 (13.9)	.409
Gender (% Female)	4 (44.4)	59 (60.2)	.483
Race			
White	7 (77.8)	83 (85.6)	.622
Non-white (Black, Asian, Native American, Hispanic)	2 (22.2)	15 (14.4)	.622
Comorbidities			
Afib	1 (11.1)	7 (7.1)	.517
CVD	0	6 (6.1)	1.00
Hx TIA	0	2 (2.0)	1.00
Hx CVA	0	2 (2.0)	1.00
CHF	2 (22.2)	12 (12.2)	.334
CAD	9 (100)	91 (92.9)	1.00
Current Smoker	2 (22.2)	24 (24.5)	1.00
Diabetes	3 (33.3)	30 (30.6)	1.00
Dyslipidemia	5 (55.6)	71 (72.4)	.279
HTN	7 (77.8)	63 (64.3)	.493
Obesity	1 (11.1)	18 (18.4)	1.00
Peripheral Vascular	1 (11.1)	12 (12.2)	1.00
Psychiatric Disorder n=35 (32.7%)	**n=4 (44.4%)**	**n=31 (31.6%)**	
Anxiety	1 (25.0)	16 (51.6)	.603
Dementia	1 (25.0)	5 (16.1)	.546
Depression	3 (75.0)	24 (77.4)	1.00
Substance	0	8 (25.8)	.553
Charlson Comorbidity	5.43+-2.30	3.98 +-1.79	.015
GRACE Risk Score	123.00+-37.53	99.69+-30.79	.022

[a]Early adverse events (hospital readmission or death before BRIDGE appointment).

The mean age of all study participants was 62.5 years. The majority (58.7%) were female, and white (86.3%) with a median length of initial hospital stay ranging from 2-4 days. Table 7 shows a comparison of patients who attended BRIDGE versus those who did not. With the exception of a higher percentage of dyslipidemia among BRIDGE users and slightly elevated rates of depression among non-attenders, there were no significant differences between the two groups.

Table 7

Demographic Differences Between BRIDGE and Usual Care Participants No. (%)

Variable n=80	Attend n=62 (77.5%)	Did Not Attend n=18 (22.5%)	p-value
Age (mean ±SD)	62.9±14.1	60.9±14.8	0.596
Gender (% Female)	35 (56.5)	12 (66.7)	0.438
Race			
White	53 (85.5)	16 (88.9)	1.00
Non-white (Black, Asian, Native American, Hispanic)	9 (14.5)	2 (11.1)	1.00
Comorbidities			
Afib	4 (6.5)	1 (5.6)	1.00
CVD	4 (6.5)	0	0.570
Hx TIA	2 (2.8)	0 (0)	1.00
Hx CVA	1 (1.6)	0	1.00
CHF	7 (11.3)	4 (22.2)	0.256
CAD	59 (95.2)	18 (100.0)	1.00
Current Smoker	16 (25.8)	3 (16.7)	0.539
Diabetes	2 (32.3)	4 (22.2)	0.413
Dyslipidemia	49 (79.0)	9 (50.)	0.033
HTN	41 (66.1)	9 (50.0)	0.213
Obesity	13 (21.0)	1 (5.6)	0.172
Peripheral Vascular	5 (8.1)	4 (22.2)	0.109
Psychiatric Disorder n=27 (43.5%)	**n=17 (27.4)**	**n=10 (55.6%)**	
Anxiety	9 (52.9)	5 (50.0)	1.00
Dementia	3 (17.6)	1 (10.0)	1.00
Depression	12 (70.6)	8 (80.0)	0.678
Substance	4 (23.5)	2 (20.0)	1.00
GRACE Risk Score	100.8±30.9	104.8±32.9	0.527
Charlson Comorbidity	4.05±1.74	3.98 ±1.96	0.745

Attendance

As seen in Table 6, 77.5% (n=62) of the patient's referred to the BRIDGE program attended their scheduled appointment. The median time from discharge to attending a BRIDGE program appointment was 15 days (see *Figure 6*). The time elapsed between discharge and being seen by any medical provider was longer (20 days) for patients who did not attend BRIDGE. However, patients who did not attend BRIDGE were also seen by cardiology sooner (31 days versus 59 days). Consistent with these findings, patients contacted by phone for a missed or cancelled appointment (n=58) reported that the primary reason for not attending was getting an earlier appointment with either cardiology or their primary care provider (34.5%).

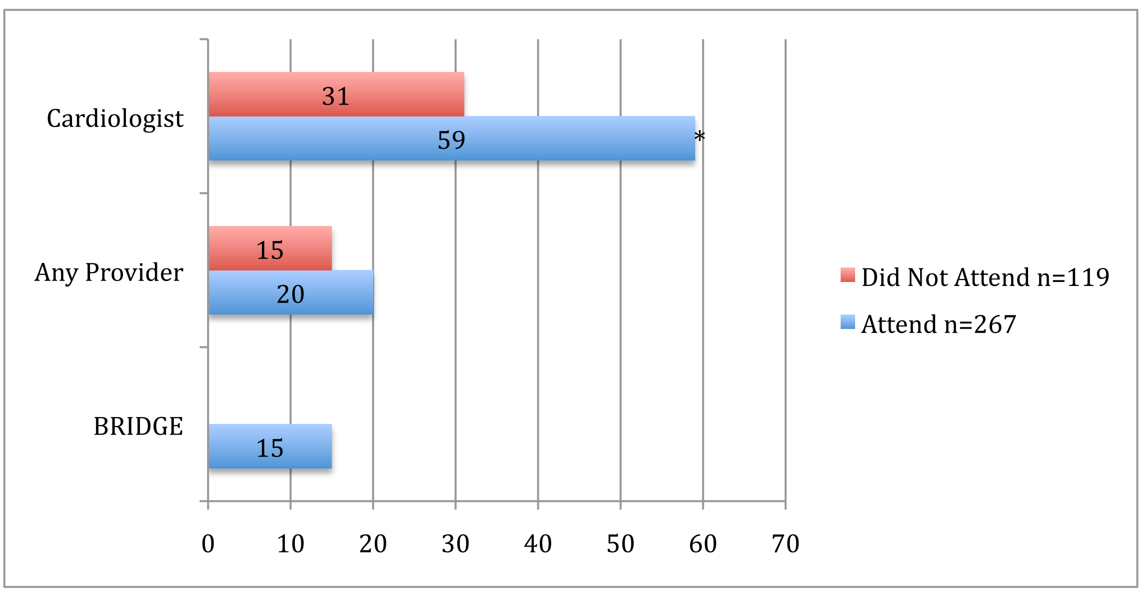


Figure 6. Mean days to follow-up (data from full registry).

*P $\leq$ 0.05

Readmissions

It was hypothesized that patients who took advantage of the BRIDGE program would have lower readmission rates than patients who received usual care. In fact, as shown in *Figure 7*, patients who attended the BRIDGE program had lower rates of readmission at 30, 60, 90, and 180 days after hospital discharge for an ACS event than did non-attenders.

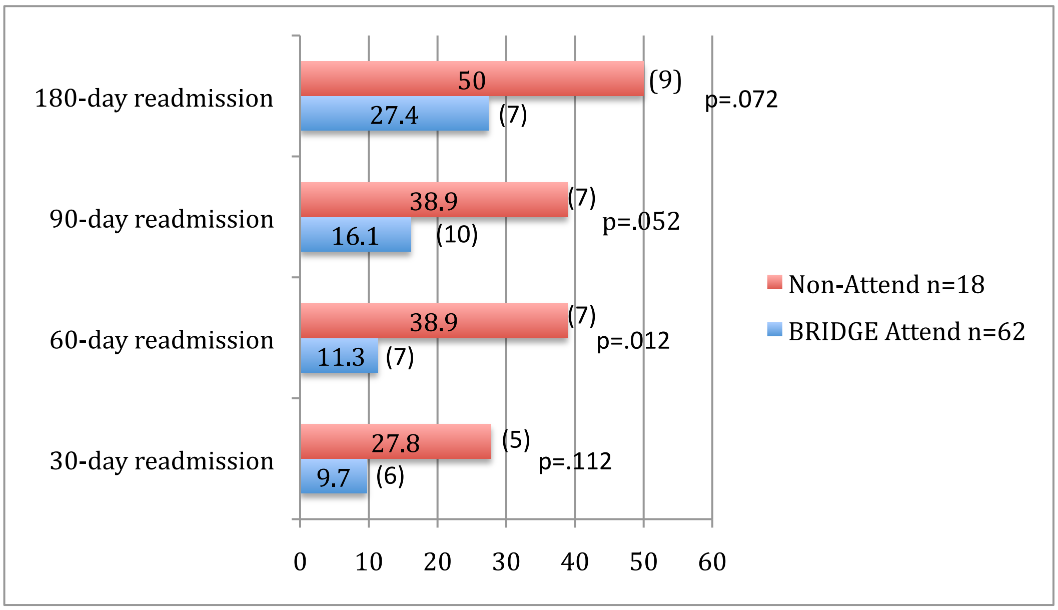


Figure 7. Readmission rates for BRIDGE attenders versus non-attenders.

Patients participating in the BRIDGE program, moreover, had an unadjusted risk of readmission between .200-.378 compared to usual care (see Table 8). Data were adjusted independently for patients' overall health by the Charlson Comorbidity index and for the severity of their event using the GRACE Risk Score on discharge. Because these two measures had a linear relationship with an r-value of .812, they could not be used simultaneously in a model. However, adjusting for either measure independently provided no additional benefit. The adjustment with either CCI or GRACE demonstrated poor model calibration with nonsignificant Hosmer and Lemeshow tests.

Table 8

Odds of Being Readmitted 30, 60, 90, and 180 Days After Discharge for Patients Who Participated in the BRIDGE Program.

Days after DC	OR	95% CI	Adjusted OR CCI	95% CI	Adjusted OR GRACE	95% CI
30 Days	.179	.042-.761	.268	.069-1.038	.285	.075-1.091
60 Days	.138*	.037-.514	.191*	.054-.669	.203*	.059-.699
90 Days	.233*	.007-.776	.268*	.078-.922	.306	.093-1.009
180 Days	.378	.128-1.112	.311	.095-1.021	.373	.119-1.167

*p-value <0.05

The forest plot below (*Figure 8*) shows the unadjusted odds of being readmitted if the patient attended his BRIDGE appointment. At 60-days post-discharge patients were significantly less likely to be readmitted though at all points post-discharge there was a trend towards being less likely to be readmitted. The effect appears to diminish over time as might be expected subsequent to a single-dose intervention.

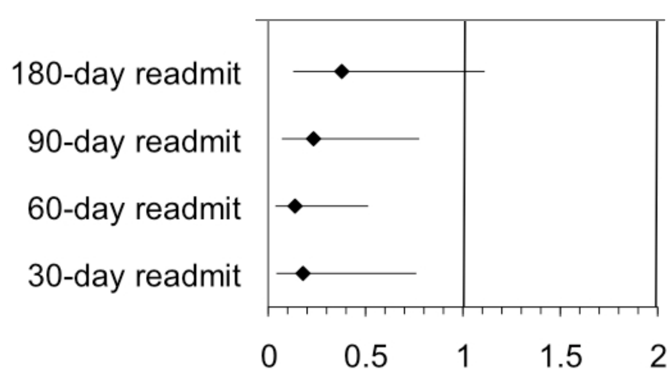


Figure 8. Unadjusted odds of readmission with BRIDGE participation.

Discussion

It was hypothesized that when compared with patients who had usual care, BRIDGE participants would have lower rates of hospital readmissions. This study found that the NP-driven, single-dose, transitional care program was an effective strategy to lower all-cause hospital readmissions for ACS patients. Even with adjustments for severity of illness and severity of event, patients who chose to attend their BRIDGE appointments fared better than patients who received high-level, evidence-based usual care. Although this study was designed to address readmissions within 30-days of hospital discharge, the maximum benefit was observed 60-days post discharge with a positive trend at all other time points.

Limitations

The design of this program is straight forward, and the results are positive. However, there are some limitations that should be considered with regard to this study. Study data were collected retrospectively. As a result, causality may not be assumed. There is the potential that unmeasured variables may be confounding the results. As previously stated, this study was conducted via an observational registry and lacks randomization. Patients chose whether or not to attend and the resulting groups were not necessarily equivalent. Therefore, the results may not be generalizable. Usual care at the study institution has a high rate of compliance with evidence-based therapies and thereby sets the bar higher for significance to be found.

The sample size for this study is small particularly for those receiving usual care. Despite the registry having over 500 patients, after exclusions and limitations of the data, the final sample included only 80 cases that met the study criteria. With such a small beginning sample and outcome rates as low as 9.7%, there was an insufficient number of outcomes to adequately power a multiple regression analysis. Despite the small sample size, significance was established at both 60 and 90-days post discharge. With a larger sample, it is likely that there would have been a significant difference at 30-days post discharge as well. Patients with missing follow-up data were excluded from the study.

Consistent with the institution's high level of care, when the BRIDGE program began (2008), post-discharge follow-up within 14 days was a reasonable standard. Today, follow-up time frame recommendations may be for as early as 7 days post-discharge (Hernandez et al., 2010). Although there are published guidelines for recommended follow-up times for heart failure patients, little research exists regarding follow-up for patients with AMI or ACS. Conducting the BRIDGE intervention at day 14 post-discharge was problematic for monitoring 30-day outcomes. Because patients with adverse events prior to the BRIDGE appointment were excluded from the study, the program truly only evaluated the later half of the 30-day measuring period. Adjusting the time to follow-up date might have a significant impact on findings in the future. Comparing those who were excluded for early adverse events to the final study sample revealed one significant difference: patients with early adverse events had higher Charlson Comorbidity Scores. The CCI for the study population was

3.98. The CCI for patients with early adverse events was 5.43. These patients had nearly a 35% increase risk of mortality in the first year (Charlson et al., 1987).

Conclusion

The general cardiology BRIDGE program is a novel solution to implement a transitional care program. This NP-based model is an effective strategy to improve patient care quality and reduce hospital readmissions. The NPs provide a high level of service ensuring the health of their patients, providing education to the patients and their families, reconciling medications, and communicating with the patient's discharge team and outpatient care provider. Patients who participated in this program had a trend toward lower readmission rates at 30, 90, and 180-days post discharge than those who opted for usual care. The observation of a significant reduction in readmission rates at 60-days post-discharge for BRIDGE attendees provides further support for the effectiveness of the intervention. The median time-from discharge to follow-up with a cardiologist for BRIDGE participants was 59 days. The median time for follow-up with a cardiologist for usual care was 31 days. The lower 60-day readmission rate reflects how the BRIDGE intervention fared against a high level of usual care with patients that received care by their cardiologist 28 days earlier.

CHAPTER IV

THE BRIDGE PROGRAM IS COST EFFECTIVE

Introduction

Readmission rates following hospital discharge for a cardiac condition are both common and costly. In the absence of efficient and effective transitional care, nearly 20% of all Medicare patients discharged will be rehospitalized within 30 days (Krumholz et al., 2009). Half of those readmitted will be patients who have had no contact with a healthcare provider since their discharge (Jencks, Williams, & Coleman, 2009). The cost of unexpected readmissions exceeded 17 billion dollars in 2004 (Jencks et al., 2009; Krumholz et al., 2009). From a societal perspective, this is of significant concern for our financially troubled healthcare system. As a matter of policy, legislation has been passed to further penalize hospitals for excessive readmissions.

Readmission rates are of particular concern in cardiovascular disease (CVD) where readmissions meet or exceed the national average for all Medicare beneficiaries. Cardiovascular disease (CVD) is the leading cause of death in the United States (US) with more than 1 out of every 3 adult Americans afflicted in some manner (Centers for Disease Control and Prevention, 2011). Not only does CVD carry the highest mortality rate, but cardiac diagnoses are associated with substantial morbidity, disability, and hospital utilization and account for the highest number of hospital discharges. Considering the prediction that Americans will suffer approximately 785,000 first coronary events this year and that a further 470,000 will experience a recurrent event (Roger et al., 2011), there may be nearly a half-million rehospitalizations from coronary events (assuming they all are hospitalized). These numbers provide for an ideal opportunity to develop transitional care interventions for a well-defined population with exceptional evidence-based therapies for secondary prevention. These interventions may be further prompted by legislation that will bundle payments for patients readmitted after discharge from acute myocardial infarctions (AMI), heart failure or pneumonia (Patient Protection and Affordable Care Act of 2010).

Improving the hospital-to-home transition is paramount to reducing readmissions for patients suffering from acute coronary syndromes (ACS) such as ST-elevated myocardial infarction, nonST-elevated myocardial infarction, and unstable angina. Ideally, the cost of such programs can be offset by avoided readmissions. However, few transitional care studies have reported their overall effect in this way. For example, Coleman, Parry, Chalmers and Min (2006) conducted a randomized trial of 750 patients with a variety of medical diagnoses. Study participants in the intervention arm received tools to promote cross-site communication among providers, were encouraged to take a more active and assertive role in their care, and were provided with a “transitional coach” to follow their progress; control subjects received usual care. Outcomes revealed that mean hospital costs were $488 lower for the intervention group 180-days post-discharge when compared to those receiving usual services. Another program, funded by the Agency on Healthcare Research and Quality (AHRQ), and now endorsed by the Joint Commission Resources, implemented a similar design in their *“Re-Engineered Discharge”* or Project Red Model (Project Red [Re-engineered Discharge], 2011). By designating a “discharge advocate” to work with each patient, tailoring discharge booklets to each individual (designed for the program), and asking a clinical pharmacist to do a telephone follow-up 2-4 days after discharge, the project demonstrated reductions in hospital utilization and a per-patient savings of $412. Krumholz et al. (2002) randomized 88 heart failure patients to receive a one hour face-to-face education session within 2-weeks of hospital discharge (45% of which were in-home visits) followed by 4 weekly telemonitoring calls. The study concluded that the combination of education and phone follow-up substantially reduced adverse events after discharge and reduced readmission costs by $7,515 per patient. Naylor et al. (2004) demonstrated that a 3-month comprehensive NP-driven, in-home, transitional care program for elders with heart failure, decreased readmissions and lowered healthcare costs. In this program, patients were visited daily in the hospital and provided education. Following discharge, patients received at least eight home visits during the first 90 days after discharge and the NPs were available by telephone daily.

Patient education on secondary prevention measures is the most common theme among transitional care programs. In addition to diet and lifestyle modifications, keeping patients on a multidrug regimen of beta-adrenergic blocking agents [ß-blockers], angiotensin converting enzyme inhibitors [ACE-inhibitors] or angiotensin receptor blocking agents [ARBs] in patients intolerant to ACE-inhibitors, aspirin, HMG-CoA reductase inhibitors [statins], and clopidogrel for up to 1 year post-event (combined pharmacotherapy) is essential. This evidence-based combination drug regimen is the key to avoiding future events and maintaining homeostasis for ACS patients (Antman et al., 2009; Smith Jr et al., 2006). The co-administration of these agents is estimated to reduce post-event mortality by between 72 and 87% (Hippisley-Cox & Coupland, 2005; Mukherjee et al., 2004; Wald & Law, 2003). Despite the accomplishments of these programs and many others, no single intervention has been successful enough to garner overwhelming support from the healthcare delivery system at large (Jencks et al., 2009). Part of the lack of acceptance is a paucity of data to determine whether these programs are quality effective and cost effective, particularly as they relate to hospital readmissions.

To conduct a successful cost analysis pertaining to hospital readmissions, it is essential to understand the multiple perspectives of this phenomenon and those of this study. A societal view of hospital readmissions, for example, assumes that lower readmission costs are a benefit to society and the overall health care system. An institutional view, on the other hand, might consider lower readmissions as generating less revenue (at least until hospitals are penalized for readmissions). The perspective of an insurance company is more complicated and requires weighing the cost of hospitalization against the cost of long-term outpatient therapies. From a patient's perspective, the cost of a hospital readmission is reinforced by the quality of life (i.e. staying home with family and or being with friends) they receive in return. The perspective of this study parallels the societal perspective: that fewer hospital readmissions are a benefit.

After understanding the perspective of a cost analysis, the next requirement involves defining the actual costs of an intervention and determining how data can be obtained. In determining the cost of a nurse practitioner (NP)-led transitional care visit, for example more than just the nurses' salaries must be taken into consideration. The true cost involves the amount of time devoted to each patient, the space used for the NP patient consultation, as well as support staff salaries and supply costs. The ultimate goal is to capture all costs that are associated with the ability for the patient to be seen at a clinic and for the NP to provide needed care.

Compared to usual care, the NP-driven transitional care model Bridging the Discharge Gap Effectively (BRIDGE), as previously described, reduced hospital readmissions by 18.1%. This reduction was reported in chapter 3, and was derived by comparing actual rates of readmission 30-days post discharge for BRIDGE participants against those receiving usual care. To determine if there is a cost savings in providing this type of transitional care to ACS patients, the costs of BRIDGE were compared against avoided readmission costs. It was hypothesized that participation would reduce costs over usual care.

Methods

Design

As previously described, this study included consecutive patients discharged from UMHS after an ACS event. Demographic, clinical, and follow-up data were collected retrospectively on all patients referred to BRIDGE from March 2008 to March 2009. Patients readmitted before their BRIDGE appointment were excluded from the study.

Setting

Bridging the Discharge Gap Effectively is a nurse practitioner (NP)-based program nested within an existing cardiology practice. The BRIDGE program is designed to ensure that patients who are discharged after an ACS event have support throughout the hospital-to-home transition. The clinic is staffed by five, specialized, cardiovascular nurse practitioners who function in collaboration with onsite cardiologists.

Sample

As described in chapter 3, the study cohort included 424 registry eligible patients referred to the BRIDGE program. Included in this study were individuals diagnosed with ACS (n=107), which comprised 25.2% of the referrals. Patients with an early adverse event (EAE) who died or were rehospitalized prior to their initial BRIDGE appointment were excluded from the final sample (n=9). The final study sample included 80 patients after removing 18 patients with missing data (see *Figure 9*).

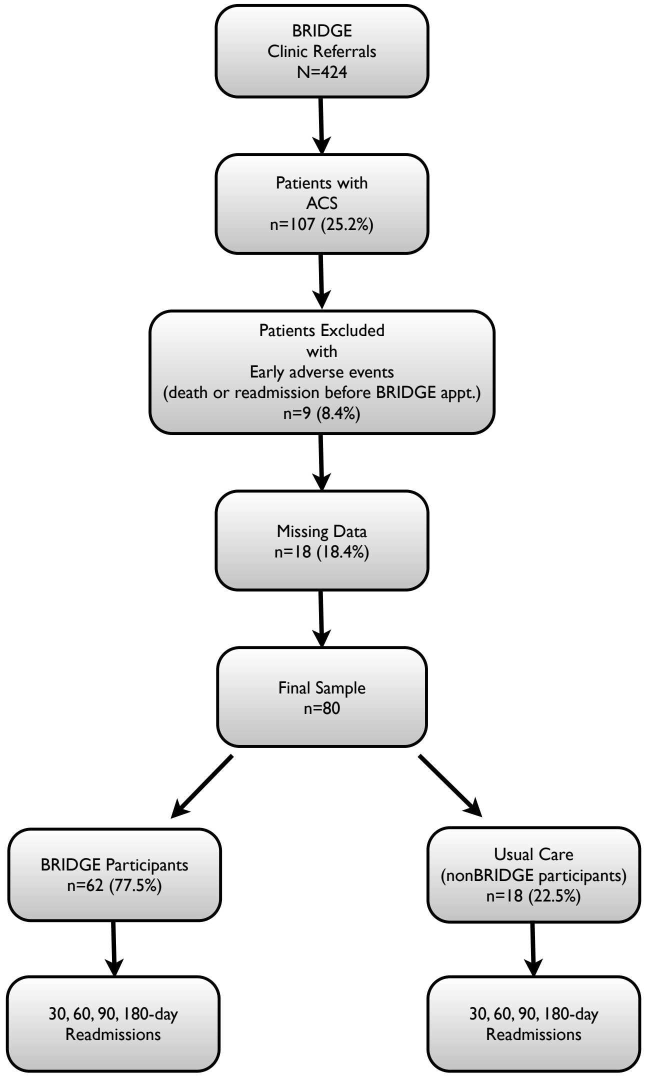


Figure 9. Patient flow diagram for analysis of cost avoidance from readmissions.

Intervention

Being seen in the BRIDGE clinic is the intervention in this study. Five specially trained cardiology nurse practitioners independently provided care and support in the BRIDGE clinic as an extension of the discharge team. The NPs performed complete physical assessments and medication reconciliation, adjusted medications, and provided education, counseling, and referrals.

They ensured that the American College of Cardiology/American Heart Association guidelines for secondary prevention medications were met.

Measures

Consistent with the analyses presented in chapters 2 and 3, two separate measures were used to evaluate subjects' state of health and severity of disease. The Charlson Comorbidity Index (CCI) served as a measure of an individual's state of health or illness (Charlson et al., 1987; Charlson et al., 1994). This is a well established tool, found to be a valid for predicting mortality (Needham et al., 2005). The GRACE Risk Model for discharge is a tool to predict the risk of death in patients with ACS from discharge to six months out and provided a means to quantify the severity of the subject's event. The discriminatory and predictive validity of this tool are widely published (Elbarouni et al., 2009; Ramsay et al., 2007).

Approach

Full descriptions of the development, maintenance and registry methods are described in chapters 1 and 2. In summary, consecutive data for all patients referred to the BRIDGE program were collected into a de-identified, online, clinical database. Basic demographics, admission data, discharge data, and 6-month follow-up data were collected including detailed information pertaining to medications and variables to calculate the CCI score and the GRACE Risk Score.

Data Analysis

Summary statistics for baseline characteristics were reported as means and standard deviations for continuous variables, and percentages for categorical variables. Group comparisons were made using independent-samples t-test for continuous variables, and Pearson chi-squared or Fisher's Exact Test for categorical variables. All variables were assessed for compliance with statistical assumptions. Missing data were excluded from the sample. Data were analyzed using PASW 18.0.

Cost Analysis

A cost analysis was performed comparing BRIDGE costs against avoided 30-day hospital readmissions between patients who participated in the BRIDGE program and patients who had usual care.

The BRIDGE clinic operates on a variable (per patient) cost basis. To assess the per patient cost or savings of the BRIDGE program, the difference in observed readmission rates for participants and nonparticipants was multiplied by the average cost of a cardiac readmission (MS-DRGs 283-316) and deducted from the cost of an individual BRIDGE visit. Overall program savings was determined by calculating the additional readmission costs that would have resulted if participants had been readmitted at the same rate as nonparticipants and then deducting the cost of their BRIDGE visits.

Incremental Costs. Incremental patient costs including personnel costs and overhead costs were obtained from institutional administrative data for the 2010 fiscal year (D. E. Karpenko, personal communication, October 5, 2010).

NP and medical assistant (MA) salaries were reported as hourly rates (see Table 8). The first 2 months of the fiscal year 2010 were utilized to develop the model for analysis, as these were the most current and available data.

NP and MA rates were inflated by 30.0% and 32.5% respectively (based on institutional pay scales) for fringe benefits. The cost of space is based on square footage and includes utilities and maintenance. Room costs were calculated on an average of 260-work days per year and multiplied by 40% for the utilization of associated spaces (reception, waiting room, and check out). Supply costs were derived by dividing the supply costs for the entire clinic, by the total number of clinic visits during the same period.

To interpret the data in Table 8, begin by looking at the hourly rates for the NP and MA. Prorate these figures by the amount of time allocated for the care of one patient. In this case, the model allowed for 30 minutes of NP time and 10 minutes of MA time (to put patients in rooms and obtain vital signs) for each patient. Per clinic protocol, NPs were scheduled for 30 minutes (which includes dictation time) with each patient. MAs spend on average 10 minutes with patients situating them in rooms and collecting vital signs. Add to this the prorated room rental fee for 30 minutes and the per-person supply cost. The sum of these 4 components is $43.85. This represents the per-person cost of a BRIDGE visit.

Table 9

Variable Per-Patient Costs for the BRIDGE Program

Variable	Cost	Unit	Amount utilized	Cost per-patient visit
Nurse Practitioner	$64.76	60 minutes	30 minutes	$32.38
Medical Assistant	$20.20	60 minutes	10 minutes	$3.30
Room	$20.68	Day	30 minutes	$1.15
Supplies	$7.02	Visit	--	$7.02
TOTAL COST PER-PATIENT PER APPOINTMENT				**$43.85**

Model inputs. Table 9 shows a summary of the model inputs for this analysis. In addition to the cost of a BRIDGE visit, this model additionally requires readmission rates and hospitalization costs.

Readmission costs. The average cost for an inpatient cardiology admission for the MS-DRGs 283-316 (AMI, circulation disorders, endocarditis, heart failure, cardiac arrest, peripheral vascular disease, atherosclerosis, hypertension, valve disorders, arrhythmias, angina, syncope, and chest pain) was obtained from the American Hospital Directory (see Table 10). The American Hospital Directory is an analysis group that provides data from the Medicare Provider Analysis and Review (MedPAR) database that enables institutions to benchmark financial information, quality, and outcomes against other institutions. MedPAR is updated annually and contains 100% of the billing data for Medicare fee-for-service claims for hospital discharges (American

Hospital Directory, 2011). The average charge is from the study institution for the fiscal year ending September 30, 2009.

Table 10

Model Inputs

Parameter	BRIDGE (n=62)	NonBRIDGE (n=18)	Sensitivity Range Tested	Source for Data
Cost				
BRIDGE visit	\$43.85[a]	\$0	25%-200%	From Table 9
Readmission	\$27,558[b]	\$27,558[b]	25%-200%	American hospital directory 2011
Observed readmission probabilities				
30 Day	9.7%	27.8%	25%-200%	Observed data
60 Day	11.3%	38.9%	25%-200%	Observed data

[a]From Table 9

[b]Average cost of a cardiology admission based on MedPar data

Probabilities. Readmission rates for BRIDGE and nonBRIDGE participants were calculated in an earlier study presented in chapter 3 (refer above to Table 10).

Sensitivity Analysis

To assess the stability of the model, a 1-way sensitivity analysis was performed. Because there is a degree of uncertainty associated with the model inputs and insufficient data to adequately establish upper and lower limits of each, inputs were widely varied (Manning, Fryback, & Weinstein, 1996). Each input was varied 25%-200% consistent with ranges in the literature (Choudhry et al., 2007; Choudhry et al., 2008; Dhalla, Smith, Choudhry, & Denburg, 2009) to estimate the degree to which the model parameters influenced the results. This range provides conservative estimates of the best and worst case scenarios at a level consistent with values utilized in current literature.

Results

Sample

Of 107 patients included in this study the mean age was 62.5 years, with the majority being white (86.3%) and female (58.7%). Nine patients were excluded from the study due to having an early adverse event and 18 patients were excluded because of missing data. Overall, 77.0% (n=62) of referred patients attended their scheduled BRIDGE program appointment (refer back to *Figure 9*). There were no significant differences in demographics or comorbidities between patients who were excluded from the study (see Table 11) nor were there differences between patients who received usual care and those who participated in the BRIDGE program (see Table 12). The median length of initial hospital stay was 3 days, ranging from 2-4 days.

Table 11

Differences Between Sample and Those Excluded with an EAEs[a] No. (%)

Variable **n=107**	**EAEs** **n=9 (8.4%)**	**All Others** **n=98 (91.6%)**	**p-value**
Age (mean ±SD)	66.09 (14.96)	62.4 (13.9)	.409
Gender (% Female)	4 (44.4)	59 (60.2)	.483
Race			
White	7 (77.8)	83 (85.6)	.622
Non-white (Black, Asian, Native American, Hispanic)	2 (22.2)	15 (14.4)	.622
Comorbidities			
Afib	1 (11.1)	7 (7.1)	.517
CVD	0	6 (6.1)	1.00
Hx TIA	0	2 (2.0)	1.00
Hx CVA	0	2 (2.0)	1.00
CHF	2 (22.2)	12 (12.2)	.334
CAD	9 (100)	91 (92.9)	1.00
Current Smoker	2 (22.2)	24 (24.5)	1.00
Diabetes	3 (33.3)	30 (30.6)	1.00
Dyslipidemia	5 (55.6)	71 (72.4)	.279
HTN	7 (77.8)	63 (64.3)	.493
Obesity	1 (11.1)	18 (18.4)	1.00
Peripheral Vascular	1 (11.1)	12 (12.2)	1.00
Psychiatric Disorder n=35 (32.7%)	**n=4 (44.4%)**	**n=31 (31.6%)**	
Anxiety	1 (25.0)	16 (51.6)	.603
Dementia	1 (25.0)	5 (16.1)	.546
Depression	3 (75.0)	24 (77.4)	1.00
Substance	0	8 (25.8)	.553
Charlson Comorbidity	5.43+-2.30	3.98 +-1.79	.015
GRACE Risk Score	123.00+-37.53	99.69+-30.79	.022

[a]Early adverse events (hospital readmission or death before BRIDGE appointment).

Table 12

Demographic Differences Between BRIDGE and Usual Care Participants No. (%)

Variable n=80	**Attend** **n=62 (77.5%)**	**Did Not Attend** **n=18 (22.5%)**	**p-value**
Age (mean +SD)	62.9+14.1	60.9+14.8	0.596
Gender (% Male)	27 (43.5)	6 (33.3)	0.438
Race			
White	53 (85.5)	16 (88.9)	1.00
Non-white (Black, Asian, Native American, Hispanic)	9 (14.5)	2 (11.1)	1.00
Comorbidities			
Afib	4 (6.5)	1 (5.6)	1.00
CVD	4 (6.5)	0	0.570
Hx TIA	2 (2.8)	0 (0)	1.00
Hx CVA	1 (1.6)	0	1.00
CHF	7 (11.3)	4 (22.2)	0.256
CAD	59 (95.2)	18 (100.0)	1.00
Current Smoker	16 (25.8)	3 (16.7)	0.539
Diabetes	2 (32.3)	4 (22.2)	0.413
Dyslipidemia	49 (79.0)	9 (50.)	0.033
HTN	41 (66.1)	9 (50.0)	0.213
Obesity	13 (21.0)	1 (5.6)	0.172
Peripheral Vascular	5 (8.1)	4 (22.2)	0.109
Psychiatric Disorder n=27 (43.5%)	**n=17 (24.7%)**	**n=10 (55.6%)**	
Anxiety	9 (52.9)	5 (50.0)	1.00
Dementia	3 (17.6)	1 (10.0)	1.00
Depression	12 (70.6)	8 (80.0)	0.678
Substance	4 (23.5)	2 (20.0)	1.00
GRACE Risk Score	100.8+30.9	104.8+32.9	0.527
Charlson Comorbidity	4.05+1.74	3.98 +1.96	0.745

Readmissions

Chapter 3 evaluated the differences in readmission rates between patients who attended the BRIDGE program and those who received usual care. ACS patients who attended had significantly lower rates of readmission at 30, 60, 90, and 180 days post-hospital discharge (see *Figure 10*). This analysis builds on those findings.

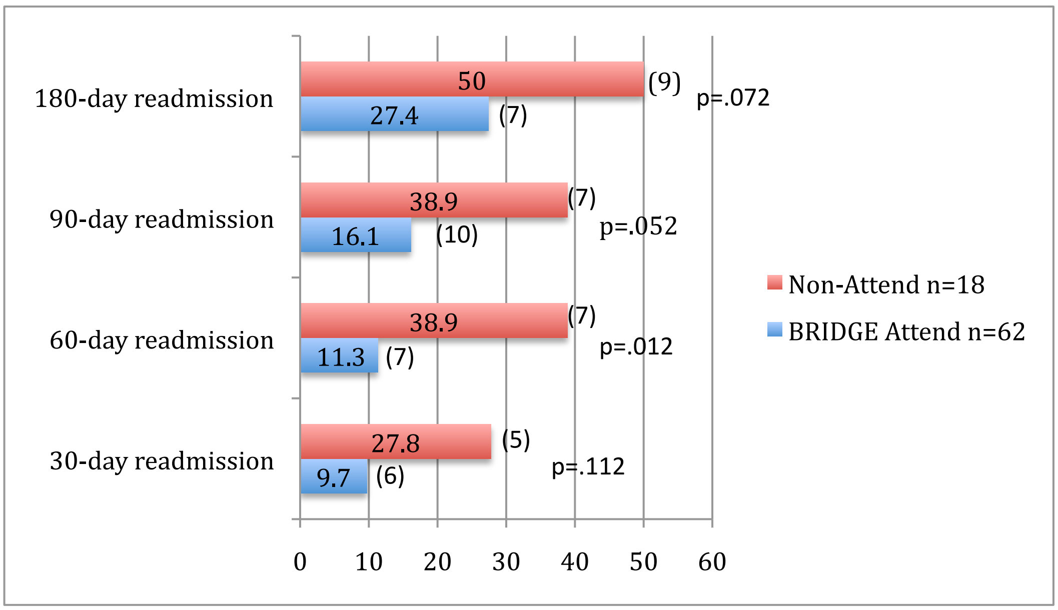


Figure 10. Readmission rates for BRIDGE and non-BRIDGE participants.

Cost

It was hypothesized that, when compared with usual care, there would be a cost reduction in care associated with participation in the BRIDGE program in avoided readmissions. In fact, BRIDGE participants were 18.1% less likely to be readmitted 30 days post-discharge, 27.6% less likely to be readmitted at 60 days, and 22.8% and 22.6% less likely to be readmitted at 60 days and 180-days respectively. The incremental cost for a BRIDGE appointment (as noted earlier in

Table 10) was $43.85 per-patient compared to the average Medicare charge for a cardiology admission of $27,558 (American Hospital Directory, 2011). The reduction in expected 30-day readmissions for BRIDGE patients compared to the incremental BRIDGE costs, translated into a $4,944 per-patient savings, or an overall program savings of $306,537. Savings as a result of avoided readmission within 60 days of discharge were even greater (see Table 13). The difference between groups was 9.5% greater at 60 days post-discharge than at 30 days post-discharge. This change resulted in an additional 35% savings in avoided readmission costs ($121, 286).

Table 13

BRIDGE Savings

	Base Case
30-Day Readmission	
Per Patient Savings	$4,944[a]
Program Savings	$306,537[b]
60-Day Readmission	
Per Patient Savings	$7,562[a]
Program Savings	$468,854[b]

[a] [BRIDGE Cost – ([Probability $\text{readmit}_{nonattend}$-Probability readmit_{attend}]*Readmit Cost)]

[b][(n_{attend}*Probability $\text{readmit}_{nonattend}$*Readmit Cost) – ($n_{attend}$*Probability readmit_{attend}*Readmit Cost) – (n_{attend}*BRIDGE Cost)]

Sensitivity Analysis

One-way sensitivity analyses were performed on the base case for both per-patient and programmatic savings. These findings were robust to a wide range of variation in model inputs. At 30 days post-discharge, there was a per-patient savings across all of the variations for model inputs (see *Figure 11*). The cost of the BRIDGE visit had little influence on patient savings, whereas, variations in the absolute difference in admission rates between BRIDGE and usual care participants and in the cost of readmission both largely impacted patient savings. When readmission costs are extremely high, or when the gap between participants and nonparticipants is at its highest extreme, the most benefit is observed.

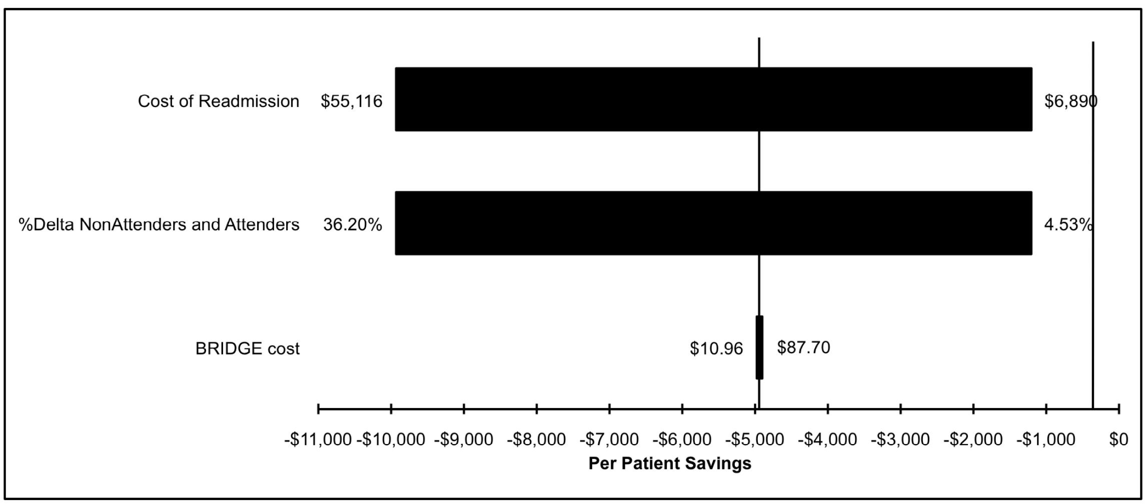


Figure 11. Tornado plot showing one-way sensitivity analysis for 30-day per-patient savings in the base case.

Overall program savings behaved similar to per-patient savings (see *Figure 12*). However, programmatic savings rely on applying the rate of readmissions from nonparticipants to those who participated in the BRIDGE program and calculating additional avoided readmission costs if all of those patients had been readmitted. Therefore, rates of readmission for each group were varied instead of simply reflecting the difference between groups. Again, the actual BRIDGE cost had only a small impact on total program savings. Readmission rates of nonparticipants and the cost of readmission had the widest variation. When the cost of readmission is at its highest extreme, program costs are also at their maximum. The program only becomes less effective as the rate of readmission for nonattendees decreases and approaches the rate of readmission of attendees. Only when the rate of readmission of nonattendees is lower than the rate of readmission of BRIDGE attendees does the program actually have a cost.

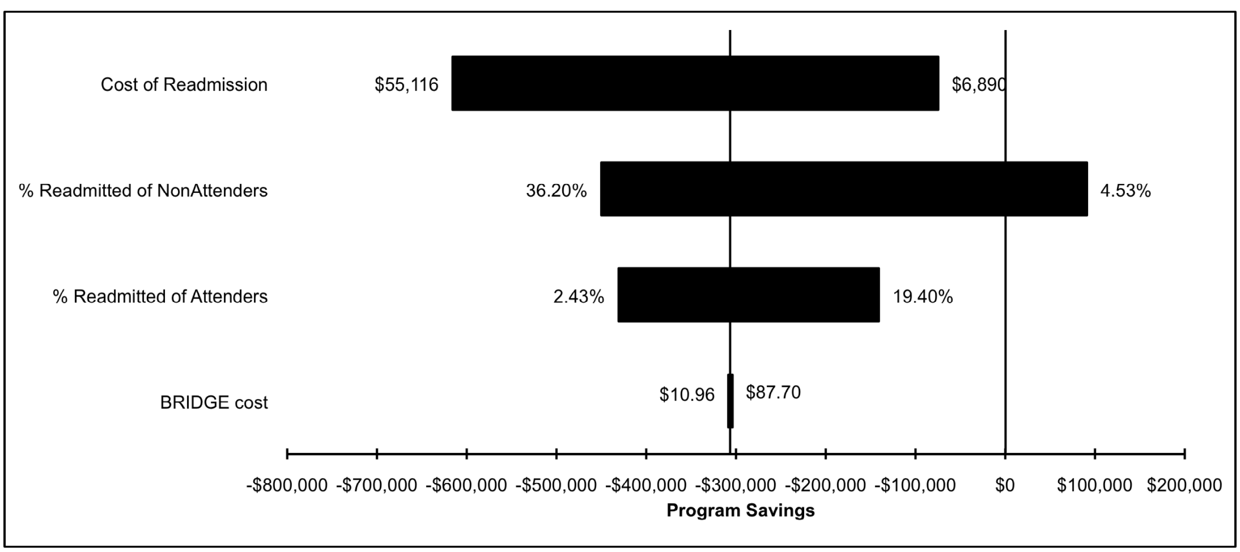


Figure 12. Tornado plot showing one-way sensitivity analysis for 30-day program savings in the base case.

Discussion

These results highlight the benefits of the BRIDGE program and support the hypothesis that the BRIDGE program provides a significant savings in avoided hospital readmissions when compared to usual care. The analysis demonstrated that the BRIDGE model reduces health care costs associated with readmissions that are in excess of intervention costs. On average there was a per-patient savings of $4,944 in avoided readmissions within 30 days of hospital discharge. Over the duration of the program, this equates to a $306,537 savings with ACS patients. If the BRIDGE transitional care program became the standard of care for just these patients, this could result in a societal savings to the healthcare system of more than 1.6 billion dollars per year. Of course, this assumes that the rate is based on using the same formula, program costs, average readmission costs, and probabilities for attendees and substituting the number of discharges for the predicted incidence (785,000), and the national average for readmission following AMI (19.9%).

In comparison to transitional care programs in the literature, the BRIDGE program performs equally as well. The transitional care programs developed by Coleman et al. (2006) and Jack et al. (2009) greatly improved the quality of transitional care between hospital and home, but with only modest savings. The Care Transitions Intervention (Coleman et al., 2006) and Project Red (Jack et al., 2009) both required tools, educators, and dedicated NPs. The Care Transitions Intervention required NPs to provide in-home follow-up for 28 days after discharge along with telemanagement support. The average per-patient cost for this intervention was $206 (reported cost of program divided by number of patients in the intervention group). By emphasizing discharge teaching on an outpatient basis within 2-weeks of discharge, and providing telemanagement support, Krumholz et al. (2002) reported a much larger savings in readmission costs. However, this population, unlike Coleman et al. and Jack et al. was limited to heart failure patients. Naylor et al. also restricted their study to heart failure patients but required significantly more in-home follow-up over a 3-month period, and saved $4,845 per-patient. Like the BRIDGE program, all of these programs were able to demonstrate a cost savings to varying degrees. Yet despite their success and the inclusion of best and ideal practices, these programs have not realized national acceptance or implementation. One possible flaw in these programs is patient ownership. In each of these programs, a provider who may not be a member of the patient's primary care or specialty care team follows the patient longitudinally. In light of this issue, designing the BRIDGE intervention as a one-time visit and making the NPs an extension of the discharge team is novel. That the program is distinct and lacks "patient" competition may make it more user friendly by patients and providers while still providing significant cost savings.

This analysis was performed with a societal perspective as is recommended for cost-effectiveness analyses (Weintraub, Cole, & Tooley, 2002). From this perspective, avoiding costly readmissions by implementing a less expensive program is a positive trade-off. Yet, even when one considers the BRIDGE program from other perspectives, it continues to be an attractive option.

The patient perspective would require additional data on travel expenses, time, charges, and lost work, as well as social and quality of life indicators. Despite these other factors, it is a reasonable hypothesis that, for most patients, a hospitalization is far more expensive and incurs far more consequences than a one-time outpatient visit. From an insurer's perspective, the reimbursement cost for a one-time clinic visit is far less than the cost of a hospitalization.

The most controversial perspective is clearly from the institution's point of view. Traditionally, hospital revenue is generated by admissions. Under this structure, there is a monetary incentive to readmit patients. With the signing of the Patient Protection and Affordable Care Act of 2010, the Centers for Medicare and Medicaid Services will begin penalizing hospitals with excessive 30-day readmission rates for AMI, heart failure and pneumonia. These fines may be exorbitant as they will be levied against inpatient Medicare beneficiary payments, and will increase from 1 percent to 3 percent by 2015 (Foster, 2010; Patient Protection and Affordable Care Act of 2010). Though this change is to take place in 2013, penalties will be assessed on data from the fiscal year 2012---thus creating a great sense of urgency to reduce hospital readmission now. At the same time that these changes in reimbursement are to occur, a pilot program to evaluate a bundled payment structure encompassing hospital charges and post-discharge care will be initiated. This legislation provides strong motivation for hospitals to collaborate with payers to develop an infrastructure that will support the hospital-to-home transition of patient care in an effort to reduce system costs.

Limitations

This study has several limitations, the most notable being that follow-up was initiated within 14-days of discharge. At the onset of the BRIDGE program (2008), this was an acceptable standard of practice. Today, however, 7 days is the ideal goal based on studies done in heart failure (Hernandez et al., 2010). Having the intervention at day 14 post-discharge and attempting to measure outcomes at 30-days was problematic. In reality, only the two-week period after the BRIDGE visit was measured. Readmissions and deaths prior to the scheduled appointment date were excluded. When comparing those who were excluded for early adverse events to the study population, one significant difference stood out: patients with early adverse events had higher Charlson Comorbidity Scores. The CCI for the study population ($\simeq 4$) was not significantly different between participant and nonparticipants. The CCI for patients with early adverse events was significantly higher (≥ 5). This difference translates to nearly a 35% increase risk of mortality in the first year (Charlson et al., 1987). This supports other research that earlier follow-up is critical. Ad hoc, a 60-day cost analysis was preformed. This time period conservatively reflects the true outcomes of the BRIDGE intervention. The median time-from discharge to follow-up with a cardiologist for participants is 59 days. The median time for follow-up with a cardiologist for usual care was 31 days. This 60-day analysis reflects only BRIDGE intervention against usual care that did receive care by their cardiologist 30 days earlier. The difference in the readmission rate is 9.5% greater at 60-days than at 30-days post-discharge (National increase 8.6%;

Jencks et al., 2009). The per-patient savings at 60-days was $7,562 with a program savings of $468,854 in avoided readmissions for patients discharged with an ACS event. This savings is 53% greater than what was observed 30-days post-discharge.

Another significant limitation of this study is that key inputs were obtained from the literature. It is reassuring, given this limitation, that the results of the sensitivity analysis were robust to wide variations of model inputs. The average cost of a cardiac hospitalization was varied from $6,890 (least benefit observed) to $55,116 (most benefit observed). This generous range is meant to provide confidence over a number of unmeasured variables that could impact the model assumptions such as readmission diagnoses, length of stay, and geographic location. As the cost of hospitalizations increase, it becomes even more desirable to avoid readmissions. From both the per-patient and program perspective, there were consistently cost savings over a range of 25%-200% of the base case. Cost of the BRIDGE program was similarly varied to account for differences in NP salary, benefits, costs of support staff, space, utilities, supplies, and geographic location that could occur. BRIDGE cost had little impact on the outcome when varied from 25%-200% of the base case.

Another limitation of this study is that it was conducted via an observational registry and not a randomized controlled trial. Patients chose whether or not to attend and the resulting groups were not necessarily equivalent. Therefore, the results may not be generalizable. However, it has been argued that results from well done observational studies may more closely approximate usual care (Avorn, 2007). Given the high adherence with evidence-based therapies at the study hospital, this study may actually have a dual benefit. Ideally, it reflects typical care among patients who utilize this facility and the benefit of BRIDGE is in comparison to patients who are already receiving high quality evidence-based management. Because the most critical input in this model is the difference in readmission rates between BRIDGE participants and those who received usual care, knowing that patients receiving usual care represent a well-cared-for cohort makes this a more conservative estimate of the program's benefit.

Results of the one-way sensitivity analysis performed on the difference in readmission rates demonstrate the model's sensitivity to this input. The wider the gap between usual care and BRIDGE participants in readmissions, the more money is saved. In the per-patient scenario, there was a cost savings over the entire range of 25%-200% of the base case--- even with a difference as small as 4.53%. The results for program savings were not as resilient. The formula for calculating the programmatic savings required that the actual rates for each group be examined instead of examining the difference between the groups. As the rate of readmission for patients with usual care approaches the rate of those participating in BRIDGE (narrowing the gap to 0 or performing better than BRIDGE), there are no longer avoided readmissions and, therefore, no savings. This is an expected finding. If, usual care had lower readmission rates than the BRIDGE program, there would be no need for such a program.

Conclusion

This cost and benefit analysis suggests that referring patients to an NP-driven one-time transitional care clinic after discharge for an ACS event provides a substantial cost savings in terms of avoidable hospital readmissions compared to program costs. As health care policy continues to change with the rising cost of providing care, so does accountability. These results further support the growing body of research demonstrating that transitional care not only helps patients navigate an overburdened healthcare system, but also does so with a cost advantage that should motivate hospitals and payers to collaborate.

Appendix

An Example of Calculating Potential Penalties for High Readmission Rates

To calculate the exact penalty, one must first determine the amount of excessive payments made for each applicable condition. PPACA defines excessive payments as the product of the number of patients with the applicable condition, the base DRG payment made for those patients, and the percentage of readmissions above expected. Take heart failure (HF) as an example. If a hospital treated 250 HF patients, the average reimbursement for those patients was $5,000 (arguably a low figure, but convenient for this example), and the readmission rate was 20 percent higher than expected, then the excessive payments for HF would be calculated as follows:

HF Excessive Payments = (250 patients) x ($5,000 per patient) x (0.20)
= $250,000

Next, add this value to the excessive payments calculated for AMI and pneumonia, say $0 and $100,000 respectively. Then the total excessive payments would be:

Total Excessive Payments = $250,000 + $0 + $100,000
= $350,000

If the hospital's total inpatient operating payments from Medicare were $25 million in FFY 2012, then their excessive payments were 1.4 percent of total operating payments ($350,000 ÷ $25,000,000). However, the maximum penalty in FFY 2013 is 1 percent of the total operating payments, less than this hospital's total excessive payments. Based on the above example, this hospital would lose $250,000 of its inpatient operating payments in FFY 2013 (PPACA, 2010, Section 3025).

And what happens if private payers follow suit? Obviously the pain just gets worse.

From "Healthcare Reform: Pending Changes to Reimbursement for 30-Day Readmissions," by D. Foster, August 2010, Thomson Reuters, p. 2.

CHAPTER V

CONCLUSION

Summary and Findings

This research adds to the growing body of knowledge on transitional care and how a nurse practitioner (NP)-led model can improve patient care quality and outcomes. Results of this study offer several insights for health care administrators and providers aiming to improve the continuity of care for patients during the hospital-to-home transition. This chapter provides a summary of the overall study findings, limitations, and conclusions as they relate to the research questions posed, as well as implications for future research.

The purpose of this research was to explore three separate but related research questions pertaining to the transitional care of patients with acute coronary syndrome (ACS) who were referred to the Bridging the Discharge Gap Effectively (BRIDGE) program at the University of Michigan. The Integrated Client-Focused Transitional Care Model and its four main constructs (patient, clinician, system, and outcomes) formed the theoretical framework guiding the study. This model posits that for patients to achieve optimal outcomes during their hospital-to-home transition, patient-specific characteristics and behaviors must be balanced by the system's environment and the skills and abilities of the clinicians operating within that environment. Each of the three studies tested a different aspect of the model and its interrelationship with the other constructs. The first study examined patients' persistence rates to medications endorsed by the American Heart Association and the American College of Cardiology in secondary prevention of future ACS events. The degree of persistence was thus a measure of patient-specific behavior that depended upon appropriate clinician prescribing and was deemed paramount to positive health outcomes. The second study, consistent with other studies of transitional care, measured hospital readmission rates as an outcome of the transition process (Naylor, Aiken, Kurtzman, Olds, & Hirschman, 2011). The third study then evaluated the system costs of providing a BRIDGE program in comparison to avoided hospital readmissions in patients receiving usual care.

Study one (Chapter 2) used a regression model to determine if there was a difference in six-month medication persistence rates (beta-adrenergic blocking agents [ß-blockers], angiotensin converting enzyme inhibitors [ACE-inhibitors] or angiotensin receptor blocking agents [ARBs] in patients intolerant to ACE-inhibitors, aspirin, HMG-CoA reductase inhibitors [statins], and clopidogrel) following discharge from the hospital for an ACS event between patients who participated in the NP-delivered BRIDGE program and those who did not. It was hypothesized that when compared to patients who had usual care, patients in the BRIDGE program would exhibit higher rates of medication persistence six months after discharge. There were several interesting findings from the analysis. First, data revealed that more patients discharged on ACE-Is attended their BRIDGE appointment than did patients prescribed any other medication.

The rationale for this finding is unclear given that there were no apparent demographic differences or disease severity differences between the 2 groups. One possible explanation for this may be related to clinician behavior. That is to say, since 75.3% of patients received prescriptions for ACE-Is and only one-quarter of patients did not, perhaps where ACE-Is were warranted clinicians were more inclined to stress the importance of early follow-up in the BRIDGE clinic. Second, overall medication persistence 6-months after discharge for any single agent was high for all study participants and there were no differences in 6-month persistence rates between usual care and BRIDGE participants. There were no cases where patients were taking zero medications. Given the small sample size, little can be concluded about the persistence habits of patients prescribed 4 or 5-drug combined pharmacotherapy regimens. While, a slightly higher percentage of patients who attended BRIDGE remained on a 5-drug regimen six months after discharge, further research and a larger sample are needed to determine if the intervention group really does have higher persistence and whether persistence is potentially provider driven. Unfortunately only 4 of the 21 models tested were predictive of medication persistence at six-months: ß-blockers or ACE-inhibitors adjusted for either the CCI or GRACE Risk Score. However, these four models did explain between 22.9% and 53.1% of the variance in six-month medication persistence for the drug class being analyzed. Potentially with a larger sample size these models will demonstrate better discrimination.

In study two (Chapter 3) readmission rates were calculated to determine if there was a difference in hospital readmissions following discharge between ACS patients who participated in the NP-delivered BRIDGE program and those who did not. It was hypothesized that when compared with patients who had usual care, patients who participated in the BRIDGE program would have a lower 30-day hospital readmission rate. In fact, the NP-driven, single-dose, transitional care program was found to be an effective strategy to lower all-cause hospital readmissions for ACS patients out to 180-days post-discharge. Even with adjustments for severity of illness and severity of event, patients who chose to attend their BRIDGE appointments fared better than patients with usual care.

The final study (Chapter 4) incorporated a cost model to determine costs associated with the BRIDGE program and the difference in costs associated with its use compared to nonuse (usual care) in hospital readmissions following discharge from the hospital for an ACS event. It was hypothesized that compared with usual care, there would be a cost reduction for care associated with participation in the BRIDGE program. Indeed, the results of the cost model support the BRIDGE program and highlight the potential savings in avoided hospital readmissions when compared to usual care. The analysis demonstrated that the BRIDGE model reduced health care costs associated with readmissions in excess of operational costs. On average, there was a per-patient savings of $4,944, which translated into an annual savings of $306,537 in avoided ACS readmission costs.

Limitations

While the implications of this study in informing healthcare administrators and providers about the potential outcomes of transitional care are tremendous, the results must be considered in light of several limitations. Perhaps most important is that this intervention takes place within a large academic medical center in Ann Arbor, Michigan. As such, while results may offer valuable insight into a real-world settings (Avorn, 2007), they may not be generalizable outside of the study population. Particularly pertinent in this study is that the rate of compliance with evidence-based standards for usual care is extremely high.

Another concern is that this study lacks randomization and is at risk of selection bias in two ways. First, the study represents patients who either chose to be treated at the UMHS or who were mandated by their health insurance to seek treatment here. Second, all patients made a choice to attend the BRIDGE program. Therefore, the between-group comparisons may be biased if individuals who chose to be seen differ in some as yet unmeasured manner from those who did not. Because this was an anticipated limitation, specific follow-up was built into the abstraction phase, per clinic protocol, to contact patients who opted out by phone to determine their reason for not attending.

Other potential threats to internal validity included information bias and attribution bias. Although a quality and audit system were in place to minimize the potential for information bias, it is difficult to estimate if this may have impacted the study. Also, there may be an attribution bias in this study. A crucial assumption of this model is that education about disease and management will lead to better patient adherence to secondary preventions and medication persistence. This assumption may not be true for all patients, and may vary by the style, education, and training of the NP providing care. Outcomes observed may therefore be wrongfully attributed to BRIDGE, when in fact, they are due to some outside unmeasured variable, maturational effect or the Hawthorne effect.

Another limitation, given the use of an observational registry, is that data were collected retrospectively. To calculate drug persistence, for example, patients with contraindications to study medications were excluded from the analysis. However, if a patient had a troublesome effect or a contraindication to a medication that was not explicitly documented, the patient may have been misclassified as having lower medication persistence. This error would result in an overestimation of BRIDGE's potential to improve medication persistence (Mukherjee et al., 2004).

Lastly, the concept of persistence is itself a potential limitation of this study. In this study, persistence was measured by self-report. Despite evidence that self-reported persistence, at least in the short-term, is equitable to pill counts (Haynes et al., 1980; Yiannakopoulou et al., 2005) this may raise concern for those desiring a more substantive measure. This is particularly salient given the strong association of poor outcomes with medication non-adherence among ACS patients (Gehi et al., 2007). Hence, these results should not be taken out of context. While persistence is an essential component of adherence, these results only reflect self-reported medication persistence six months post-discharge and do not offer any quantitative measure of medication adherence rates with a prescribed medication regimen.

Conclusion

As a nation, health care is of great concern. Our population is growing older, living longer with more chronic disease (Centers for Disease Control and Prevention, 2011), and incurring greater care-related costs (Stanton, 2006). As the health care system has grown in complexity, an unfortunate chasm has divided inpatient and outpatient care along the care continuum. For patients with ACS, for example, the inability for or lag in follow-up with a care provider after hospital discharge often leads to increased readmissions or other complications.

But as noted previously, there are a host of other reasons for hospital readmission following an ACS event beyond the lack of timely outpatient follow-up. Included among these are premature discharge, insufficient discharge education, poor patient comprehension (Greenwald & Jack, 2009), a shortage of cardiologists (Fye, 2004), and lack of adherence to the joint American Heart Association/American College of Cardiology secondary prevention guidelines (Eagle, Kline-Rogers, et al., 2004; Mehta et al., 2002). Despite numerous care models aimed to address these issues, none have commanded strong enough support for widespread deployment (Jencks et al., 2009). Current efforts are focusing on why this is so and what, if any programs might meet the complex needs of patients between hospital discharge and outpatient follow-up (American College of Cardiology, 2011; Brooten et al., 2002; Coleman et al., 2006; Greenwald & Jack, 2009; Naylor et al., 2004; Naylor et al., 1999; Phillips et al., 2004; Sinclair et al., 2005; Stewart et al., 1998). Although heart failure is the most scrutinized diagnosis in this area, legislative changes promoting penalties on hospitals for excessive readmission rates have widened the scope of analysis to models of care for individuals with other diagnoses such as ACS and pneumonia. Many of these models tested variations or combinations of enhanced discharge education, telephone follow-up, or in-home visits in increasing care quality (Coleman et al., 2006; Naylor et al., 2004; Sinclair et al., 2005; Stewart et al., 1998). Phillips et al. (2004) argued that such interventions could potentially lower hospital readmissions and costs as well if patients can successfully recover from their illness and avoid relapse.

Adherence to standardized best-practice guidelines is one way to ensure that patients have the best opportunity for success in the transition between hospital discharge and follow-up. The concept of adherence is prevalent in transitional literature, but surprisingly few measure it (Peikes, Chen, Schore, & Brown, 2009). Further, no study has explicitly explored the concept of “dose” that is, how much transitional support is needed for a successful recovery. Indeed, most of what we know about dosage is more implied than quantified. For example, studies that only emphasize discharge teaching may be considered to be low dose interventions while studies with multiple home visits might be higher dose. No study has been able to specify the ideal amount of care needed, examined a single-dose model of care, or considered how dose requirements for transitional care may vary by patient characteristics and/or disease state.

The University of Michigan Health System's (UMHS) approach to managing the transitional care gap for patients with cardiovascular (CV) disease is Bridging the Discharge Gap Effectively (BRIDGE), a program designed to ensure that patients discharged after an ACS event have support through the hospital-to-home period. This ambulatory clinic is staffed by five independent, specialized, CV NPs, who function in collaboration with on-site cardiologists and who act as an extension of the in-hospital care team (Housholder & Norville, 2009). NPs in the BRIDGE clinic assess the clinical status of their patients, make therapeutic adjustments, provide education and make referrals (Housholder & Norville, 2009). By offering this service to all CV patients within 14 days of discharge, the UMHS is able to provide a safety-net for patients to avoid poor outcomes due to lack of care during the hand-off between inpatient and outpatient services.

This model could easily be replicated for other sites and other conditions. BRIDGE was created within an established practice, and therefore, no additional overhead costs were required. Further, NPs are known for their abilities to develop therapeutic relationships while identifying the patient's needs and providing patient, family, and caregiver education (Brown & Grimes, 1995; Horrocks et al., 2002; Naylor & Keating, 2008).

Future Research

Future analyses utilizing a larger sample size are necessary for further evaluation of the BRIDGE program as it will allow detection of true differences between patients who receive transitional care and usual care. Additionally, low readmission rates in the intervention group (BRIDGE participants) prohibited developing a multivariate model for medication persistence. A larger sample will thus facilitate development of regression models explaining medication persistence behavior and readmissions. A larger sample is also needed to appreciate how this program effects racial, ethnic, and gender minorities, and if such a program may help to decrease CV disparities among and between different population cohorts. Of note, this study is unique in that it has a higher percentage of female over male participants, although like many other studies, they are largely Caucasian.

Future research should also aim to better define the BRIDGE program within the context of transitional care and measure other appropriate outcomes for model development. For example, both patient and provider surveys would be helpful to evaluate patient's satisfaction with the BRIDGE program, and to appraise how a patient's knowledge attitudes and beliefs related to ACS are effected by the program. A provider survey could potentially identify barriers to BRIDGE utilization and offer alternative processes to facilitate transition.

Given the significant reductions in readmission and the value of the program from avoided readmissions, further research into the benefit of BRIDGE for other disease states is warranted. While patients with ACS benefit from this one-time treatment, perhaps those with other conditions, such as heart failure, may not. Similarly, it would be interesting to examine how specific diagnoses (i.e. depression) effect patient's decisions to participate and the resulting outcomes.

As other measures of outcomes should be evaluated, so should other measures of patient adherence. As noted earlier, this study measures self-reported medication persistence. Future research employing a more quantitative measure of medication persistence and adherence, as well as an assessment of lifestyle modifications, would be of great value in further appraising the benefits of transitional care over usual care.

Finally, the BRIDGE program is an exemplar of the Integrated Client-Focused Transitional Care Model. Transitional care theory is by nature developmental. That is to say that while older transition models are useful, they require expansion. Transitional care is integrally joined to two diverse and evolving areas of health care (hospital or acute care and outpatient or ambulatory care). As these aspects of healthcare mature and change, so must any conjoining transitional care model. The Integrated Client-Focused Transitional Care Model incorporates new concepts in healthcare such as patient-centered care. Within this model, the patient is the essential construct as patients are given more responsibility for their care. Yet, the patient remains the critical element that all other forces in a team-approach must work to balance. Therefore, both the theoretical framework and the BRIDGE program require further validation of the theoretical underpinnings and analysis of measurable constructs. BRIDGE, in particular, should be compared to other models including physician models and models that vary dosage.

Summary

Transitional care is a highly debated focus area today. Many institutions and groups are working feverishly to design and implement their own models. While patients will reap the greatest rewards of improved hospital-to-home care, soon institutions may be severely penalized if the lack of transitional care results in excessive readmission rates.

The BRIDGE model is an appealing strategy for improving transitional care. It is clear that many patients require early post-discharge education, medication counseling, and referrals beyond what was received at discharge. BRIDGE fulfils this need and has demonstrated initial success in reducing 30-day readmissions at a cost value. Ultimately, BRIDGE capitalizes on available resources and successfully improves patient care quality that, in turn, may improve adherence to secondary prevention measures, lower readmission rates, and is cost appealing. In conclusion, the BRIDGE model is a novel means to address transitional care and a practical method to address the vexing nation-wide problem of hospital readmissions for ACS patients.

References

Agency for Healthcare Research and Quality. (2010). Hospital readmsisions research. Retrieved from http://www.ahrq.gov

Akincigil, A., Bowblis, J., Levin, C., Jan, S., Patel, M., & Crystal, S. (2008). Long-term adherence to evidence based secondary prevention therapies after acute myocardial infarction. *Journal of general internal medicine, 23*(2), 115-121. doi: 10.1007/s11606-007-0351-9

Albert, N. M. (2008). Improving Medication Adherence in Chronic Cardiovascular Disease. *Critical Care Nurse, 28*(5), 54-64.

American College of Cardiology. (2011). Hospital to Home: Reducing readmissions. Improving transitions. Retrieved July 17, 2011, 2011, from http://www.h2hquality.org/Home/tabid/38/Default.aspx

American Heart Association. (2009). Heart disease and stroke statistics-2009 update. Dallas, Texas: American Heart Association. Retrieved from americanheart.org

American Hospital Directory. (2011, 04/14/2011). Your best resource for hospital information and custom data services. Retrieved July 20, 2011, 2011, from www.ahd.com

Anderson, J., Adams, C., Antman, E., Bridges…, C., Califf, R. M., Casey Jr, D. E., . . . Wright, R. S. (2011). 2011 ACCF/AHA Focused Update Incorporated Into the ACC/AHA 2007 Guidelines for the Management of Patients With Unstable Angina/Non-ST-Elevation Myocardial Infarction : A Report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines. *Circulation, 123*, e426-e579. doi: 10.1161/CIR.0b013e318212bb8b

Antithrombotic Trialists' Collaboration. (2002). Collaborative meta-analysis of randomised trials of antiplatelet therapy for prevention of death, myocardial infarction, and stroke in high risk patients. *BMJ, 324*(7329), 71-86. doi: 10.1136/bmj.324.7329.71

Antman, E. M., Anbe, D. T., Armstrong, P. W., Bates, E. R., Green, L. A., Hochman, J. S., . . . Krumholz, H. M. (2004). ACC/AHA guidelines for the management of patients with ST-elevation myocardial infarction. *Journal of the American College of Cardiology, 44*(3), E1-E211. doi: 10.1016/j.jacc.2004.07.014

Antman, E. M., Hand, M., Armstrong, P. W., Bates, E. R., Green, L. A., Halasyamani, L. K., . . . JR. (2009). 2007 focused update of the ACC/AHA 2004 guidelines for the management of patients with ST-elevation myocardial infarction. *Journal of the American College of Cardiology, 51*(2), 210-247. doi: 10.1016/j.jacc.2007.10.001

Arora, V., & Farnan, J. (2008). Care transitions for hospitalized patients. *Medical Clinics of North America, 92*, 315-324. doi: 10.1016/j.mcna.2007.11.002

Avorn, J. (2007). In Defense of Pharmacoepidemiology-Embracing the Yin and Yang of Drug Research. *New England Journal of Medicine, 357*(22), 2219-2221. doi: doi:10.1056/NEJMp0706892

Benner, J., Glynn, R., Mogun, H., Neumann, P., Weinstein, M. C., & Avorn, J. (2002). Long-term persistence in use of statin therapy in elderly patients. *Journal of the American Medical Association, 288*(4), 455-461. doi: 10.1001/jama.288.4.455

Bodenheimer, T. (2008). Coordinating care--a perilous journey through the health care system. *The New England Journal of Medicine, 358*(10), 1064-1071.

Bridges, W. (2004). *Transitions: making sense of life's changes*. Cambridge, MA: De Capo Press.

Brindis, R., & Krumholz, H. M. (2010). President's Page: National Quality Initiatives Put ACC's Mission Into Action. *Journal of the American College of Cardiology, 56*(15), 1260-1262. doi: 10.1016/j.jacc.2010.09.004

Brooten, D., Brown, L., Munro, B., York, R., Cohen, S. M., Roncoli, M., & Hollingsworth, A. (1988). Early discharge and specialist transitional care. *Journal of Nursing Scholarship, 20*(2), 64-68.

Brooten, D., Naylor, M., York, R., Brown, L. P., Munro, B. H., Hollingsworth, A. O., . . . Youngblut, J. M. (2002). Lessons learned from testing the quality cost model of advanced practice nursing (APN) Transitional Care. *Journal of Nursing Scholarship, 34*(4), 369-375.

Brown, S. A., & Grimes, D. E. (1995). A meta analysis of nurse practitioners and nurse midwives in primary care. *Nursing Research, 44*(6), 332-339.

Burke, L. E., Dunbar-Jacob, J. M., & Hill, M. N. (1997). Compliance with cardiovascular disease prevention strategies: a review of the research. *Annals of Behavioral Medicine, 19*(3), 239-263. doi: 10.1007/BF02892289

CAPRIE Steering Committee. (1996). A randomised, blinded, trial of clopidogrel versus aspirin in patients at risk of ischaemic events (CAPRIE). *Lancet, 348*(9038), 1329-1339.

Centers for Disease Control and Prevention. (2011). Healthy aging. Retrieved February 12, 2012, from http://www.cdc.gov/chronicdisease/resources/publications/AAG/aging.htm#aag

Charlson, M., Pompei, P., Ales, K., & MacKenzie, C. (1987). A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. *Journal of Chronic Diseases, 40*(5), 373-383. doi: 10.1016/0021-9681(87)90171-8

Charlson, M., Szatrowski, T., Peterson, J., & Gold, J. (1994). Validation of a combined comorbidity index. *Journal of Clinical Epidemiology, 47*(11), 1245-1251. doi: 10.1016/0895-4356(94)90129-5

Chick, N., & Meleis, A. I. (1986). Transitions: a nursing concern. In P. L. Chinn (Ed.), *Nursing Research Methodology* (pp. 237-257). Boulder, CO: Aspen Publication.

Chiu, W., & Newcomer, R. (2007). A systematic review of nurse-assisted case management to improve hospital discharge transition outcomes for the

elderly. *Professional Case Management, 12*(6), 330-336. doi: 10.1097/01.PCAMA.0000300406.15572.e2
Choudhry, N., Avorn, J., Antman, E., Schneeweiss, S., & Shrank, W. H. (2007). Should Patients Receive Secondary Prevention Medications For Free After A Myocardial Infarction? An Economic Analysis. *Health Affairs, 26*(1), 186-194. doi: 10.1377/hlthaff.26.1.186
Choudhry, N., Patrick, A., Antman, E., Avorn, J., & Shrank, W. H. (2008). Cost-effectiveness of providing full drug coverage to increase medication adherence in post myocardial infarction medicare beneficiaries. *Circulation, 117*, 1261-1268. doi: 10.1161/CIRCULATIONAHA.107.735605
Choudhry, N., & Winkelmayer, W. (2008). Medication adherence after myocardial infarction: a long way left to go. *Journal of general internal medicine, 23*(2), 216-218.
Coleman, E., Parry, C., Chalmers, S., & Min, S. (2006). The care transitions intervention: results of a randomized controlled trial. *Archives of Internal Medicine, 166*(17), 1822-1828.
Conrad, D. A., & Christianson, J. B. (2004). Penetrating the "Black Box": Financial Incentives for Enhancing the Quality of Physician Services. *Medical Care Research and Review, 61*(3 suppl), 37S-68S. doi: 10.1177/1077558704266770
Cramer, J., Roy, A., Burrell, A., & Fairchild, C. (2008). Medication compliance and persistence: terminology and definitions. *Value in Health, 11*(1), 44-47. doi: 10.1111/j.1524-4733.2007.00213.x
Cumbler, E., Carter, J., & Kutner, J. (2008). Failure at the transition of care: challenges in the discharge of the vulnerable elderly patient. *Journal of Hospital Medicine, 3*(4), 349-352. doi: 10.1002/jhm.304
Davidson, P., Dracup, K., Phillips, J., Padilla, G., & Daly, J. (2007). Maintaining hope in transition: a theoretical framework to guide interventions for people with heart failure. *Journal of Cardiovascular Nursing, 22*(1), 58-64.
Dhalla, I. A., Smith, M. A., Choudhry, N. K., & Denburg, A. E. (2009). Costs and Benefits of Free Medications after Myocardial Infarction. *Healthcare Policy, 5*(2), 68-86. doi: PMC2805141
DiMatteo, M. (2004). Variations in patients adherence to medical recommendations: A quantitative review of 50 years of research. *Medical Care, 42*(3), 200-209. doi: 10.1097/01.mlr.0000114908.90348.
Donabedian, A. (1966). Evaluating the quality of medical care. *The Milbank Memorial Fund Quarterly, 44*(3), 166-206.
Eagle, K., Kline-Rogers, E., Goodman, S., Gurfinkel, E. P., Avezum, A., Flather, M. D., . . . Steg, P. G. (2004). Adherence to evidence-based therapies after discharge for acute coronary syndromes: An Ongoing Prospective, Observational Study. *The American Journal of Medicine, 117*(2), 73-81. doi: 10.1016/j.amjmed.2003.12.041
Eagle, K., Lim, M., Dabbous, O., Pieper, K., Goldberg, R. J., Van deWerf, F., . . . Fox, K. A. A. (2004). A validated prediction model for all forms of acute coronary syndrome: estimating the risk of 6-month post-discharge death in

an International registry. *Journal of the American Medical Association, 291*(22), 2727-2733. doi: 10.1001/jama.291.22.2727

Elbarouni, B., Goodman, S., Yan, R., Welsh, R., Kornder, J. M., DeYoung, J. P., . . . Yan, A. T. (2009). Validation of the Global Registry of Acute Coronary Event (GRACE) risk score for in-hospital mortality in patients with acute myocardial coronary syndrome in Canada. *American Heart Journal, 158*(3), 392-399. doi: 10.1016/j.ahj.2009.06.010

Ellerbeck, E. F., Jencks, S. F., Radford, M. J., Timothy, F., Craig, A. S., Gold, J. A., . . . Vogel, R. A. (1995). Quality of care for Medicare patients with acute myocardial infarction: a four-state pilot study from the cooperative cardiovascular project. *Journal of the American Medical Association, 273*(19), 1509-1514. doi: 10.1001/jama.1995.03520430045037

Fishbein, M., & Ajzen, I. (1975). *Belief, attitude, intention, and behavior: An introduction to theory and research*. Reading, MA: Addison-Wesley.

Fisher, J., Amico, K., Fisher, W., & Harman, J. (2008). The information-motivation-behavioral skills model of antiretroviral adherence and Its Applications. *Current HIV/AIDS Reports, 5*(4), 193-203. doi: 10.1007/s11904-008-0028-y

Fisher, J. D., & Fisher, W. A. (2002). The Information-Motivation-Behavioral Skills Model. In R. J. DiClemente, R. A. Crosby & M. C. Kegler (Eds.), *Emerging Theories in Health Promotion Practice and Research* (pp. 40-70). San Fransisco, CA: Jossey-Bass.

Fisher, W. A., & Fisher, J. D. (2003). The Information-Motivation-Behavioral Skills Model: a general social psychological approach to understanding and promoting health behavior. In H. Tennen & G. Affleck (Eds.), *Social Psychological Foundations of Helath and Illness* (pp. 82-106). Malden, MA: Blackwell Publishing LTD.

Foster, D. (2010). Healthcare Reform: Pending Changes to Reimbursement for 30-Day Readmissions. *Thomson Reuters*.

Fye, W. B. (2004). Cardiology workforce: a shortage, not a surplus. *Health Affairs, Jan-July* (Supp Web Exclusives), W4-43-59. doi: 10.1377/hlthaff.W4.64

Gehi, A. K., Ali, S., Na, B., & Whooley, M. A. (2007). Self-reported medication adherence and cardiovascular events in patients with stable coronary heart disease: the heart and soul study. *Archives of Internal Medicine, 167*(16), 1798-1803.

Granger, C., Goldberg, R., Dabbous, O., Pieper, K., Eagle, K., Cannon, C., . . . Flather, M. (2003). Predictors of hospital mortality in the global registry of acute coronary events. *Archives of Internal Medicine, 163*(19), 2345-2353.

Greenwald, J., & Jack, B. (2009). Preventing the preventable: reducing rehospitalizations through coordinated, patient-centered discharge processes. *Professional Case Management, 14*(3), 135.

Harrison, M. B., Browne, G. B., Roberts, J., Tugwell, P., Gafni, A., & Graham, I. D. (2002). Quality of Life of Individuals With Heart Failure: A Randomized Trial of the Effectiveness of Two Models of Hospital-to-Home Transition. *Medical Care, 40*(4), 271-282.

Haynes, R., Taylor, D., Sackett, D., Gibson, E., BERNHOLZ, C. D., & MUKHERJEE, J. (1980). Can simple clinical measurements detect patient noncompliance? *Hypertension, 2*, 757-764.

Haynes, R. B., McKibbon, K. A., & Kanani, R. (1996). Systematic review of randomised trials of interventions to assist patients to follow prescriptions for medications. *The Lancet, 348*(9024), 383-386. doi: 10.1016/S0140-6736(96)01073-2

Hernandez, A. F., Greiner, M. A., Fonarow, G. C., Hammill, B. G., Heidenreich, P. A., Yancy, C. W., . . . Curtis, L. H. (2010). Relationship Between Early Physician Follow-up and 30-Day Readmission Among Medicare Beneficiaries Hospitalized for Heart Failure. *JAMA: The Journal of the American Medical Association, 303*(17), 1716-1722. doi: 10.1001/jama.2010.533

Hippisley-Cox, J., & Coupland, C. (2005). Effect of combinations of drugs on all cause mortality in patients with ischaemic heart disease: nested case-control analysis. *British Medical Journal, 330*(7499), 1059-1063. doi: 10.1136/bmj.330.7499.1059

Ho, P., Spertus, J., Masoudi, F., & Reid, K. (2006). Impact of medication therapy discontinuation on mortality after myocardial infarction. *Archives of Internal Medicine …, 166*, 1842-1847.

Holzemer, W., & Reilly, C. (1995). Variables, variability, and variations research: implications for medical informatics. *Journal of the American Medical Association, 2*(3), 183-190. doi: 10.1136/jamia.1995.95338871

Horrocks, S., Anderson, E., & Sallisbury, C. (2002). Systematic review of whether nurse practitioners in primary care can provide equivalent care to doctors. *British Medical Journal, 324*, 819-823. doi: 10.1136/bmj.324.7341.819

Housholder, S., & Norville, J. (2009). *Bridge clinic background*. unpublished manuscript. University of Michigan. Ann Arbor.

Jack, B., Chetty, V., Anthony, D., Greenwald, J. L., Sanchez, G. M., Johnson, A. E., . . . Culpepper, L. (2009). A reengineered hospital discharge program to decrease rehospitalization. *Annals of Internal Medicine, 150*, 178-187.

Jacob, L., & Poletick, E. (2008). Systematic review: predictors of successful transition to community- based care for adults with chronic care needs. *Care Management Journals, 9*(4), 154-165. doi: 10.1891/1521-0987.9.4.154

Jencks, S., Williams, M., & Coleman, E. (2009). Rehospitalizations among patients in the Medicare fee-for-service program. *The New England Journal of Medicine, 360*(14), 1418-1428.

Jerant, A., DiMatteo, R., Arnsten, J., Moore-Hill, M., & Franks, P. (2008). Self-report adherence measures in chronic illness: retest reliability and predictive validity. *Medical care, 46*(11), 1134-1139.

Jha, A., Orav, E., & Epstein, A. (2009). Public Reporting of Discharge Planning and Rates of Readmissions. *New England Journal of Medicine, 261*(27), 2637-2645.

Kind, A. J. H., Smith, M. A., Frytak, J. R., & Finch, M. D. (2007). Bouncing back: patterns and predictors of complicated transitions 30 days after

hospitalization for acute ischemic stroke. [Comparative Study]. *Journal of the American Geriatrics Society, 55*(3), 365-373. doi: 10.1111/j.1532-5415.2007.01091.x
Krumholz, H., Amatruda, J., Smith, G., Mattera, J., Roumanis, S., Radford, M., . . . Vaccarino, V. (2002). Randomized trial of an education and support intervention to preventreadmission of patients with heart failure. *Journal of the American College of Cardiology, 39*(1), 83-89. doi: 10.1016/S0735-1097(01)01699-0
Krumholz, H., Merrill, A., Schone, E., Schreiner, G. C., Chen, J., Bradley, E. H., . . . Drye, E. E. (2009). Patterns of hospital performance in acute myocardial infarction and heart failure 30-day mortality and readmission. *Circulation: Cardiovascular Quality and Outcomes, 2*, 407-413. doi: 10.1161/CIRCOUTCOMES.109.883256
Manning, W. G., Fryback, D. G., & Weinstein, M. C. (1996). Reflecting uncertainty in cost-effestiveness analysis. In M. R. Gold, L. B. Russel, J. E. Siegel & M. C. Weinstein (Eds.), *Cost-effectiveness in health and medicine*. New York: Oxford University Press.
Margulis, A. V., Choudhry, N. K., Dormuth, C. R., & Schneeweiss, S. (2011). Variation in initiating secondary prevention after myocardial infarction by hospitals and physicians, 1997 through 2004. *Pharmacoepidemiology and drug safety, 20*(10), 1088-1097. doi: 10.1002/pds.2144
McLaughlin, T. J., Soumerai, S. B., Willison, D. J., Gurwitz, J. H., Borbas, C., Guadagnoli, E., . . . Gobel, F. (1996). Adherence to national guidelines for drug treatment of suspected acute myocardial infarction: evidence for undertreatment in women and the elderly. *Archives of Internal Medicine, 156*(7), 799-805. doi: 10.1001/archinte.1996.00440070131015
Mehta, R., Montoye, C., Faul, J., Nagle, D., Kure, J., Raj, E., . . . Changezi, H. (2004). Enhancing quality of care for acute myocardial infarction: shifting the focus of improvement from key indicators to process of care and tool use The American College of Cardiology Acute Myocardial Infarction Guidelines Applied in Practice Project in Michigan: Flint and Saginaw Expansion. *Journal of the American College of Cardiology, 43*(12), 2166-2173.
Mehta, R., Montoye, C., Gallogly, M., Baker, P., Blount, A., Faul, J., . . . Eagle, K. A. (2002). Improving quality of care for acute myocardial infarction: The Guidelines Applied in Practice (GAP) Initiative. *Journal of the American Medical Association, 287*(10), 1269-1276. doi: 10.1001/jama.287.10.1269
Meleis, A. I., Sawyer, L. M., Im, E. O., Hilfinger Messias, D. K., & Schumacher, K. (2000). Experiencing transitions: An emerging middle range theory. *Advances in Nursing Science, 23*(1), 12-28.
Mitchell, P., Ferketich, S., & Jennings, B. (1998). Quality health outcomes model. *Image: Journal of Nursing Scholarship, 30*(1), 43-46.
Mitchell, P. H., & Lang, N. (2004). Framing the problem of measuring and improving healthcare quality: has the quality health outcomes model been useful? *Medical Care, 42*(2 suppl), II-4-II-11. doi: 10.1097/01.mlr.0000109122.92479.fe

Mukherjee, D., Fang, J., Chetcuti, S., Moscucci…, M., Kline-Rogers, E., & Eagle, K. A. (2004). Impact of combination evidence-based medical therapy on mortality in patients with acute coronary syndromes. *Circulation, 109*, 745-749. doi: 10.1161/01.CIR.0000112577.69066.CB

National Cholesterol Education Program. (2002). Third Report of the National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III) Final Report. *Circulation, 106*(25), 3143.

Naylor, M., Aiken, L., Kurtzman, E., Olds, D., & Hirschman, K. (2011). The Importance Of Transitional Care In Achieving Health Reform. *Health Affairs, 30*(4), 746-754. doi: 10.1377/hlthaff.2011.0041

Naylor, M., Brooten, D., Campbell, R., Maislin, G., McCauley, K. M., & Schwartz, J. S. (2004). Transitional care of older adults hospitalized with heart failure: a randomized, controlled trial. *Journal of the American Geriatrics Society, 52*, 675-684. doi: 0.1111/j.1532-5415.2004.52202.x

Naylor, M., Brooten, D., Jones, R., Lavizzo-Mourey, R., Meze, M., & Pauly, M. (1994). Comprehensive Discharge Planning for the Hospitalized Elderly. *Annals of internal medicine, 120*(12), 999-1006.

Naylor, M., & Keating, S. (2008). Transitional Care. *AJN The American Journal of Nursing, 108*(9), 65-73. doi: 10.1097/01.NAJ.0000336420.34946.3a

Naylor, M. D., Brooten, D., Campbell, R., Jacobsen, B. S., Mezey, M. D., Pauly, M. V., & Schwartz, J. S. (1999). Comprehensive Discharge Planning and Home Follow-up of Hospitalized Elders: A Randomized Clinical Trial. *Journal of the American Medical Association, 281*(7), 613-620. doi: 10.1001/jama.281.7.613

Needham, D., Scales, D., Laupacis, A., & Pronovost, P. (2005). A systematic review of the Charlson comorbidity index using Canadian administrative databases: a perspective on risk adjustment in critical care research. *Journal of Critical Care, 20*(1), 12-19. doi: 10.1016/j.jcrc.2004.09.007

Newby, L., Eisenstein, E., Califf, R., Thompson, T., Nelson, C., Peterson, E., . . . Topol, E. (2000). Cost effectiveness of early discharge after uncomplicated acute myocardial infarction. *The New England Journal of Medicine, 342*(11), 749-755.

Newby, L., LaPointe, A., Nancy, M., & Chen, A. (2006). Long-term adherence to evidence-based secondary prevention therapies in coronary artery disease. *Circulation, 113*, 203-212. doi: 10.1161/CIRCULATIONAHA.105.505636

Orszag Testimony, President's Fiscal Year 2010 Budget, U.S. House of Representatives, 111th Cong Sess. 11 (2009).

Patient Protection and Affordable Care Act of 2010, & Pub. L. No. 111-148, 124 Stat. 119. (2010).

Pender, N. J., Murdaugh, C. L., & Parsons, M. A. (2006). Individual models to promote health *Health promotion in nursing practice*. Upper Saddle River, NJ: Pearson, Prentice Hall.

Phillips, C., Wright, S., Kern, D., Singa, R., Shepperd, S., & Rubin, H. R. (2004). Comprehensive discharge planning with postdischarge support for older patients with with congestive heart failure: a meta-analysis. *Journal of the American Medical Association, 291*(11), 1358-1367. doi: 10.1001/jama.291.11.1358

Project Red [Re-engineered Discharge]. (2011). Retrieved August 4, 2011, 2011, from http://www.jcrinc.com/AHRQ-Project-Red/

Ramsay, G., Podogrodzka, M., McClure, C., & Fox, K. (2007). Risk prediction in patients presenting with suspected cardiac pain: the GRACE and TIMI risk scores versus clinical evaluation. *QJM, 100*(1), 11-18. doi: 10.1093/qjmed/hcl133

Ramsay, S., Whincup, P., Lawlor, D., Papacosta, O., Lennon, L. T., Thomas, M. C., . . . Morris, R. W. (2006). Secondary prevention of coronary heart disease in older patients after the national service framework: population based study. *British Medical Journal, 332*, 144-145. doi: 10.1136/bmj.38704.770127.BE

Roger, V. L., Go, A. S., Lloyd-Jones, D. M., Adams, R. J., Berry, J. D., Brown, T. M., . . . Wylie-Rosett, J. (2011). Heart disease and stroke statistics--2011 update: A report from the American Heart Association. *Circulation, 123*(4), e18-e209.

Rosamond, W., Flegal, K., Friday, G., Furie, K., Go, A. S., Greenlund, K., . . . Hong, Y. (2007). Heart disease and stroke statistics--2007 update: a report from the American Heart Association statistics committee and stroke statistics subcommittee. *Circulation, 115*, e69-e171. doi: 10.1161/CIRCULATIONAHA.106.179918

Rosenstock, I. M. (1974). Historical origins of the health belief model. *Health Education Monographs, 2*(4), 328-335.

Schumacher, K., & Meleis, A. I. (1994). Transitions: a central concept in nursing. *Journal Of Nursing Scholarship, 26*(2), 119-127.

Simpson, E., Beck, C., Richard, H., Eisenberg, M. J., & Pilote, L. (2003). Drug prescriptions after acute myocardial infarction: Dosage, compliance, and persistence. *American Heart Journal, 145*(3), 438-444. doi: 10.1067/mhj.2003.143

Sinclair, A., Conroy, S., Davies, M., & Bayer, A. (2005). Post-discharge home-based support for older cardiac patients: a randomised controlled trial. *Age and Ageing, 34*, 338-343. doi: 10.1093/ageing/afi116

Smith Jr, S., Allen, J., Blair, S., Bonow…, R., Brass, L. M., Fonarow, G. C., . . . Taubert, M. A. P. a. A. (2006). AHA/ACC guidelines for secondary prevention for patients with coronary and other atherosclerotic vascular disease: 2006 update: endorsed by the National Heart, …. *Circulation, 113*, 2363-2372. doi: 10.1161/CIRCULATIONAHA.106.174516

Smith, S. C., Benjamin, E. J., Bonow, R. O., Braun, L. T., Creager, M. A., Franklin, B. A., . . . Taubert, K. A. (2011). AHA/ACCF Secondary Prevention and Risk Reduction Therapy for Patients With Coronary and Other Atherosclerotic Vascular Disease: 2011 Update: A Guideline From the American Heart Association and American College of Cardiology Foundation. *Circulation, 124*(22), 2458-2473. doi: 10.1161/CIR.0b013e318235eb4d

Sokol, M., McGuigan, K., Verbrugge, R., & Epstein, R. (2005). Impact of medication adherence on hospitalization risk and healthcare cost. *Medical care, 43*(6), 521-530.
Spencer, F., Lessard, D., Gore, J., Yarzebski, J., & Goldberg, R. (2004). Declining length of hospital stay for acute myocardial infarction and postdischarge outcomes: a community-wide perspective. *Archives of Internal Medicine, 164*(7), 733-740.
Speroff, T., Miles, P., & Mathews, B. (1998). Improving health care, Part 5: Applying the Dartmouth clinical improvement model to community health. *The Joint Commission Journal on Quality Improvement, 24*(12), 679.
Stanton, M. (2006). *The high concentration of U.S. healthcare expenditures*. (AHRQ Publication No. 06-0060). Rockville, MD: Agency for Healthcare Research and Quality. Retrieved from http://www.ahrq.gov/research/ria19/expendria.htm.
Stewart, S., & Horowitz, J. (2002). Detecting early clinical deterioration in chronic heart failure patients post-acute hospitalisation—a critical component of multidisciplinary, home-based intervention? *European Journal of Heart Failure, 4*(3), 345-351.
Stewart, S., Pearson, S., Luke, C., & Horowitz, J. (1998). Effects of home-based intervention on unplanned readmissions and out-of-hospital deaths. *Journal of the American Geriatrics Society, 46*(2), 174-180.
Wald, N. J., & Law, M. (2003). A strategy to reduce cardiovascular disease by more than 80%. *British Medical Journal, 326*(7404), 1419-1423.
Walker, L. O., & Avant, K. C. (2005). *Theory Synthesis* (4th ed.). Upper Saddle River, New Jersey: Pearson Education, Inc.
Warner, K. E., & Luce, B. R. (1982). Introduction to cost-benefit and cost-effectiveness analysis *Cost-benefit and cost-effectiveness analysis in health care: principles, practice, and potential*. Ann Arbor, MI: Health Administration Press.
Weintraub, W., Cole, J., & Tooley, J. (2002). Cost and cost-effectiveness studies in heart failure research. *American Heart Journal, 143*(4), 565-576. doi: http://dx.doi.org.proxy.lib.umich.edu/10.1067/mhj.2002.120965
Weiss, M. E., Piacentine, L. B., Lokken, L., Ancona, J., Archer, J., Gresser, S., . . . Vega-Stromberg, T. (2007). Perceived readiness for hospital discharge in dult medical-surgical patients. *Clinical Nure Specialist, 21*(1), 31-42.
Wilson, P. W. F., D'Agostino, R. B., Levy, D., Belanger, A. M., Silbershatz, H., & Kannel, W. B. (1998). Prediction of coronary heart disease using risk factor categories. *Circulation, 97*(18), 1837-1847. doi: 10.1161/01.CIR.97.18.1837
World Health Organization. (2010). Adherence to long-term therapies: evidence for action. 1-209.
Yiannakopoulou, E., Papadopulos, J., Cokkinos, D. K., & Mountokalakis, T. D. (2005). Adherence to antihypertensive treatment: a critical factor for blood pressure control. *Journal of …*.
Yusuf, S., Zhao, F., Mehta, S. R., Chrolavicius, S., Tognoni, G., & Fox, K. K. (2001). Effects of clopidogrel in addition to aspirin in patients with acute

coronary syndromes without ST-segment elevation. [Clinical Trial]. *The New England Journal of Medicine, 345*(7), 494-502. doi: 10.1056/NEJMoa010746