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PREDICTORS OF PATIENT ACTIVATION AT ACS HOSPITAL DISCHARGE AND
HEALTH CARE UTILIZATION IN THE SUBSEQUENT YEAR

A Dissertation Presented

By

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University of Massachusetts Graduate School of Biomedical Sciences, Worcester
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CLINICAL AND POPULATION HEALTH RESEARCH

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ABSTRACT

Background. AHA guidelines have been established to reduce Acute Coronary Syndrome (ACS)-related morbidity, mortality and recurrent events post-discharge. These recommendations emphasize the patient as an engaged member of the health care team in secondary prevention efforts. Patients with high levels of activation are more likely to perform activities that will promote their own health and are more likely to have their health care needs met. Despite evidence and strong expert consensus supporting patients as active collaborators in their own ACS care, the complexity and unexpected realities of self-managing one's care at home are often underestimated. This study seeks to examine the correlates of patient activation at hospital discharge and then identifies activation trajectories in this same cohort in subsequent months. Lastly, this study examines the association between patient activation and health care utilization in the year subsequent to an ACS event.

Methods. This study incorporates three aims: Aim 1, identification of the correlates of low patient activation post-discharge; Aim 2, identification of patient activation trajectories among this same cohort in the months following hospitalization; and Aim 3, examination of the association between patient activation and health utilization, post-discharge.

Results. Fifty-nine percent of ACS patients identified as being at the lowest two activation stages at the time of hospital discharge. Perceived stress ($p < 0.001$) and depression ($p < 0.001$) were both correlates of low activation at discharge. Three distinct activation trajectories were identified post-discharge: low, stable (T1), high, sharp decline (T2), and sharp improvement (T3). The majority of patients (67%) identified as being in T1. Those patients of older age (OR: 2.22; CI 1.4- 3.5), identifying as Black in race (OR: 2.14; CI 1.1- 4.3), and reporting moderate/high perceived stress (OR: 2.54; CI 1.4- 4.5) had increased odds of being in the low, stable trajectory. The bivariate analysis indicated a significant association ($P = 0.008$) between

low patient activation and self-reported hospital readmissions in the months following discharge. In the final model, moderate to severe depression (OR: 1.60; CI 1.1- 2.3) was the strongest predictor of readmissions in the 12 months subsequent to discharge.

Conclusions: Patients reported low activation at hospital discharge after an ACS event indicated that these patients were not prepared to take an active role in their own care. Correlates of low activation at discharge include moderate to high perceived stress, depression, and low social support. Furthermore, in the months following hospital discharge, the majority of these patients followed either a low/stable or a sharp decline activation trajectory. Hence, these results suggest that over time patients feel less and less confident to take an active role in self-management. Lastly, we found that patient activation may impact healthcare utilization in the year subsequent to hospital discharge, although patient self-reported depression appears to be the strongest predictor of utilization in the subsequent year. Future research is needed to better understand the relationship(s) among patient activation, depression, and health care utilization.

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LIST OF ABBREVIATIONS

- ACS – Acute Coronary Syndrome
- AHA – American Heart Association
- AIDS/HIV– Acquired Immune Disease, Human Immunodeficiency Virus
- BIC – Bayesian Information Criterion
- COPD – Chronic Obstructive Pulmonary Disease
- CHD, CHF- Chronic Heart Disease, Chronic Heart Failure
- ER, ED – Emergency Room, Emergency Department
- GA – Georgia
- GBTM – Group-Based Trajectory Modeling
- GED – General Education Diploma
- GRACE - Global Registry of Acute Coronary Events
- IRB- Internal Review Board
- LOS- Length of Stay (Hospital)
- MA- Massachusetts
- MOS-SSS – Medical Outcomes Study, Social Support Study
- NSTEMI- Non- ST Elevated Myocardial Infarction
- PAM– Patient Activation Measure
- PHQ9- Patient Health Questionnaire 9
- PSS- Perceived Stress Scale
- STEMI- ST Elevation Myocardial Infarction
- TICS- Telephone Interview for Cognitive Status

CHAPTER I
INTRODUCTION

Introduction

Acute coronary syndrome (ACS) is an umbrella term that refers to heart conditions resulting from decreased blood flow to the cardiac muscle. Most commonly, ACS refers to an Acute Myocardial Infarction (AMI) or unstable angina (UA); these represent the most common subset of cardiovascular diseases and are life-threatening disorders that remain a source of high morbidity and mortality despite advances in treatment.[1] Annually, more than 1.2 million Americans have experienced a new or recurrent coronary event (acute myocardial infarction [AMI] or death. Within the first year of surviving an AMI, 25% of men and 38% of women die. Within six years of surviving an AMI, 18% of men and 35% of women have a recurrent AMI, 7% of men and 6% of women experience sudden cardiac death, and 22% of men and 46% of women become disabled with heart failure. [2] While ACS mortality has declined over the past decade, the prevalence of ACS is projected to more than double in the next 20 years as the U.S. population ages. Thus, ACS presents a substantial challenge as the growing burden of this disease threatens the sustainability of the United States' health care system.[3] While ACS mortality has declined in patients hospitalized for an event, these same patient survivors need to have the ability to manage their chronic illness once they are discharged from the hospital. Consequently, while the acute, hospitalization phase of ACS involves a crisis management approach to ensure cardiac stabilization and patient survival, the post-discharge period entails the active patient as an important element in managing his/her own chronic illness care.

The Cost Burden of ACS

The burden of Acute Coronary Syndrome (ACS) is substantial, having an economic impact on Americans of more than \$150 billion, annually.[4] Recent literature has estimated the

total first year costs to a patient after an ACS event to be \$25,000 with hospitalization, and an average length of stay of 4.6 days accounting for the majority of this bill.[5-7] The economic burden resulting from ACS extends beyond the hospital. The American Heart Association reported the annual healthcare cost per patient discharged with ACS to be about \$8,170, of which \$7,545 was incurred for subsequent hospitalizations and other medical care and \$625 for pharmacy costs. In the workforce, ACS is a leading cause of disability with an estimated per claim loss of productivity for short-term disability estimated at \$7,943 and \$52,473 for long-term disability.[8, 9] These findings are substantial considering that over one-third % of all ACS patients are younger than 65 years of age and diagnosed with a chronic illness that will extend throughout their lifetime.[10, 11]

Hospital Utilization Post-Discharge

Although mortality associated with ACS has been declining, the need to better manage patient's post-discharge and chronic care is increasing. In particular, one in five ACS patients is readmitted to the hospital within the first 30 days post-hospital discharge [12, 13] and 50% are rehospitalized within 6 months.[10] The average cost for each subsequent readmission is estimated at \$15,000 per patient or approximately 65% of the total cost of the initial ACS admission. However, as few as 10% of these readmissions related to a recurrent MI (Myocardial Infarction) and only half were accounted for by any cardiovascular reason.[13] Recent literature underscores that many of these rehospitalizations may be due to the patient's inability to correctly identify the signs and symptoms of a recurrent acute event. Hence, while ACS patients may be susceptible to rehospitalization post-discharge, these readmissions may not be due to cardiac symptoms. Some evidence has suggested that a patient's feeling of loss of control and lack of information to recognize a recurrent event after an initial hospital discharge may be pivotal to subsequent hospitalizations.[14] In an effort to reduce readmissions, interventions

have aimed at discharge support arrangements, patient-centered discharge instructions, and patient education. Yet only a few of these interventions were associated with a reduced risk for readmissions.[14] Moreover, little work has been done to examine the nature of ER visits in the year subsequent to the initial ACS discharge, despite these visits being common and costly. It may be that if patients were better able to recognize the signs and symptoms of recurrent ACS events, there would be a decrease in both readmissions and ER utilization.

Clinical Guidelines: Recovery after ACS Hospitalization

Recently, the American Heart Association (AHA) and the American College of Cardiology (ACC) recommendations have been expanded to underscore the patient's active role in the long-term management of their disease. The transition from hospital to home after an event can be challenging for an ACS patient. AHA guidelines have been established to reduce ACS-related morbidity, mortality and recurrent events, post-discharge. These recommendations emphasize patient education aimed at secondary prevention by underscoring the importance of symptom identification, lifestyle modification, risk management, medication adherence and instruction, and cholesterol management.[15] However, despite the evidence and strong expert consensus supporting the role of the patients as active collaborators in their own ACS care, the complexity and unexpected realities of self-managing one's care at home are often underestimated.[16, 17] Hence, a significant gap exists between expectations for disease self-management as published in national guidelines and actual implementation of these recommendations.[16] Moreover, recent literature has underscored the lack of engaged, active patient collaborators, emphasizing rather that cardiac patients often feel unprepared for their transition home and have expressed needs for information and knowledge about their diagnosis to guide their self-management. [18, 19] Lacking in clear expectations and self-management guidance, ACS patients often experience anxiety, depression, and fear as they attempt to manage

their chronic disease. An integrative review of 61 studies focused on patient recovery and transitions, reported that cardiac patients' understanding of and perception of their acute event shapes their self-management activities in the time subsequent to hospitalization.[16] Yet, there exists little evidence surrounding how to gauge ACS patients' disease comprehension and knowledge at hospital discharge. Currently, there is a fundamental lack of peer-reviewed literature exploring the ACS patient's level of activation at hospital discharge and how this activation impacts recovery.

The Role of Self-Management in ACS Chronic Care

In contrast to the care received during the initial hospitalization phase, the post-discharge period requires long-term, continual care and a component of active disease self-management which is dependent on the patient. Recent models of healthcare delivery have underscored the teaching of self-management skills to patients with chronic illnesses.[20-23] As a result, patient self-management programs have been developed for various chronic illnesses and are widely recognized as important in improved health outcomes, including reducing both short-term risks and long-term complications.[24-35] However, the evidence regarding the impact of self-management and patient education on chronically ill populations is mixed. While such interventions may increase knowledge, studies have reported variable impact on outcomes.[36, 37] Further research is needed to understand which patient characteristics are associated with active ACS self-management, and in turn, how this active role influences patients' quality of life and their health care utilization.

Patient Activation Conceptualized

The Chronic Care Illness Model emphasizes patient-oriented care by calling on patients to be active members in their own care. The activated patient is a crucial element in this self-management model. Hibbard conceptualized the notion of the "activated patient" after a review

of published articles revealed that being an engaged and active participant in one's own chronic illness care was associated with increased quality of life, better health outcomes, and cost savings. [38] Activation may be defined as the steps necessary to empower an individual to make a behavioral change. In 2004, Hibbard et al. developed and validated the Patient Activation Measure (PAM) to assess patient activation or a patient's knowledge, confidence, and ability to take an active and collaborative role in managing their own health and health care.[38] This work not only led to conceptual understanding of patient activation but also incorporated measure refinement that produced a description of four progressively higher 'stages of activation'. The first PAM stage involves beliefs about the patient's role, the second stage involves the patient's knowledge and confidence to take action, stage three (3) involves the patient taking action and making lifestyle changes that favor prevention, and the last stage (4) involves the patient maintaining these healthy behaviors and lifestyle changes even under times of stress. Patient activation is important because engaged, informed, and skilled patients are more likely to participate in activities which promote their self-care.[38]

Patient Activation Research

The PAM addresses key patient psychological factors and personal competencies that are needed to self-manage one's own care. Higher PAM stages have been positively correlated with self-efficacy, preventative actions, and health outcomes in various disease and payer populations throughout the world. [39-47] Higher patient activation is associated with engagement in healthy behaviors (diet, exercise), adherence to preventive guidelines/screenings [38, 48-50] and effective communication among some populations. Emerging evidence also suggests that patient activation is a factor that predicts hospitalization and emergency room utilization among chronically ill populations. [48, 49, 51, 52] While PAM has been utilized to examine these relationships in chronically ill patients, the majority of this work has been focused on outpatient

diabetic populations. [53-58] Here, and across a variety of patient populations (healthy and diseased) it has been established that older age[56, 58], low socio-economic status [59], lower education level[59] , and individuals living alone are more likely to have lower (worse) PAM scores, yet never has the impact of these sociodemographic variables specifically been examined in an ACS population. Clinical variables also have been associated with PAM scores in chronic disease populations, although again, much of this work has been conducted primarily in the realm of diabetes. In these studies, lower health status [58], a longer disease duration [60], and multiple co-morbidities [61-64] have been predictors of lower (worse) PAM scores. While this evidence highlights the important role of certain sociodemographic and clinical variables as influencing activation, recent studies have also begun to underscore the impact of several psychosocial variables such as cognitive impairment [65] , depression [59, 66], and social support [54, 57] on chronically ill patients' activation. Recognition of these psychological variables is not limited to their role in activation, as a recent systematic review reported that these same psychosocial diagnoses have a profound effect on cardiovascular disease.[67] A significant gap in the literature exists in understanding how these demographic, clinical, and psychosocial characteristics may influence PAM scores in an ACS population.

PAM may change in the months after an acute event

Recent studies [45, 49, 61, 68-70] have suggested that patient activation is a modifiable patient characteristic that changes over time, yet the current literature lacks a basic understanding of the longitudinal patterns of patient activation and the impact of these patterns on an ACS patient's health care utilization. The concept of illness trajectories or distinct patterns of functional decline over time is well established in the palliative care [71] literature. These trajectories are defined by key time points in the illness that tend to be particularly problematic for patients: at diagnosis, during the transition home after initial treatment, at recurrence, and

during the terminal stage.[72] Trajectories offer valuable insights into the patient's changing needs over the course of an illness by suggesting the critical time points at which to target proactive support and management in an effort to reduce poor outcomes. For instance, both continuity of care and self-rated health trajectories have been established as important predictors of diabetes functioning. Persons with diabetes reporting poor perception of health status were at higher risk for lower functioning at four years follow-up than their study counterparts.

Activation is a patient characteristic that is similar to other health behaviors in its ability to change as a result of individual exposures, interactions, and risks over time. Understanding these distinct post-discharge trajectories may provide valuable insight into ACS self-management.

However, there is a paucity of longitudinal research on cardiovascular behavior trajectories, post-discharge. Most recently, empirical work has assessed medication adherence [73], dietary adherence [74], and self-management and quality of life [75] trajectories; and concluded that these behavior trajectories do indeed impact cardiovascular outcomes. Yet relatively little is known about the trajectories of patient activation and the impact of these trajectories on ACS outcomes.

Conceptual Model

Although recent studies have adopted various models to understand the interplay of factors that lead to self-management among chronically ill patients, this proposed study analysis will be based on a modified version of Andrikopoulou and Cameron et al.'s conceptual models for heart failure disease management. [76, 77] These models are based on the assumption that

each patient has certain baseline risk factors for cardiovascular-related hospitalization and rehospitalization. [76] These baseline risk factors (sociodemographic domain, psychosocial domain, etc.) interact to influence and with different stimuli influencing the patient's care seeking behavior.

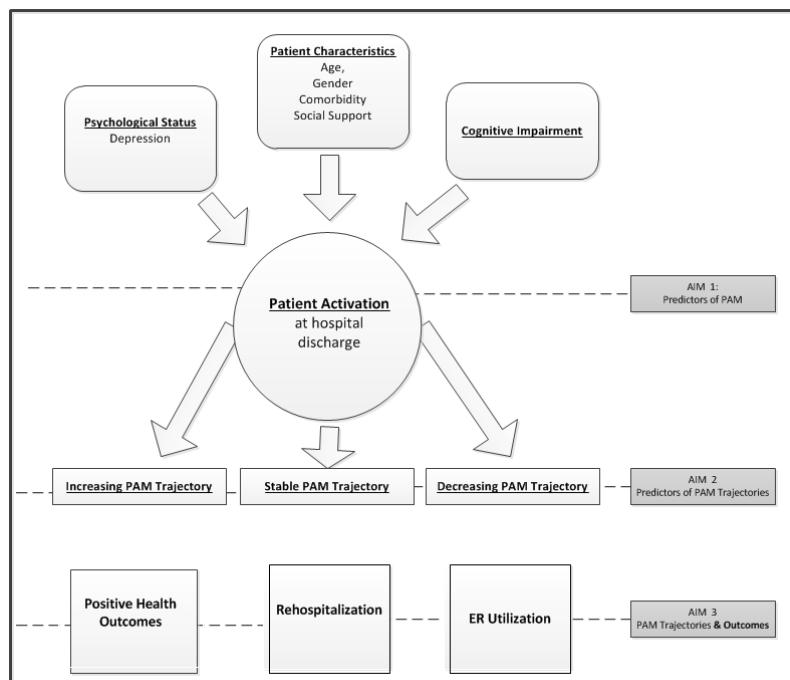


Figure 1: Conceptual Framework (Adapted from Andrikopoulou et al. & Cameron et al.)

For the proposed study, our model has been adapted to incorporate the role of patient activation in the ACS patient's post-hospital discharge care seeking patterns. As in the Andrikopoulou and Cameron models, we postulate that patients will possess a series of "risk factors" that will interact and ultimately influence their activation levels. The individual's patient activation/patient activation trajectory will in turn influence whether or not the patient utilizes specific healthcare services (rehospitalization, ER utilization). The three risk factor domains (psychological status, cognitive impairment, and sociodemographics) of the adapted

Andrikopoulou model will guide Aims 1 and 2 as exposures of the outcome in the study analyses. Similarly, the adapted model provides a framework for Aim 3 which will seek to understand the association between patient activation trajectories (exposures) and rehospitalization and emergency room utilization in the 12 months subsequent to the initial hospitalization.

Specific Aims

This study will use data from the NHLBI-funded Transitions, Risks, and Action in Coronary Events – Center for Outcomes Research and Education (TRACE-CORE) study, a longitudinal prospective cohort study of 2,187 ACS survivors. [78] The goal of this study is to examine possible predictors of patients' activation scores at hospital discharge, and then to identify and characterize activation trajectories that may influence readmission and ER utilization outcomes.

Aim 1: To examine the relationship between baseline (in hospital) PAM stage and demographic, clinical, and psychosocial characteristics in ACS patients.

H1a. ACS patients reporting lower patient activation (stages 1 & 2) at baseline will be older and of lower socioeconomic status (e.g., lower income and education) than ACS patients with higher activation (stages 3 & 4).

H1b. ACS patients reporting lower patient activation (stages 1 & 2) at baseline will be more likely to report more co-morbidities (e.g., diabetes) than ACS patients with higher activation (stages 3 & 4).

H1c. ACS patients reporting lower patient activation (stages 1 & 2) at baseline will be more likely to have a diagnosis of depression and/or cognitive impairment than ACS patients with higher activation (stages 3 & 4).

Aim 2: To identify and characterize trajectories (baseline, 1- and 3 months) of patient activation following an ACS event and to examine associations among baseline individual level demographic, psychosocial, and clinical characteristics and trajectories of PAM.

H2a. PAM trajectories will include stable, improving and decreasing activation over time in ACS patients.

H2b. ACS patients of older age at baseline with lower social support and lower education will be more likely to report low stable or decreased patient activation over time than ACS patients with higher social support, education and of younger age at baseline.

H2c. ACS patients with more comorbidities (e.g., diabetes) and higher GRACE risk scores at baseline will be more likely to report decreasing PAM trajectories over time.

H2d. ACS patients with a diagnosis of depression and/or cognitive impairment at baseline will be more likely to report low, stable or decreased PAM trajectories over time.

Aim 3: To examine the association among the baseline patient activation score, 3-month post-discharge activation trajectory, and re-hospitalization and ER utilization within 12 months post-discharge.

H3a. Lower patient activation at baseline (stages 1 & 2) will be associated with higher rates of hospitalization and ER utilization in the 12 months following hospital discharge in ACS patients.

H3b. (Exploratory due to potentially limited power) Decreasing patient activation trajectories will be associated with higher rates of hospitalization and ER utilization in the 12 months following hospital discharge in ACS patients.

Patient data at hospital discharge is an important measure of health and activation. While the validated patient activation measure provides a quantitative score, more research is needed to understand the determinants of activation at discharge and the impact of activation trajectories on

chronic ACS care. This study will provide an understanding of the characteristics associated with baseline activation scores and highlight the trajectories that follow. Understanding the predictors of activation and subsequent trajectories provides a foundation for future research to develop tools and interventions that aim to enhance patient activation. Once implemented, these strategies will assist clinicians in best ACS discharge practices and outpatient follow-up in effort to increase self-management and maximize health outcomes.

Innovation

This study will be the first to focus solely on ACS patients, a population in which the PAM score has yet to be closely examined. This study will closely investigate the psychosocial, clinical, and sociodemographic correlates of patient activation, using the PAM-6 in an ACS population. The innovation of this study will be to identify trajectories of activation in ACS patients, post-hospital discharge. Once the PAM trajectories have been established, this study will examine the impact of these patterns on rehospitalization and ER utilization. This study will provide a way in which to identify those ACS patients who have low PAM scores (low or decreasing patient activation trajectories), and who may be at the highest risk for poor outcomes. The findings from the proposed study will enhance the current literature since the study is the first of its kind to examine PAM trajectories among ACS patients and closely examine the impact of these trajectories on healthcare utilization.

CHAPTER II

PSYCHOSOCIAL CORRELATES OF LOW PATIENT ACTIVATION (PA)
AMONG ADULTS HOSPITALIZED WITH AN ACUTE CORONARY SYNDROME,
TRACE-CORE

Abstract

Background

Annually, over two million Americans are hospitalized due to an ACS event. In an effort to improve health and control the costs related to post-hospital discharge, the American Heart Association (AHA) has underscored the role of self-management interventions to help patients be active collaborators in their care. Patient activation is one way by which to determine whether patients maintain the knowledge and skills to be active participants in their chronic care illness.

Objective

This study examined the association of psychosocial factors and patient activation levels among hospitalized acute coronary syndrome (ACS) patients.

Methods

This study used cross-sectional data from the TRACE-CORE cohort of patients hospitalized with ACS at six hospitals in two states (N=2,060). Patient activation was measured by the Patient Activation Measure (PAM-6). Psychosocial correlates included depression (PHQ-9), perceived stress (PSS), and social support (MOS). Multinomial logistical regression models, adjusted for clinical and demographic characteristics, assessed the association between psychosocial correlates and patient activation levels.

Results

Mean age was 61 (SD=11) years, 66% were male, 76% non-Hispanic white, and 50% reported some college education; 19% reported low activation. Higher perceived stress (adjusted Odds Ratio (aOR) =2.1; 95% Confidence Intervals (CI): 1.4-3.0) was significantly associated with lower activation level. Depression (aOR=1.4; 95% CI: 0.86-2.0) and low social support

(OR=1.34; 95% CI: 0.93-1.9) were associated with activation, but were not statistically significant.

Conclusion

Low patient activation, indicative of one's not being able to manage one's own care, is prevalent among ACS inpatients. Patients with high perceived stress may be more likely to have low activation. Further research is needed to understand the direction of the relationship between psychosocial factors and patient activation among ACS patients.

Introduction

Annually, two million Americans are hospitalized with new or recurrent acute coronary syndromes (ACS), with hospital costs per patient discharge estimated at \$25,000 and an economic impact of more than \$150 billion annually. [4-6, 79] Each year, 1.1 million Americans will survive an ACS event, 20% of whom will be readmitted within 30 days of discharge, incurring additional costs.[9] In an effort to improve health and control the costs related to post-hospital discharge, the American Heart Association (AHA) has underscored the role of self-management interventions to help patients be active collaborators in their care.[2, 15, 80] Yet, managing one's own care post-hospitalization can be complicated. ACS patients often report uncertainty surrounding their condition [81], lack understanding regarding the recovery process, and feel unprepared to make the necessary behavioral modifications associated with their ACS diagnosis.[16]

Patient activation is a concept that refers to having the knowledge, skills, and readiness to assume responsibility for managing one's health care and healthcare needs [38]. Patients with high levels of activation are more likely to perform activities that will promote their own health and are more likely to have their health care needs met. [24, 82] Among both healthy and cardiovascular disease populations, higher patient activation has been related to a broad range of health outcomes, including engagement in self-management behaviors, heart healthy behaviors (e.g., healthy diet, regular exercise) [47, 83], adherence to preventive care [47, 49, 82, 84-86] and effective communication with clinicians [40, 43, 45, 65, 87]. Chronically ill patients who are highly activated are more likely to report higher quality of life, improved health status, and positive health outcomes over time, in comparison to patients with low activation [49, 52, 59, 63, 64]. Increasing evidence has found an association between patient activation and reduced

hospitalizations, decreased emergency room utilization, and improved medication adherence for patients with various chronic conditions, including cardiovascular diseases.[52, 59]

Research conducted in both outpatient [88, 89] and inpatient [89, 90] settings among multi-morbid patient populations suggests that psychosocial risk factors influence patient activation. Among patients with diabetes, HIV/AIDS, and cardiovascular disease, depression [24, 54, 66, 88, 89] has been associated with lower patient activation levels.[82, 91] Similarly, low social support and high patient perceived stress have been associated with lower activation in COPD, CHF and diabetes populations. [54, 57, 92] A recent study reported that among general medical inpatients, low patient activation was associated with greater depressive symptoms.[59] Although this study was the first to examine patient activation in an inpatient population, it was not specific to any disease population.

The current literature lacks research examining psychosocial correlates of patient activation among adults hospitalized with an ACS. Patient levels of activation in self-managing their chronic conditions have been widely recognized as an important contributor to both short- and long-term health outcomes.[49, 51] Hence, successful transitions from hospital to home may be aided by the patient's ability to manage their own care. An abbreviated measure of patient activation may provide meaningful information to health care teams' efforts to promote successful patient transitions between care settings.

Study Aim

The goals of this study are to describe patient activation levels in a sample of patients hospitalized with ACS and to examine psychosocial correlates of lower patient activation during hospitalization. We hypothesize that patients who report higher depressive symptoms, higher stress, and lower levels of social support will have lower levels of patient activation at hospital

discharge. Once patient activation and its psychosocial correlates are better understood in inpatient ACS populations, further research can address how to best intervene to encourage successful transitions from the hospital to a home care setting.

Methods

We conducted a cross-sectional analysis of baseline data from a large cohort of ACS survivors enrolled in the Transitions, Risks, and Actions in Coronary Events - Center for Outcomes Research and Education (TRACE-CORE) study.

Sampling and Recruitment

The design and methods of TRACE-CORE have been described elsewhere.[78] Briefly, TRACE-CORE enrolled a cohort of adults hospitalized with an ACS at one of six medical centers located in MA and GA between April 2011 and May 2013. Study inclusion involved patients who were 21 years in age or older, admitted to the hospital with a confirmed diagnosis of ACS (ICD9 codes: 410, 411, 412, 786.5), fluent and/or comfortable participating in English or Spanish, and having survived the index hospitalization. [78] Patients were excluded if their diagnosis of ACS was secondary to another acute medical issue, if they were admitted for palliative, hospice care, or if they had suffered trauma. Those patients who screened positive for delirium by the Confusion Assessment Method [93] or who had a diagnosis of dementia were excluded from the study, as were those individuals who were pregnant or incarcerated. The Committee for the Protection of Human Subjects at the University of Massachusetts Medical School and Institutional Review Boards at each participating recruitment site approved this study. All participants provided written informed consent.

Trained staff conducted baseline interviews with patients during hospitalization. Additionally, trained staff at each study site abstracted participants' medical records. Inter-rater reliability of medical record abstractions was performed on 5% of charts.[78] A total of 2,187 ACS patients were enrolled in TRACE-CORE.

Data Collection Instruments

Patient activation was assessed with the 6-item Patient Activation Measure scale (PAM-6; Insignia Health, LLC), a validated instrument that comprehensively assesses patient knowledge, skills, and confidence to take an active role in disease self-management [38, 54] irrespective of the medical condition. The PAM-6 short form is a statistical derivation of original PAM-13 with 88% of the reliability of the PAM 13 (Personal communication CS, May 27, 2015). Each question of the PAM-6 solicits a response on a 4-point Likert scale, ranging from strongly-disagree to strongly-agree. The responses to the six questions are summed to give an overall raw score, which is then transposed to a 0-100 point scale. Total PAM scores were categorized into one of four activation levels along an empirically derived continuum using cutoffs provided by InsigniaHealth. Each activation level reveals insight into an array of health-related characteristics, including attitudes, motivators, behaviors, and outcomes.[38, 54] Level 1 (score of ≤ 47) is the lowest activation level which corresponds to patients with low self-management engagement, Level 2 (score 47.1-55.1) is representative of patients becoming aware of their health and self-management actions that need to be taken, Level 3 (score 55.2 - 66.9) is indicative of patients having key facts and starting to build their self-management skills, while Level 4 (score ≥ 67) represents the highest level at which patients are able to maintain healthy behavior changes and self-management even under times of stress.[54] For patients missing a response to the six items in the PAM-6 (N=44; 2%), the score of the complete

responses was summed and divided by the number of completed items and then multiplied by 6 to get the raw score (Personal communication CS, May 27, 2015).

Psychosocial characteristics examined included depression, stress, and social support. Depression was measured using the validated Patient Health Questionnaire (PHQ-9), which has been used to make criteria-based diagnoses of depressive disorders. [94, 95] The items of the PHQ-9 (score range: 0-27) are scored on a 4-point Likert scale. For this analysis, depression was dichotomized into minimal or mild depression (≤ 9) versus moderate or severe depression (≥ 10) [95]. Perceived stress was measured using the 4-item Perceived Stress Scale (PSS4), a widely-used instrument that assesses the degree to which situations in one's life are appraised as stressful. [94, 96] Each item is rated on a 5-point Likert scale ranging from never (0) to almost always (4), and items are summed to produce a final score (range: 0-16), with higher scores indicating higher perceived stress. Stress was dichotomized into minimal to low stress (≤ 7) versus moderate to severe stress (≥ 8). [94, 96] The MOS Social Support Survey (MOS-SSS) [97, 98] assesses social support utilizing support scales measuring four domains, including emotional/informational, tangible, affectionate, and positive social interaction, along with an overall functional social support index. These support measures are distinct from structural measures of social support, are reliable (all α 's > 0.91), and are fairly stable over time. [98] Each of the five psychometrically sound MOS-SSS items was rated on a 5-point Likert scale ranging from none of the time (1) to all of the time (5), and items are summed to produce a final score (range: 5-25). Utilizing previous literature as our guide, MOS-SSS score was dichotomized into minimal or low social support (< 15) versus moderate to high social support (≥ 16). [99, 100]

Clinical characteristics were abstracted from patients' medical records for the index hospitalization, including ACS diagnosis (STEMI, NSTEMI, unstable angina) and hospital

length of stay (categorized as 7 days versus 8 or more days). ACS severity was assessed using the GRACE six-month mortality score. The GRACE risk prediction model, a tool for predicting death in patients with ACS, has demonstrated very good discriminative ability. [101, 102] The GRACE model incorporates the summation of points over three categories including the patient's medical history and findings at admission and during the hospitalization. Higher GRACE scores indicate increased risk of mortality within the six months after hospital discharge. [102-105] Total GRACE score was categorized into three groups representative of low (1-88), intermediate (89-118), and high (>119) risk.[101, 106] Comorbidities included history of diabetes, hypertension, CHD, CHF, and hyperlipidemia. Cognitive status was measured by the Telephone Interview for Cognitive Status (TICS), a valid instrument that has been used to assess a variety of domains impacted by dementia disorders (e.g., time and place, receptive and expressive language functions, immediate verbal memory).[107-109] The total TICS score (range: 0-41) is comprised of the sum of the 11 items with lower scores representing more cognitively impaired. Referencing the work of Desmond et al., patients were categorized as cognitively impaired (<25) versus without cognitive impairment (>=26).[110] Age and sex were abstracted from medical records, and participants self-reported their race/ethnicity (categorized as non-Hispanic, white; non-Hispanic, black; and other race/ethnicity) and education (less than high school, high school graduate/GED, some college, and college graduate or more).

Data Analysis

Descriptive analyses summarized baseline demographics, and clinical, and psychosocial characteristics of the study sample. Baseline patient characteristics were reported according to PAM level, and bivariate, chi-square analysis for categorical data was used to compare the

percentage of patients in each activation level by psychosocial, demographic, and clinical correlates. We calculated odds ratios (ORs) and 95% confidence intervals (CI) to estimate the associations between depression, perceived stress and social support with patient activation level using multinomial logistic regression models. [78] Unadjusted models were first computed. Given our interest, we first examined the impact of each of the three psychosocial factors (depression, stress, social support) on the outcome and then included all three factors in the multivariate analysis. Clinical and demographic characteristics associated ($p < 0.10$) with PAM level in the bivariate analyses were added to the model one at a time, starting with the variable with largest effect size. Variables were retained in the model if the OR was statistically significant ($p < 0.05$) for at least one patient activation level. Patients in PAM level 4, the highest level of activation, were the reference group for this analysis because our interest was in factors that are associated with low activation. [111] All analyses were performed using STATA 13 (StataCorp LP, College Station, Texas, USA).

Results

Of the 2,187 patients enrolled in TRACE-CORE, we excluded 127 patients who were missing measures of patient activation level ($n=1$), depression ($n=51$), stress ($n=42$), social support ($n=15$), race/ethnicity ($n=8$), marital status ($n=2$), and length of hospital stay ($n=8$) at baseline, resulting in an analytic sample of 2,060 adults hospitalized with ACS.

Demographics

Participants had a mean age of 61 years ($SD=11$), two-thirds were male (67%), most were non-Hispanic white (76%) and married (59%), and 54% reported some college education. The study sample had a mean six month mortality GRACE risk score of 95.8 ($SD=28.6$) indicative of average mortality risk in the six months post-discharge being in the low and intermediate risk

range.[101, 105] Nineteen percent of our study sample was at low patient activation (Level 1), 38% at Level 2, 21% Level 3, and 22% at Level 4.

The bivariate analyses [Table 2.1] detected a significant association between patient activation level and race/ethnicity ($p=0.001$); a greater proportion (65%) of ACS patients who identified as non-Hispanic, black or “other” race had the lower (Levels 1 & 2) activation scores. Additionally, this analysis detected that those patients with a high school diploma or less education (61%) were also more likely to have activation scores in Levels 1 & 2 ($p=0.001$). The ACS patient’s age, gender, and marital status were not significantly associated with patient activation.

Psychosocial Characteristics

In bivariate analysis, low patient activation was associated with a greater proportion of individuals diagnosed with moderate to severe depression ($p<0.001$), moderate to high perceived stress ($p<0.001$), and minimal to low social support ($p=0.011$). This analysis also identified some clinical correlates of patient activation, including having a history of CHD ($p=0.051$), hyperlipidemia ($p=0.014$), or cognitive impairment ($p=0.005$). ACS category at hospitalization, Grace Risk score, and length of hospital stay were not significantly associated with patient activation (Table 2.1).

Final Model

In the final adjusted multivariate model [Table 2.2], perceived stress remained a significant correlate of patient activation; patients with higher stress scores were two times more likely to report being at the lowest activation level (OR=2.07; 95% CI: 1.4- 3.0) than patients who reported lower levels of perceived stress. Although not a statistically significant factor, patients who reported moderate to severe depression (OR=1.38; 95% CI: 0.9-2.0) or low social

support (OR=1.34; 95% CI: 0.93-1.9) also tended report low patient activation (Level 1) in comparison to patients with mild depression or high social support. Patients with a diagnosis of CHD had 47% higher odds of being at the lowest patient activation level (OR: 1.47; 95% CI: 1.1- 2.0) than patients without CHD. Patients with cognitive impairment were 45% (OR=1.45; 95% CI: 0.4-1.9) more likely to be at patient activation level 1, and 57% more likely to be in activation level 2 (OR=1.57; 95% CI: 1.0- 2.5) than patients without cognitive impairment. The remaining comorbidities did not have a statistically significant association on patient activation in the final model.

Discussion

In a large, diverse sample of ACS survivors, we characterized level of patient activation and examined psychosocial correlates of activation during hospitalization. Following hospitalization for ACS, 19% of patients reported being in the lowest patient activation level and more than half (57%) were in Levels 1 & 2, indicating that they do not demonstrate either the skills or knowledge to take an active role in their own chronic care after leaving the hospital [45, 82]. Furthermore, among a diverse group of ACS inpatients, higher levels of perceived stress and depression were associated with the lowest patient activation level at hospital discharge. High perceived stress and depression may be barriers to patient activation.

Our observation that more than half of this sample of ACS inpatients have low levels of patient activation is of concern in light of previous patient activation research that has demonstrated that lower patient activation leads to poorer health outcomes in chronically ill populations [88]. Prior studies have found that chronically ill outpatients (i.e., with diabetes, cardiovascular disease) who are less activated (Levels 1 & 2) are at an increased risk for hospitalization [24, 62, 64, 86] and emergency room use.[52] Moreover, general medical

service inpatients who report low patient activation have nearly twice the risk of 30-day readmissions than their more activated counterparts.[62] This literature provides a foundation upon which to further interpret our results. ACS inpatients are particularly vulnerable to low activation as they transition from hospital to home care. Low activation indicates the inability to take an active role in their own self-care, thus increasing the risk of poor health outcomes following hospitalization for ACS.

This is the first study we are aware of that identified an association between perceived stress and patient activation level within an inpatient ACS population. After adjusting for confounders, we found that patients who reported higher levels of stress were significantly more likely to be in the lowest patient activation categories. While this study is the first to establish this relationship, prior literature has reported the important role of stress as a determinant in cardiac care and rehabilitation. [112, 113] In one systematic review focused on cardiac rehabilitation attendance after hospitalization, both high stress and depression were associated with a patient's decision not to participate in these programs. A patient's perceived stress levels after cardiovascular hospitalization also has been associated with up to a threefold increased risk for readmission after an event.[114-116] Our findings suggest that patients with high perceived stress are more likely to have low activation may indicate that this group is particularly vulnerable to poor health outcomes post-discharge. It is possible that tailored interventions that seek to increase patient activation at the time of hospital discharge may have the dual benefit of reducing perceived stress and early readmissions in ACS patients.[116]

Our findings also indicate that ACS patients with depression are more likely to report the lowest level of patient activation, despite that in the final analysis depression no longer remained statistically significant. Previous patient activation research has identified similar inverse

relationships between depression and patient activation in other chronic illness populations. [66, 88, 89, 117] Our findings agree with those of two recent studies which concluded among general inpatients that those who scored at low activation levels were more likely to report an increase in depressive symptoms.[62, 90] Additionally, among these inpatients with lower levels of patient activation there was a higher rate of post-discharge 30-day hospital utilization. Previous literature has suggested that depression and patient activation may influence each other in a cyclical manner; depressive symptoms are often associated with feelings of helplessness that lead to lower patient activation, which in turn leads to increased depression, which may lead to poor health outcomes.[62, 66] The association between depression and ACS is well-established, as is the role of depression as a risk factor for recurrence and mortality among ACS inpatients. [118-120] Our findings suggest that low levels of patient activation may contribute to this association. However, additional research is needed to more comprehensively understand the relationship between patient activation and depression, and this relationship's impact on ACS outcomes. Seventeen percent of our ACS study population reported low social support, and in bivariate analyses these patients were also more likely to also report low patient activation during hospitalization. Yet, in our final multivariable-adjusted regression model that included all three psychosocial factors, social support no longer remained a statistically significant correlate of patient activation level. These findings contradict an accumulating body of literature which has demonstrated that social support is associated with patient activation and self-management behaviors.[119, 121-123] While social support provides patients with reassurance and increased emotional support, it may be that the entwined relationship of social support, perceived stress, and depression on patient activation is more complex. Our findings suggest that further research

is needed to more thoroughly explore the relationships between low social support, depression, and perceived stress, and patient activation level among adults hospitalized with ACS.

Strengths and Limitations

Strengths of this study include the large, racially and geographically diverse cohort of patients with ACS enrolled as part of the TRACE-CORE study. This study utilized standardized data collection instruments to ascertain a wealth of information on patient activation along with other psychosocial, cognitive, and clinical data not typically available in ACS populations at the time of hospital discharge. The PAM-6 short form is a statistical derivation of original PAM-13 that has yet to be utilized widely throughout multiple disease populations; hence, while there is always the possibility of measurement error in this outcome, the PAM-6 has 88% of the reliability of the PAM-13, which is a validated and reliable instrument in multiple disease and diverse populations. Due to the cross-sectional design of this study, causality of the associations between the studied correlates and patient activation level cannot be established. Similar to all observational studies, this work is limited by non-response bias as we do not know how those individuals who chose not to enroll differ from our study sample, a fact which in turn may make our findings less generalizable to the population. Unmeasured confounders, such as the impact of caregivers and completion of cardiac rehabilitation programs, may have also introduced bias. Still, given the vast sample of both electronic medical record and self-reported data available on these ACS survivors, we are confident our findings provide a foundation in which to base future work in this realm.

Conclusion

Over half of ACS inpatients in the TRACE-CORE cohort were at the lowest two activation levels (Levels 1 & 2), indicating that these patients were not prepared to take an active

role in their own care, and that this is of concern as they transition from the hospital to home. High perceived stress is a significant correlate of the lowest patient activation level in this ACS population. Additionally, depression and low social support had an influence on activation in this patient population. This secondary analysis of a large, diverse ACS population provides a foundation upon which to further establish studies on patient activation in the realm of cardiovascular inpatients, with a particular focus on psychosocial and demographic correlates. A better understanding of patient activation among inpatients may lead to more tailored interventions prior to discharge in an effort to improve ACS outcomes.

4.3 Clinical Implications

Our findings suggest that patient activation, a modifiable behavior [38, 82], is correlated with high perceived stress at the time of ACS discharge. The time before hospital discharge is an optimal opportunity to utilize the PAM in an effort to better gauge patients' knowledge, skills, and ability to be collaborative partners in their ACS chronic care. Future research is needed to examine when and how to appropriately intervene when patients are low in activation. [124-127] For example, once identified at discharge, patients with low activation may require tailored discharge education and planning as well as referrals for stress and depression in the effort to increase activation and engagement in their own health.

Table 1: Demographic, clinical, and psychosocial characteristics in relation to level of patient activation levels among adults hospitalized with ACS, TRACE-CORE (N=2,060), N (%)

Demographic Characteristics		Level 1 (N=401) Lowest activation	Level 2 (N=770)	Level 3 (N=431)	Level 4 (N=458) Highest activation	p-value
Age	≤ 59 years	196 (49%)	319 (41%)	211 (49%)	206 (45%)	0.089
	60-69 years	124 (31%)	248 (32%)	127 (29%)	140 (31%)	
	≥70 years	81 (20%)	203(26%)	93(22%)	112 (24%)	
Gender	Female	137 (34%)	253 (33%)	135 (31%)	164 (36%)	0.470
Race	Non-Hispanic, White	282 (70%)	565 (73%)	343 (80%)	372 (81%)	0.001
	Non-Hispanic, Black	79 (20%)	139 (18%)	58 (13%)	50 (11%)	
	Other	40 (10%)	66 (9%)	30 (7%)	36 (8%)	
Education	≤ High school	90 (22%)	134 (17%)	51 (12%)	65 (14%)	0.001
	High School Grad/GED	108 (27%)	244 (32%)	134 (31%)	122 (27%)	
	Some college	112 (28%)	209 (27%)	136 (32%)	134 (29%)	
	College or more	91 (23%)	183 (24%)	110 (26%)	137 (30%)	
Married		222 (55%)	455 (59%)	267 (62%)	270 (59%)	0.291
Clinical Characteristics						
ACS Category	STEMI	57 (14%)	123 (16%)	66 (15%)	67 (15%)	0.741
	NSTEMI	235 (59%)	414 (54%)	244 (57%)	266 (58%)	
	Angina	109 (27%)	233 (30%)	121 (28%)	125 (27%)	
Length of Stay	≤ 7 days	345 (86%)	640 (84%)	359 (83%)	384 (84%)	0.61
	≥ 8 days	56 (14%)	130 (16%)	72 (17%)	74 (16%)	
Grace Risk Score	Low	163(59%)	343 (45%)	173 (40%)	192 (42%)	0.432
	Intermediate	149 (37%)	290 (38%)	163 (38%)	167 (36%)	
	High	89(22%)	137 (18%)	95 (22%)	99 (22%)	
Comorbidities	CHD	173 (43%)	306 (40%)	155 (36%)	160 (35%)	0.051
	CHF	66 (16%)	100 (13%)	61 (14%)	63 (14%)	0.915
	Diabetes, Type 1	9 (2%)	8 (1%)	7 (2%)	7(2%)	0.449
	Diabetes, Type 2	129 (32%)	250 (32%)	137 (32%)	135 (29%)	0.731
	Hyperlipidemia	282 (70%)	511 (72%)	287 (67%)	325 (71%)	0.014
	Hypertension	288 (72%)	587 (76%)	334 (77%)	347 (76%)	0.250
	Stroke	23 (6%)	33 (4%)	23 (5%)	33 (7%)	0.183
	Cognitive Impairment	45 (11%)	80 (10%)	27 (6%)	28 (6%)	0.005
Psychosocial Characteristics						
Depression	Mild/Minimal	277 (70%)	596 (77%)	352 (82%)	376 (82%)	<0.001
	Moderate/Severe	124 (30%)	174 (23%)	79 (18%)	82 (18%)	
Perceived Stress	Mild/Minimal	267 (67%)	584 (76%)	349 (81%)	383 (84%)	<0.001
	Moderate/Severe	134 (33%)	186 (24%)	82 (19%)	75 (6%)	
Social Support	Low/Minimal	90 (22%)	136 (18%)	64 (15%)	68 (15%)	0.011
	Moderate/High	311 (78%)	634 (82%)	367 (85%)	390 (85%)	

Table 2.2: Multinomial models of the association of psychosocial characteristics with patient activation level during hospitalization for acute coronary syndromes, TRACE-CORE. (N=2, 060)

		Crude OR (95% CI)		
		Level 1 (Lowest patient activation) *	Level 2	Level 3
<i>Psychosocial Correlates</i>				
Moderate/Severe Depression		1.43 (1.00; 2.05)	1.11 (0.81; 1.53)	0.95 (0.66; 1.38)
Moderate/High Perceived Stress		2.09 (1.46; 3.00)	1.53 (1.11; 2.13)	1.22 (0.84; 1.79)
Low Social Support		1.38 (0.96; 1.97)	1.13 (0.82; 1.56)	0.98 (0.67; 1.42)
		Multivariable-Adjusted Model, OR (95% CI)		
		Level 1	Level 2	Level 3
<i>Psychosocial Correlates</i>				
Moderate/Severe Depression		1.38 (0.86; 1.97)	1.06 (0.76; 1.46)	1.25 (0.85; 1.84)
Moderate/High Perceived Stress		2.07 (1.44; 2.99)	1.51 (1.08; 2.11)	0.94 (0.65; 1.38)
Low Social Support		1.34 (0.93; 1.92)	1.12 (0.81; 1.55)	0.99 (0.68; 1.44)
<i>Demographic Correlates</i>				
Race	Non-Hispanic, White	REF	REF	REF
	Non-Hispanic, Black	2.60 (1.75; 3.87)	2.06 (1.44; 2.93)	1.28 (0.85; 1.93)
	Other	1.60 (0.98; 2.60)	1.30 (0.85; 2.01)	0.93 (0.56; 1.54)
<i>Education</i>	< HS Graduate	REF	REF	REF
	High School Grad/GED	0.74 (0.49; 1.14)	1.08 (0.74; 1.58)	1.43 (0.91; 2.24)
	Some college	0.80 (0.52; 1.22)	0.92 (0.62; 1.34)	1.36 (0.86; 2.14)
	College or more	0.65 (0.41; 1.01)	0.77 (0.52; 1.14)	1.06 (0.67; 1.70)
<i>Clinical Correlates</i>				
<i>Comorbidities</i>	CHD	1.47 (1.11; 1.96)	1.27 (0.99; 1.63)	1.07 (0.82; 1.42)
	Hyperlipidemia	0.96 (0.71; 1.30)	0.81 (0.63; 1.04)	0.81 (0.61; 1.08)
	Cognitive Impairment (TICS)	1.45 (0.38; 1.94)	1.57 (0.98; 2.52)	1.05 (0.51; 1.29)

*Reference group =Level 4 patient activation which is indicative of high patient activation

CHAPTER III

TRAJECTORIES OF PATIENT ACTIVATION AFTER HOSPITALIZATION FOR AN
ACS EVENT, TRACE-CORE

Abstract

Background: Among cardiovascular disease populations, trajectories of patient activation and self-management impact patients' quality of life and outcomes over time, underscoring meaningful timepoints at which to effectively intervene after hospitalization for an ACS event.

Objective: Post-hospital discharge, ACS patients vary considerably in patient activation and self-management behaviors. Our goal was to characterize trajectories of patient activation among ACS patients over the first three months after hospitalization and to examine baseline correlates of these trajectories.

Methods: This study used cross-sectional data from the TRACE-CORE cohort of patients hospitalized with ACS at six hospitals in two states. Patient activation was measured by the Patient Activation Measure (PAM-6); healthcare utilization was self-reported. Data analysis was carried out in four stages in effort to identify distinct PAM trajectories. We applied group-based trajectory modeling (GBTM) on the repeated measures of PAM level over time (baseline, 1-and 3-month). We assessed the bivariate association of each baseline characteristics with the identified trajectory groups using chi-square analysis. In a final step, a multinomial logistic regression model was estimated to assess the relationship of correlates of interest to trajectory group membership.

Results: Among 1,160 ACS patients, we identified 3 distinct trajectories of activation, post-hospitalization. The majority of the patients identified as being in trajectory 1 (n=765; 67%) in which their activation started out low and remained low, stable over a three-month period. Patients aged 70 year or older were significantly more likely to be in the "low, stable" (OR: 2.22; 95% CI: 1.4-3.5) or the "high, sharp decline" (OR: 2.56; 95% CI 1.5-4.5) trajectory versus "sharp improvement" trajectory. Race was also correlated with patient activation trajectory.

Non-Hispanic, Black patients had greater odds of being in the “low, stable” (OR: 2.14; 95% CI: 1.1-4.3) or the “high, sharp decline” (OR: 3.04; 95% CI 1.4-6.7) trajectory versus the “sharp improvement” group compared to non-Hispanic white patients. Patients who reported moderate to severe perceived stress (OR: 2.54; 95% CI: 1.4-4.5) at hospital discharge were significantly more likely to be in the “low, stable” group than in the “sharp improvement” group.

Conclusion: The majority of ACS patients leave the hospital with low activation or experience declines in activation in the following months, even when they report high activation at discharge, suggesting that the time in which to intervene with patient education and support may extend beyond hospitalization.

Introduction

One in five patients who survive an ACS event are re-hospitalized within 30 days at an average cost of \$15,000 [9]. About 10% of rehospitalizations are due to myocardial infarction, but the majority of patients are re-admitted for other cardiovascular-related reasons.[6, 9] This rehospitalization rate signals a need for better care management following discharge. Several studies have suggested that increasing patients' skill and ability to manage their condition, commonly referred to as patient activation [38], could facilitate better self-management of ACS after discharge and reduce up to a third of hospital readmissions.[15, 59, 80]

Our previous work reported that over half of ACS inpatients in the TRACE-CORE cohort were at the lowest two activation levels (Levels 1 & 2), indicating that these patients are not prepared to take an active role in their own care, and which is of concern as they transition from the hospital to home. Activated patients demonstrate better self-management skills, medication adherence, and healthy behaviors.[38, 40, 43, 47, 63-65, 83-85, 87, 92, 128] Across chronic illness populations, higher patient activation is associated with a decreased risk of emergency room utilization and hospitalization. [52, 59] Engagement in self-care behaviors (e.g., diet, exercise, medication adherence), awareness of the signs and symptoms that precede an acute event, and knowledge of when to seek help can reduce the risk of rehospitalization. Conversely, low activation among ACS patients has been associated with clinically meaningful declines in quality of life and poorer outcomes in the month following discharge compared to highly activated patients.[129] Yet, patient activation was only assessed at one point in time in previous studies. While a recent study found that activation may fluctuates over time in chronically ill patients [58], research characterizing these fluctuations and factors associated with changes in activation among ACS patients is lacking. Understanding how patient activation changes at the

months after hospitalization may offer valuable insight into critical time points in which to target ACS patients with support and education.[130]

Among cardiovascular disease populations, trajectories of self-management [131, 132], medication adherence[73], and anxiety and depression [133] impact patients' quality of life and outcomes over time, underscoring meaningful timepoints at which to effectively intervene after hospitalization. These studies also highlight the value of defining trajectories in order to identify subpopulations of patients to target for intervention.

Study Aim

Given that little is known about how patient activation changes in an ACS population after discharge, our aims were to characterize trajectories in patient activation among ACS patients at three months following discharge and to examine baseline demographic, psychosocial, and clinical correlates of these trajectories. We hypothesized that distinct trajectories (e.g., stable, improving, declining) of patient activation would emerge over the post-discharge period.

Methods

We used data from a large prospective cohort of ACS survivors from the Transitions, Risks, and Actions in Coronary Events - Center for Outcomes Research and Education (TRACE-CORE). The design and methods of TRACE-CORE have been described elsewhere [78].

Recruitment

Briefly, TRACE-CORE enrolled a cohort of adults (age range: 27-92 years) hospitalized with ACS at six medical centers in MA and GA from 2011-2013. Patients were only included in this analysis if they completed the patient activation (PAM) measure at all three timepoints (baseline, 1- and 3-months). Institutional Review Boards at each site approved this study.

Data Collection

Patient activation was assessed with the 6-item PAM (PAM-6; Insignia Health, LLC), which comprehensively assesses patient knowledge, skills, and confidence to take an active role in disease self-management irrespective of medical condition. The PAM-6 short form has been described in detail in a previous chapter, but, briefly, the measure is used to categorize patients into one of four activation levels along an empirically derived continuum [38, 91]: Level 1 is the lowest activation level, representing disengagement in one's self-care; Level 2, signifies becoming aware but lacking confidence to take action; Level 3 involves taking action for self-care; and Level 4 is the highest level, indicating ability to maintain healthy self-management behaviors [134]. For patients missing one or two items of the PAM (N=65; 3%), the average score of the completed items was multiplied by 6 to produce a total score.[135]

Drawing from our previous PAM research, specific psychosocial correlates were examined, including depressive symptoms, stress, and social support. Depressive symptoms were measured using the Patient Health Questionnaire (PHQ-9), which has been used to make criteria-based diagnoses of depressive disorders. The Perceived Stress Scale (PSS4) is an instrument that assesses the degree to which situations in one's life are appraised as stressful [96]. We measured social support using five items from the Medical Outcomes Study, Social Support Survey (MOS-SSS).[136]

Clinical correlates were abstracted from medical records for the index hospitalization, including the patient's ACS diagnosis (STEMI, NSTEMI, Unstable Angina), hospital length of stay (<7 vs. \geq 7 days) and comorbidities (e.g. diabetes, CHD) abstracted by trained study staff on documented conditions from each patient's medical record . ACS severity was assessed using the GRACE six-month mortality prediction model [103], which incorporates the summation of

points over three categories, including the patient's medical history and findings at both admissions and during hospitalization.

During the baseline interview, participants' self-reported demographic characteristics included age, gender, race/ethnicity (non-Hispanic, white; non-Hispanic, black; and other race/ethnicity), and education (less than high school, high school graduate/GED, some college, and college graduate or more).

Statistical Analysis

Data analysis was carried out in four stages. First, demographic, psychosocial, and clinical characteristics of the sample were summarized using descriptive statistics. We compared TRACE-CORE patients included (i.e., completed the PAM assessment at all three points) versus excluded from the analytic sample on baseline characteristics using t-tests for continuous variables and chi-squared tests for categorical variables. Second, to identify distinct PAM trajectories, we applied group-based trajectory modeling (GBTM) to the repeated measures of PAM level over time (baseline, 1-and 3-month). GBTM is a form of finite mixture modeling that uses trajectory groups as a statistical device to approximate the unknown distribution of trajectories across participants.[137] The Bayesian Information Criteria (BIC) was applied to assess model fit by balancing the model complexity (number of trajectory groups) versus goodness of fit to the sample data (maximized value of likelihood function). The adequacy of the model was then determined by evaluating the posterior probabilities of group membership with a cutoff of 0.75 for "good" model fit.[137] Third, we assessed the bivariate association of each baseline characteristic with the identified trajectory groups using chi-square analysis. We controlled for potential confounding by baseline sociodemographic and clinical characteristics including age, sex, race, and education.

In a final step, a multinomial logistic regression model was estimated to assess the relationship of correlates of interest to trajectory group membership. The increasing trajectory served as the referent, since we were most interested in baseline correlates associated with low and declining trajectories.[111] We added the correlates (clinical, demographic, psychosocial) that were significantly associated ($p < 0.10$) [Table 3.1] with at least one PAM trajectory group in the bivariate analysis. These correlates added to the adjusted model one at a time by crude relationship, starting with the largest coefficient and were retained in the model if statistically significant at $p < 0.05$. All analyses were performed using STATA 13 (StataCorp LP, College Station, Texas, USA).

Results

Of the 2,186 patients enrolled in TRACE-CORE, we excluded patients who were missing one ($n=470$) or two ($n=489$) PAM assessments over the three-month timeframe of interest. Additionally, we excluded those for whom information was missing in the psychosocial correlates of interest ($n=67$), resulting in an analytical sample of 1,160 (53%) patients hospitalized for ACS. Participants who were excluded from this analysis were younger ($p < 0.001$), reported significantly higher depression ($p < 0.05$), perceived stress ($p < 0.001$), and anxiety ($p < 0.05$), but lower social support ($p = 0.03$), and were more likely to be cognitively impaired ($p < 0.001$) at baseline. There were no significant differences between the included and excluded individuals in patient activation scores at baseline.

Analytical Sample

The 1,160 ACS patients included in this study were more likely to be male (66%), identify as non-Hispanic, white (81%), married (63%), and college-educated (59%). The mean age of the participants in the analysis was 62 years (SD: 11.7). Eighteen percent of the

participants had moderate/severe depression, 19% had high perceived stress, 19% had high anxiety, and 15% reported social isolation. Six percent of participants were cognitively impaired.

Distinct trajectories of patient activation

We observed three distinct trajectories of patient activation level [Figure 3.1] over the three-months, post-hospital discharge. Posterior probabilities for trajectory membership were 0.76 (group 1), 0.88 (group 2), and 0.85 (group 3). Using the trajectory characteristics as a guide, we labeled the first trajectory group (n=785; 67% of the sample) as “low, stable” indicating that patients in this trajectory started with very low score and remained stable with low activation over the three-month period. Trajectory group 2 (n=182; 16%) was defined as “high, sharp decline” as these patients had a very high activation score at discharge but took a sharp decline over the first month post-discharge. The final trajectory group 3 (n=193; 17%) was characterized by patients whose activation scores at baseline indicated that they were, on average, still not ready to take an active role in their own care, but following hospitalization their activation scores increased at one month post-discharge and remained high (stable) at three months post-discharge (“sharp improvement”).

Table 3.1 indicates bivariate demographic, clinical, and psychosocial correlate(s) differences across trajectory group membership. Older patients (p=0.065), were more likely to be in the low, stable trajectory, as were non-Hispanic black patients and those with less education (p<0.000). Patients who reported depression (p=0.024) and/or perceived stress (p<0.001) were significantly more likely to be in the low, stable trajectory.

Multivariate multinomial model

Age and race were strong demographic correlates of patient activation trajectory membership, post-discharge for ACS (Table 3.2). Patients aged 70 years or older were significantly more likely to be in the “low, stable” (OR: 2.22; 95% CI: 1.4-3.5) or the “high, sharp decline” (OR: 2.56; 95% CI 1.5- 4.5) trajectory versus “sharp improvement” trajectory. Race was also correlated with patient activation trajectory [Table 3.2]. Non-Hispanic, black patients had greater odds of being in the “low, stable” (OR: 2.14; 95% CI: 1.1- 4.3) or the “high, sharp decline” (OR: 3.04; 95% CI 1.4-6.7) trajectory versus the “sharp improvement” group compared to non-Hispanic, white patients. The remaining demographic correlates were not associated with any specific patient activation trajectory membership in adjusted models. Patients who reported moderate to severe perceived stress (OR: 2.54; 95% CI: 1.4- 4.5) at hospital discharge were significantly more likely to be in the “low, stable” group than in the “sharp improvement” group. Neither depression nor social support were associated with any specific trajectory of patient activation post-discharge.

Discussion

This study found three distinct trajectories of patient activation level in the three months following hospitalization for ACS. Two-thirds of adults hospitalized with ACS had low patient activation at discharge through three months, indicating that on average they were not prepared to self-manage care at the time of hospitalization and that this did not improve when they returned to a home care setting. This finding is disconcerting given the important role of self-care practices in preventing re-hospitalization for ACS and known complications, such as heart failure. Sixteen percent of ACS patients had high patient activation during hospitalization, followed by a decline as these patients transitioned to home, stabilizing at low activation through

three months. Patients in the “high, sharp decline” trajectory may have felt confident before they left the hospital, but this dissipated as they transitioned to home, perhaps as they faced the reality of the self-care demands of their condition. Although a small group, such patients may be overlooked when patient activation is only evaluated during hospitalization, highlighting the need for prospective, longitudinal assessment during the post-discharge period. The third group was characterized by moderate patient activation during hospitalization followed by a sharp increase once home. It is unclear what factors may have contributed to such increases; potential factors might include greater receipt of services, such as visiting nurse care or cardiac rehab that help increase activation.

Patients who reported higher levels of stress were significantly more likely to have low, stable trajectories of patient activation following hospital discharge, consistent with studies showing an association between stress and patient activation during cardiac rehabilitation.[112] Patients with moderate to high perceived stress at hospital discharge have a threefold risk for rehospitalization. [113, 138] A better understanding of stress reduction at both hospital discharge and follow-up could help target more positive ACS outcomes. No other psychosocial characteristics were associated with patient activation trajectories post-discharge.

Non-Hispanic blacks and older adults were more likely identify in the low, stable trajectory and in the decreasing trajectory compared to non-Hispanic whites and younger adults, respectively. These findings support previous research that has examined the role of race in association with patient self-management and participation in cardiac rehabilitation.[44] Specifically, one study found that non-Hispanic black patients had lower cardiovascular knowledge, which is essential to taking an active role in one’s chronic care.[139] African-Americans have 2.5 greater risk of mortality and re-hospitalization after a cardiovascular event,

yet are less likely to be referred to cardiac rehabilitation and when referred, are less likely to participate [139]. Thus, patient, provider and systems-factors may contribute to these disparities. Our findings are consistent with previous studies across multiple chronic illnesses that have found that older age is correlated with low activation [58, 140], lack of adherence to medication regimens [141], unhealthy diets, and other self-care behaviors.[61, 87] However, little research has explored ways to improve patient activation in older ACS patients. The results of this study indicate that efforts to improve patient activation among non-Hispanic, black ACS patients and older adults needs to begin during the hospitalization period. Tailored interventions targeted at improving patient activation interventions may be warranted.

The American Heart Association reports that virtually every component of the healthcare system fails in the goal of promoting self-care for cardiovascular patients.[142, 143] Previous studies have underscored the need to provide more complete and informative discharge instructions in effort to prevent confused, inactive patients.[143] Our results indicate that two-thirds of ACS patients have low and stable patient activation in the three months following discharge. Thus, promotion of self-care must extend beyond the initial hospitalization to ambulatory and other care settings in which patients are seen over time.

Strengths and Limitations

Strengths of this study include the large, racially diverse cohort of ACS patients enrolled in the TRACE-CORE study. Although while we were only able to examine trajectories up to the three months post-hospitalization, we believe this study provides a foundation for further research in the realm of patient activation trajectories. The PAM-6 is a statistical derivation of the original PAM-13 that has yet to be used widely throughout multiple disease populations; however, the PAM-6 has 88% of the reliability of the PAM-13, which is validated and reliable

(i.e. high test-retest reliability) in multiple disease populations. These findings are limited by non-response bias, particularly among those patients who were lost to follow-up and did not complete the PAM-6 at all three time points. While this study provides a foundation in which to examine trajectories of patient activation, post-discharge, it is limited by a three-month follow-up. Future studies should aim to examine the role of activation in the year(s) following hospital discharge.

Conclusion

Prior research has demonstrated that patient activation is modifiable. [49, 91] A better understanding of patient activation trajectories may lead to insight on when best to intervene with tailored interventions following discharge in an effort to improve ACS outcomes. Our findings suggest that the majority of ACS patients leave the hospital with low activation, or that they experience declines in activation in the following months, even when they report high activation at discharge, suggesting that the time in which to intervene with patient education and support may extend beyond hospitalization. Using the PAM as a measure of patient activation at discharge and in the months following may be one way in which clinicians can better gauge ACS patients' ability to take an active role in their health care, while also providing evaluative tool to assess self-care interventions. Patient activation interventions should also address stress, which may be an important barrier to self-care.

Tables and Figures

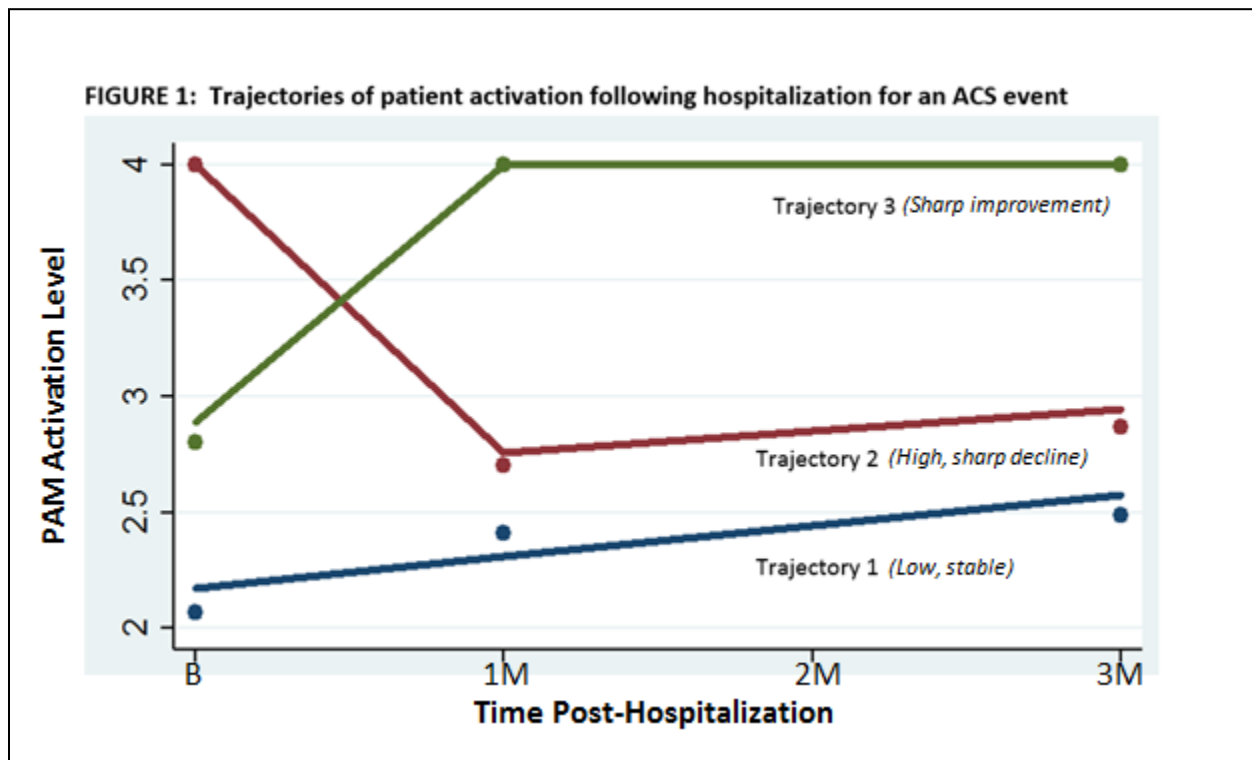


Table 3.1: Demographic, clinical, and psychosocial characteristics in relation to patient activation trajectory post-hospitalization for ACS, TRACE-CORE (N=1,160), N (%)

	Total N (%)	Low, Stable (N=785)	High, Sharp Decline (N=182)	Sharp Improvement (N=193)	P value	
Female	390 (34%)	258(33%)	67 (37%)	65 (34%)	P=0.597	
Race	Non-Hispanic, White Non-Hispanic, Black Other race/ethnicity	938 (81%) 132 (11%) 90 (8%)	625 (80%) 96 (12%) 64 (8%)	152 (84%) 26 (14%) 4 (2%)	161 (83%) 10 (5%) 22 (11%)	P=0.001
Age	≤ 60 years 60-62 years 63-70 years ≥70 years	457 (38%) 111 (10%) 310 (27%) 282 (25%)	303 (39%) 76 (10%) 206 (26%) 200 (25%)	64 (35%) 14 (8%) 53 (29%) 51 (28%)	90 (47%) 21 (11%) 51 (26%) 31 (16%)	P=0.065
Education	Less than HS graduate HS graduate 1-3 yrs College/Associate Degree College Graduate & beyond	125 (11%) 338 (29%) 361 (31%) 336 (29%)	98 (12%) 248 (32%) 240 (31%) 199 (25%)	17 (9%) 42 (23%) 64 (35%) 59 (32%)	10 (5%) 48 (25%) 57 (30%) 78 (40%)	P=0.000
Married		732 (63%)	486 (62%)	110 (60%)	136 (70%)	P=0.063
Clinical Characteristics						
Length of Stay	≥ 7 days	163 (14%)	107 (14%)	31 (17%)	25 (13%)	P=0.566
Grace Risk Score	Low Intermediate High	704 (61%) 305 (26%) 151 (13%)	482 (61%) 200 (25%) 103 (13%)	110 (60%) 55 (30%) 17 (10%)	112 (58%) 50 (26%) 31 (16%)	P=0.304
Comorbidities	CHD CHF DM2 HTN Cognitive Impairment	285 (25%) 106 (9%) 335 (29%) 812 (70%) 65 (6%)	201 (26%) 69 (9%) 228 (29%) 555 (71%) 51 (6%)	37 (20%) 20 (11%) 50 (27%) 124 (68%) 10 (5%)	47 (24%) 17 (9%) 57 (30%) 133 (69%) 4 (2%)	P=0.329 P=0.641 P=0.893 P=0.743 P=0.057
ACS Type	STEMI NSTEMI UA	172 (15%) 615 (53%) 345 (30%)	112 (14%) 404 (51%) 252 (32%)	31(17%) 98 (54%) 46 (25%)	29 (15%) 113 (59%) 47 (24%)	P=0.147
Psychosocial Characteristics						
Depression	Minimal/Mild Moderate/Severe	951 (82%) 209 (18%)	628 (80%) 157 (20%)	153 (84%) 29 (16%)	170 (88%) 23 (12%)	P=0.024
Stress	Minimal/Mild Moderate/Severe	943 (81%) 217 (19%)	608 (77%) 177 (23%)	160 (88%) 22 (12%)	175 (91%) 18 (9%)	P=-0.000
Social Support	Minimal/High Low/Very low	991 (85%) 169 (15%)	660 (84%) 125 (16%)	159 (87%) 23 (13%)	172 (90%) 21 (10%)	P= 0.149
TICS	Not Impaired Impaired	1095 (94%) 65 (6%)	734 (94%) 51 (6%)	172 (95%) 10 (5%)	189 (98%) 4 (2%)	P=0.057

Table 3.2: Multinomial logistic regression models of the association of characteristics with patient activation trajectory post-hospitalization for acute coronary syndromes, TRACE-CORE. (N=1,160)

		Crude OR (95% CI) *	
		Trajectory 1- Low, stable (N=785)	Trajectory 2- High, sharp decline (N=182)
<i>Psychosocial Correlates</i>			
Moderate/Severe Depression		1.23 (0.73; 2.05)	1.30 (0.69; 2.47)
Moderate/High Perceived Stress		2.52 (1.45; 4.37)	1.19 (0.58; 2.41)
Low Social Support		1.35 (0.82; 2.22)	1.12 (0.59; 2.12)
Multivariable Adjusted Model OR, (95% CI) **			
		Trajectory 1- Low, stable	Trajectory 2- High, sharp decline
<i>Psychosocial Correlates</i>			
Moderate/Severe Depression		1.14 (0.67; 1.93)	1.31 (0.67; 2.54)
Moderate/High Perceived Stress		2.54 (1.44; 4.49)	1.32 (0.63; 2.75)
Low Social Support		1.19 (0.71; 1.98)	0.99 (0.51; 1.90)
<i>Demographic Correlates</i>			
<i>Race</i>	Non-Hispanic, White	REF	REF
	Non-Hispanic, Black	2.14 (1.06; 4.31)	3.04 (1.37; 6.73)
	Other	0.63 (0.37; 1.09)	0.18 (0.59; 0.54)
<i>Age</i>	Less than 59 years	REF	REF
	60-62 years	1.12 (0.65; 1.95)	0.93 (0.43; 1.98)
	63-70 years	1.33 (0.89; 1.99)	1.57 (0.94; 2.63)
	Greater than 70 years	2.22 (1.40; 3.51)	2.56 (1.45; 4.50)
<i>Education</i>	< HS Graduate	REF	REF
	High School Grad/GED	0.67 (0.31; 1.40)	0.55 (0.22; 1.38)
	Some college	0.63 (0.30; 1.34)	0.84 (0.34; 2.08)
	College or more	0.39 (0.19; 0.83)	0.57 (0.22; 1.39)
<i>Clinical Correlates</i>	Cognitive Impairment (TICS)	0.57(0.19; 1.70)	0.62 (0.18; 2.17)

* Common reference trajectory was sharp improvement in patient activation level

** Adjusted for age, sex, race, education, and psychosocial characteristics.

CHAPTER IV

PATIENT ACTIVATION AS A PREDICTOR OF REHOSPITALIZATION
AND ER UTILIZATION AFTER AN ACS EVENT

Background: Recent literature has underscored the need for ACS patients to become more engaged in post-hospitalization self-management strategies. However, ACS patients often report uncertainty regarding their chronic condition and the recovery process, and without education interventions they are unprepared to make the necessary behavioral modifications and health care decisions associated with their ACS. Still, research on the relationship between patients engaged in active self-management and healthcare utilization following hospitalization in ACS populations is lacking.

Objective: A better understanding of the role of activation and patient's ability to manage their own care may aid successful transitions from hospital to home in an effort to reduce unnecessary utilization and increase quality of life among ACS populations.

Methods: Descriptive analyses summarized baseline demographics, clinical, and psychosocial characteristics of the study sample. We utilized chi-square analysis of categorical data to compare the percentage of patients at each utilization level by psychosocial, demographic, and clinical correlates. We calculated odds ratios (ORs) and 95% confidence intervals (CI) to estimate the associations between patient activation level at baseline and readmissions and/or ED utilization in the 12 months subsequent to discharge using logistic regression models. Given our interest, after examining the impact of each psychosocial individually on the outcome, we next included all three of the psychosocial factors (depression, stress, social support) in the final multivariable model.

Results: In the final adjusted multivariate models, patients who reported moderate to severe depression (OR=1.60; 95% CI: 1.1- 2.3) were more likely to report having a readmissions in the 12 months subsequent to discharge than patients who reported no or minimal depression. This analyses also detected statistically significant associations between moderate to severe

depression and the composite outcomes of *Readmissions [OR] ED utilization* (OR=1.49; 95% CI: 1.1- 2.1) and *Readmission [AND] ED Utilization* (OR=1.89; 95% CI: 1.3-2.7) in the 12 months subsequent to the initial hospitalization.

Conclusion: Our study findings indicate that while patient activation does influence utilization to some extent, a diagnosis of depression appears to account for the relationship between low patient activation and increased utilization.

Introduction

Managing one's own ACS care post-hospitalization can be complicated. ACS patients often report uncertainty regarding their chronic condition and the recovery process [144], and without education interventions they are unprepared to make the necessary behavioral modifications and health care decisions associated with their ACS.

Patients with high levels of activation are more likely to perform activities that will promote their own health and are more likely to have their health care needs met.[24, 82] Increasing evidence has found an association between patient activation and reduced hospitalizations, decreased emergency room utilization, and improved medication adherence in patients with various chronic conditions, such as diabetes, HIV, and chronic pain. Research on the relationship between patient activation and utilization outcomes following hospitalization in ACS populations is lacking. Only two studies have examined the association between patient activation and post-hospital utilization among cardiovascular patients. The first study limited the time frame to 30 days post-discharge [59] and concluded that patients with lower activation had higher rates of utilization. Similarly, a retrospective study found that among patients with cardiovascular disease, lower patient activation was associated with an increase in both ED visits and hospitalizations, yet this study focused only on an outpatient population. Among ACS patients, the post-discharge period is critical in increasing efforts to reduce hospitalization and improve health outcomes. Hence, a better understanding of the role of the patients' activation and ability to manage their own care may aid successful transitions from hospital to home in an effort to reduce unnecessary utilization and increase quality of life among ACS populations.

Study Aim

The primary goal of this study was to examine the association between baseline patient activation, readmissions and ED utilization in the year following an ACS event. We hypothesized that patients who report lower patient activation levels at hospital discharge would have higher rates of readmissions and ED utilization in the subsequent year, in comparison to their highly activated counterparts. As a secondary aim, we are interested in whether specific psychosocial characteristics known to influence ACS outcomes, namely depression, stress and social support, attenuate the relationship between patient activation and the utilization outcomes. These study findings may inform clinical care and self-management education in effort to reduce readmissions and ED utilization in the year subsequent to ACS hospitalization.

Methods

We used data from a large prospective cohort of ACS survivors who participated in the Transitions, Risks, and Actions in Coronary Events - Center for Outcomes Research and Education (TRACE-CORE). The design and methods of TRACE-CORE has been described in the previous chapters of this work.

Study Recruitment

Briefly, TRACE-CORE enrolled a cohort of adults hospitalized with ACS at six medical centers in MA and GA from 2011-2013. Inclusion criteria included ≥ 21 years in age, admission to the hospital with a confirmed diagnosis of ACS (ICD9 codes: 410, 411, 412, 786.5), and being alive at discharge. Patients were only included in the main analysis if they completed interview at baseline and had data at twelve months for the outcome after discharge. Institutional Review Boards at each site approved this study.

Data Collection

The study outcomes of interest were readmissions and ED utilization in the 12 months subsequent to the initial ACS discharge. All healthcare utilization was self-reported by patients in follow-up phone interviews and was confirmed by medical record review. For the purposes of this analysis, we not only assessed all-cause readmissions and ED utilization individually, but we also developed two composite outcomes of interest in an effort to better understand utilization in the months following discharge: the first outcome was *Readmissions [OR] ED utilization* defined as the patient having either been rehospitalized or utilizing the ER in the 12 months subsequent to the initial ACS hospitalization; the second composite outcome was *Readmission [AND] ED Utilization* which was defined as the patient having both a readmissions and ER visit within the twelve months post initial discharge.

Patient activation was assessed with the six-item Patient Activation Measure (PAM-6; Insignia Health, LLC), which comprehensively assesses patient knowledge, skills, and confidence to take an active role in disease self-management irrespective of medical condition, following hospital discharge. Psychosocial correlates measured at baseline and examined included depressive symptoms, stress, and social support. Depressive symptoms were measured using the Patient Health Questionnaire (PHQ-9), which has been used to make criteria-based diagnoses of depressive disorders.[95, 145] The Perceived Stress Scale (PSS4) is an instrument that assesses the degree to which situations in one's life are appraised as stressful.[96] We measured social support using five items from the Medical Outcomes Study, Social Support Survey (MOS-SSS).[136]

Clinical correlates were abstracted from medical records for the index hospitalization, including the patient's ACS diagnosis (STEMI, NSTEMI, Angina), hospital length of stay (<7 vs. ≥ 7 days) and comorbidities (e.g. diabetes, CHD). ACS severity was assessed using the GRACE six-month mortality prediction model [103], which incorporates the summation of points over three categories including the patient's medical history, and findings at both admissions and during hospitalization. Self-reported demographic information (age, gender, race, ethnicity, etc.) collected at the baseline interview was also assessed in this analysis.

Statistical Analysis

Our statistical analysis was carried out in four stages. First, we compared TRACE-CORE patients included (i.e., maintained 12 months of outcome data subsequent to initial discharge) versus those excluded from the analytic sample on baseline characteristics using t-tests for continuous variables and chi-squared tests for categorical variables. Second, descriptive analyses summarized baseline demographics, clinical, and psychosocial characteristics of the study sample. Baseline patient characteristics were reported according to readmissions and/or ED utilization. To identify potential confounders for modeling, the third stage utilized bivariate, chi-square analysis for categorical data to compare the percentage of patients at each utilization level (e.g. readmissions) by psychosocial, demographic, and clinical correlates. Using logistic regression models, we calculated odds ratios (ORs) and 95% confidence intervals (CI) to estimate the associations between patient activation level at baseline and readmissions and/or ED utilization in the 12-months subsequent to discharge.[78] Unadjusted models were first computed with patient activation as the independent variable. Given our interest, we next included all three psychosocial factors (depression, stress, social support) in this multivariable analysis. Clinical and demographic characteristics associated ($p < 0.10$) with PAM level in the bivariate analyses were added to the model one at a time to adjust for potential confounding,

starting with the variable with largest effect estimate. Variables were retained in the model if they were statistically significant ($p < 0.05$) for at least one utilization level (e.g. hospitalization or ED use). Patients in PAM level 1, the lowest level of activation, were the reference group for this analysis because our interest was in activation and factors associated with utilization.[111] All analyses were performed using STATA 13 (StataCorp LP, College Station, Texas, USA).

In the final stage we applied Inverse Probability Weighting (IPW) to account for participants who were lost to follow-up (thus excluded from our study sample due to missing data in the subsequent 12 months). IPW is a statistical technique commonly used to correct bias in the complete-case analysis.[146]

Results

Of the 2,187 patients enrolled in TRACE-CORE, we excluded 1,022 patients who were missing data in the 12 months subsequent to baseline, thus resulting in an analytic sample of 1,165 adults. Participants had a mean age of 61 years ($SD=11$), almost three-quarters were male (73%), most were non-Hispanic white (76%) and married (58%), and 55% reported some college education. Twenty-one percent of our study sample was at low patient activation (Level 1), 40% at Level 2, 17% Level 3, and 22% at Level 4. Of the 1,165 adults included in this analytical sample, 40% ($N=469$) had been readmitted to the hospital in the 12 months subsequent to discharge; another 40% ($N=467$) had utilized the ED; 54% ($N=626$) had been readmitted or utilized the ED; and, 27% ($N=310$) had been both readmitted and utilized the ER.

Patient Activation

The bivariate analyses [Table 4.1] detected a significant association between self-reported hospital readmissions and low patient activation level ($p=0.008$), those patients reporting activation scores in Level 1 or 2 being more likely to report readmissions. ED

utilization in the 12-months post-discharge was not associated with patient activation level. Patient activation was significantly associated with *Readmissions [OR] ED* ($p=0.018$) but not *Readmission [AND] ED* ($p=0.073$). The final adjusted logistic model [Table 4.2] included the psychosocial variables while adjusting for demographic and clinical confounders. In this final model, patient activation level was not significantly associated with any outcomes of interest.

Psychosocial Characteristics

The bivariate analyses demonstrated some differences in utilization by baseline psychosocial characteristics. Moderate to high patient perceived stress ($p<0.001$) and depression ($p<0.001$) were associated with readmissions in the 12-months subsequent to hospital discharge [Table 4.1]. Additionally, a greater proportion of individuals diagnosed with moderate to severe depression ($p<0.001$) were more likely to utilize the ED in the 12 months subsequent to initial discharge. Moderate to severe depression ($p=0.001$) and stress ($p=0.006$) were associated with the composite outcome of *Readmissions [or] ED utilization* in the 12 months subsequent to discharge. Similarly, both depression ($p<0.001$) and stress ($p=0.032$) were significantly associated with the *Readmissions [AND] ED utilization* outcome.

In the final adjusted multivariate models [Table 4.2], patients who reported moderate to severe depression (OR=1.60; 95% CI: 1.1- 2.3) were more likely to report having a readmissions in the 12 months subsequent to discharge than patients who reported no or minimal depression. This analyses also detected significant associations between moderate to severe depression and the composite outcomes of *Readmissions [OR] ED utilization* (OR=1.49; 95% CI: 1.1- 2.1) and *Readmission [AND] ED Utilization* (OR=1.89; 95% CI: 1.2-2.7) in the 12 months subsequent to initial ACS discharge. Perceived stress also did not significantly impact this utilization outcome.

Our IPW analyses produced similar results for the aforementioned findings; depression and stress remained significant predictors of utilization. In the IPW analyses both stress and age were slightly more significantly associated with the ER [OR] readmission category, only.

Discussion

In a large, diverse sample of ACS survivors, we examined the association between patient activation level during hospitalization and readmissions and ED utilization in the twelve months following discharge. Our findings demonstrate that while patient activation does influence utilization, when all other covariates are accounted for, patient activation does not significantly influence utilization.

At ACS hospital discharge, more than half (56%) of the respondents were at PAM Levels 1 or 2, indicating that these patients did not demonstrate the skills or knowledge to take an active role in their care or in care decision-making after leaving the hospital.[45, 82] In the bivariate analysis, patients reporting being at Levels 1 and 2 activation were significantly more likely to have a readmission (58%; $p=0.018$) within the twelve months subsequent to hospital discharge. However, in our final multivariate adjusted model the patient's activation level did not significantly influence readmissions or ED utilization when the effects of all variables (e.g. psychosocial aspects) were taken into account. This finding was surprising in light of recent literature that has underscored that patients who are less activated at discharge are more likely to be hospitalized, utilize the ED, and be readmitted within 30 days of the initial hospitalization than their more activated counterparts.[49, 52, 59] It may be that although patient activation plays a role in readmissions and ED utilization following a hospital event, diagnosis of depression most truly influences both patient activation and subsequent utilization.

Our findings support prior research indicating that ACS inpatients' self-reported moderate to severe depression influences readmissions and ED utilization in the months

following hospital discharge.[40-42] Specifically, this research has specifically underscores that the coexistence of depression and cardiovascular disease as a hindrance not only to patient self-management, but also serves as a catalyst for repeated hospitalizations and poor outcomes.[66, 147] Patients who reported depression were more likely to be readmitted and/or use the emergency room in the months following the initial discharge. Our findings indicate that when depression was added to the final multivariable-adjusted model, it remained a significantly strong predictor of both readmissions and ED utilization in the months subsequent to hospital discharge. Depression also impacts patient activation. The inverse relationship between patient activation and depression has been documented in previous studies; among patients with diabetes, HIV/AIDS, and cardiovascular disease; higher levels of depression [24, 54, 66, 88, 89] have been associated with lower patient activation levels.[82, 91] In effort to improve clinical implications, future studies that seek to understand the role of BOTH depression and patient activation in unnecessary health care utilization after hospital discharge are warranted in ACS populations.

Strengths and Limitations

Strengths include the large, racially diverse cohort of ACS patients enrolled in the TRACE-CORE study. While we were only able to examine re-hospitalization and ED use in a subset of TRACE-CORE patients, we believe this study provides a foundation for further research in the realm of patient activation and health care utilization after hospital discharge. A final limitation includes the potential for selection bias due to loss to follow-up, which may have biased findings toward the null because excluded patients were more likely to have markers of socioeconomic deprivation and increased psychosocial risks, both of which could be influential in increasing the rate of utilization among ACS survivors.

Conclusion

Our study findings indicate that while patient activation does influence utilization to some extent, a diagnosis of depression appears to account for the relationship between low patient activation and increased healthcare utilization. Depression is often associated with feelings of helplessness that lead to lower activation, which may result in these poorer outcomes. Further research is needed to more fully understand how to make meaningful reductions in readmissions and ED utilization following ACS hospital discharge. Specifically, these studies should focus on the benefit of assessing both patient activation and depression at hospital discharge and in the months to follow. Once the impact of these characteristics on utilization is better understood, clinical interventions that seek to increase follow-up access to clinical care and self-management education can be further strengthened in an effort to reduce readmissions and ED utilization in the year subsequent to ACS hospitalization.

Table 4.1a: Patient activation and psychosocial correlates of rehospitalization and ED utilization in the 12 months following ACS discharge (N=1,165): TRACE-CORE, 2011-13*

Characteristic	Entire Population (N=1164)	ReAdmissions (N=469)	P-Value	ED Utilization (N=467)	P-Value	
Age	≤ 59 years 60-69 years ≥ 70 years	477 (41%) 381 (33%) 307 (26%)	208 (44%) 134 (29%) 127 (27%)	0.039	210 (45%) 140 (30%) 117 (25%)	0.07
Gender	Female	418 (36%)	174 (37%)	0.48	182 (38%)	0.07
Race	Non-Hispanic, White Non-Hispanic, Black Other	907 (78%) 178 (15%) 80 (7%)	358 (76%) 79 (17%) 32 (7%)	0.474	348 (39%) 82 (18%) 37 (8%)	0.08
Education	≤ High School High School Grad/GED Some College College or more	148 (13%) 364 (31%) 376 (32%) 277 (24%)	61 (14%) 147 (31%) 148 (31%) 113 (24%)	0.975	62 (13%) 156 (33%) 144 (31%) 105 (22%)	0.49
Married		709 (61%)	271 (58%)	0.08	272 (58%)	0.14
Clinical Characteristics						
ACS category	STEMI NSTEMI UA	199 (17%) 585 (51%) 374 (32%)	69 (15%) 243 (52%) 154 (33%)	0.211	78 (17%) 234 (50%) 153 (33%)	0.92
Length of Stay	≤ 7 days ≥ 8 days	1,016 (87%) 149 (13%)	399 (85%) 70 (15%)	0.073	400 (86%) 67 (14%)	0.19
Grace Risk Score	Low Intermediate High	487 (42%) 446 (38%) 232 (20%)	189 (40%) 170 (36%) 110 (23%)	0.045	197 (42%) 169 (36%) 101 (22%)	0.36
Comorbidities	CHD CHF Diabetes, Type 1 Diabetes, Type 2 Hyperlipidemia Hypertension Stroke Cognitive Impairment	459 (39%) 140 (12%) 13 (1%) 363 (31%) 814 (70%) 876 (75%) 51 (4%) 70 (6%)	225 (48%) 80 (17%) 7 (1%) 176 (38%) 336 (72%) 371 (79%) 31 (7%) 32 (7%)	p<0.001 p<0.001 0.315 P<0.001 0.280 0.011 0.002 0.337	205 (44%) 78 (17%) 10 (2%) 176 (38%) 336 (72%) 373 (80%) 25 (5%) 38 (8%)	0.01 p<0.001 0.006 p<0.001 0.21 0.002 0.18 0.01
Psychosocial Characteristics						
Depression	Mild/Minimal Moderate/Severe	934 (80%) 231 (20%)	342 (73%) 127 (27%)	p<0.001	347 (74%) 120 (26%)	p<0.001
Perceived Stress	Mild/Minimal Moderate/Severe	1,031 (89%) 134 (12%)	395 (84%) 74 (16%)	p<0.001	408 (87%) 59 (13%)	0.32
Social Support	Moderate/High Low/Minimal	981 (84%) 184 (16%)	387 (83%) 82 (17%)	0.194	384 (82%) 83 (18%)	0.13
PAM Level (Baseline)						
	Level 1, Disengagement Level 2, Awareness Level 3, Taking Action Level 4, Maintaining	227 (20%) 421 (36%) 251 (22%) 265 (23%)	97 (21%) 187 (40%) 79 (17%) 105 (22%)	0.008	91 (19%) 170 (36%) 94 (20%) 111 (24%)	0.78

* The bivariate associations of the outcomes yes/no (in the row titles (e.g. readmission vs. not) with the characteristic in each row: when the characteristic is ordinal the p value represents the p for trend.

Table 4.1b: The association of patient activation and psychosocial correlates to the composite utilization outcomes in the 12 months following ACS discharge (N=1,165): TRACE-CORE, 2011-13

Characteristic	Entire Population (N=1164)	ReAdmission s [OR] ED (N=626)	P-Value	Readmission [AND] ED (N=310)	P-Value	
Age	≤ 59 years 60-69 years ≥ 70 years	477 (41%) 381 (33%) 307 (26%)	271 (43%) 188 (30%) 167 (27%)	0.089	147 (47%) 86 (28%) 77 (25%)	0.020
Gender	Female	418 (36%)	238 (38%)	0.10	118 (38%)	0.35
Race	Non-Hispanic, White Non-Hispanic, Black Other	907 (78%) 178 (15%) 80 (7%)	472 (75%) 108 (17%) 46 (7%)	0.084	234 (75%) 53 (17%) 23 (7%)	0.495
Education	≤ High School High School Grad/GED Some College College or more	148 (13%) 364 (31%) 376 (32%) 277 (24%)	86 (14%) 206 (33%) 191 (31%) 143 (23%)	0.247	37 (12%) 97 (31%) 101 (33%) 75 (24%)	0.971
Married		709 (61%)	368 (59%)	0.12	175 (56%)	0.06
Clinical Characteristics						
ACS category	STEMI NSTEMI UA	199 (17%) 585 (51%) 374 (32%)	102 (16%) 315 (50%) 206 (33%)	0.682	45 (15%) 162 (52%) 101 (33%)	0.37
Length of Stay	≤ 7 days ≥ 8 days	1,016 (87%) 149 (13%)	537 (86%) 89 (14%)	0.116	262 (85%) 48 (15%)	0.097
Grace Risk Score	Low Intermediate High	487 (42%) 446 (38%) 232 (20%)	259 (41%) 225 (36%) 142 (23%)	0.027	127 (41%) 114 (37%) 69 (23%)	0.475
Comorbidities	CHD CHF Diabetes, Type 1 Diabetes, Type 2 Hyperlipidemia Hypertension Stroke Cognitive Impairment	459 (39%) 140 (12%) 13 (1%) 363 (31%) 814 (70%) 876 (75%) 51 (4%) 70 (6%)	281 (45%) 98 (16%) 11 (2%) 220 (35%) 449 (72%) 494 (79%) 37 (6%) 112 (18%)	p<0.001 p<0.001 0.025 0.002 0.137 0.002 0.006 0.034	149 (48%) 60 (19%) 6 (2%) 132 (43%) 223 (72%) 250 (81%) 19 (6%) 21 (7%)	p<0.001 p<0.001 0.10 p<0.001 0.36 0.01 0.079 0.508
Psychosocial Characteristics						
Depression	Mild/Minimal Moderate/Severe	934 (80%) 231 (20%)	472 (75%) 154 (25%)	0.001	217 (70%) 93 (30%)	P<0.001
Perceived Stress	Mild/Minimal Moderate/Severe	1,031 (89%) 134 (12%)	539 (86%) 87 (14%)	0.006	264 (85%) 46 (15%)	0.032
Social Support	Moderate/High Low/Minimal	981 (84%) 184 (16%)	514 (82%) 112 (18%)	0.005	257 (83%) 53 (17%)	0.463
PAM Level (Baseline)						
	Level 1, Disengagement Level 2, Awareness Level 3, Taking Action Level 4, Maintaining	227 (20%) 421 (36%) 251 (22%) 265 (23%)	125 (20%) 241 (38%) 113 (18%) 146 (23%)	0.018	63 (20%) 116 (37%) 60 (19%) 70 (23%)	0.073

Table 4.2: Multivariable logistic models of the association of patient characteristics with hospital readmissions and ER utilization in the 12-months subsequent to discharge for acute coronary syndromes, TRACE-CORE. (N=1,165)

		Crude OR (95% CI)			
		ReAdmitted	ER	ReAdmitt (OR) ER	ReAdmitt (AND) ER
Patient Activation Level	Level 1, Disengagement	REF	REF	REF	REF
	Level 2 , Awareness	1.07 (0.77; 1.48)	1.01 (0.73; 1.41)	1.09 (0.79; 1.51)	0.99 (0.69; 1.42)
	Level 3, Taking Action	0.62 (0.42; 0.90)	0.89 (0.62; 1.29)	0.67 (0.47; 0.96)	0.82 (0.54; 1.23)
	Level 4, Maintaining	0.88 (0.61; 1.26)	1.08 (0.75; 1.54)	1.00 (0.70; 1.43)	0.93 (0.63; 1.39)
Crude OR (95%) with Psychosocial Characteristics					
Patient Activation Level	Level 1, Disengagement	REF	REF	REF	REF
	Level 2 , Awareness	1.14 (0.82; 1.60)	1.06 (0.76; 1.48)	1.16 (0.83; 1.61)	1.06 (0.74; 1.53)
	Level 3, Taking Action	0.68 (0.46; 1.00)	0.98 (0.67; 1.41)	0.73 (0.51; 1.05)	0.92 (0.61; 1.40)
	Level 4, Maintaining	0.99 (0.69; 1.43)	1.17 (0.81; 1.68)	1.10 (0.77; 1.59)	1.05 (0.70; 1.58)
Psychosocial Correlates	Moderate/Severe Depression	1.81 (1.31; 2.51)	1.95 (1.41; 2.70)	1.78 (1.28; 2.50)	2.23 (1.58; 3.14)
	Moderate/High Perceived Stress	1.42 (0.94; 2.13)	0.83 (0.5; 1.25)	1.24 (0.81; 1.88)	0.96 (0.62; 1.48)
2b. Multivariable-Adjusted Model, OR (95% CI)- FINAL MODEL					
		ReAdmitted	ER	ReAdmitt (OR) ER	ReAdmitt (AND) ER
Patient Activation Level	Level 1, Disengagement	REF	REF	REF	REF
	Level 2 , Awareness	1.26 (0.89, 1.77)	1.19 (0.84; 1.68)	1.26 (0.90; 1.78)	1.22 (0.83; 1.78)
	Level 3, Taking Action	0.78 (0.53; 1.16)	1.15 (0.78; 1.69)	0.84 (0.58; 1.23)	1.11 (0.72; 1.72)
	Level 4, Maintaining	1.07 (0.73; 1.56)	1.28 (0.88; 1.88)	1.18 (0.81; 1.71)	1.19 (0.78; 1.82)
Psychosocial Correlates	Moderate/Severe Depression	1.60 (1.14; 2.26)	1.61 (1.15; 2.27)	1.49 (1.05; 2.12)	1.89(1.32; 2.71)
	Moderate/High Perceived Stress	1.38 (0.90; 2.10)	0.80 (0.52; 1.22)	1.22 (0.79; 1.88)	0.91 (0.58;1.43)
Demographic Correlates	Gender, Female	1.03 (0.79; 1.35)	1.22 (0.93;1.59)	1.17 (0.90; 1.53)	1.09 (0.81; 1.46)
	Married	0.89(0.69; 1.16)	0.96 (0.74; 1.24)	0.96 (0.74; 1.24)	0.88 (0.66;1.17)
Age	≤ 59 years	REF	REF	REF	REF
	60-69 years	0.63 (0.45; 0.88)	0.72 (0.52;1.00)	0.71 (0.51; 0.99)	0.59 (0.40; 0.85)
	≥ 70 years	0.73 (0.47; 1.12)	0.68 (0.45; 1.05)	0.74 (0.49; 1.14)	0.61 (0.38; 0.99)
Race	<i>Non-Hispanic , White</i>	REF	REF	REF	REF
	<i>Non-Hispanic, Black</i>	0.93 (0.64; 1.35)	0.96 (0.66; 1.38)	1.03 (0.71; 1.48)	0.85 (0.57;1.28)
	<i>Other</i>	0.90 (0.69; 1.16)	1.18 (0.73; 1.91)	1.09 (0.67; 1.77)	0.97 (0.57;1.17)
Clinical Correlates					
Grace Risk Score	Low	REF	REF	REF	REF
	Intermediate	1.03 (0.74; 1.45)	0.94(0.68;1.31)	0.92 (0.66;1.28)	1.07 (0.74; 1.56)
	High	1.23 (0.76; 2.00)	1.02(0.63; 1.65)	1.17 (0.73; 1.89)	1.09 (0.63; 1.88)
Comorbidities	CHD	1.51 (1.15; 1.98)	1.17 (0.89; 1.53)	1.36 (1.04; 1.78)	1.36 (1.00;1.84)
	CHF	1.49 (0.97; 2.28)	1.65(1.08;2.53)	1.54(0.99; 2.40)	1.73 (1.11; 2.70)
	Diabetes, T1	1.68 (0.54; 5.24)	5.23 (1.40;19.6)	4.45 (0.96; 20.7)	2.69 (0.86; 8.37)
	Diabetes, T2	1.41 (1.08; 1.86)	1.50 (1.15; 1.97)	1.29 (0.99; 1.70)	1.80 (1.34; 2.41)
	Hypertension	1.10 (0.81; 1.50)	1.28(0.94; 1.74)	1.22 (0.98; 3.60)	1.18 (0.83; 1.68)
	Stroke	2.02(1.11; 3.69)	1.22(0.68; 2.20)	1.88(0.98; 3.60)	1.46 (0.79; 2.69)
	Cognitive Impairment (TICS)	0.87 (0.51; 1.49)	1.45 (0.86; 2.45)	1.49(0.79; 1.88)	0.87 (0.48; 1.55)

CHAPTER IV

CONCLUSIONS AND DISCUSSION

The overall purpose of this research was to examine predictors for patient activation in a cohort of individuals following hospitalization for an acute coronary (ACS) event. Patient activation encompasses a concept of patient empowerment in which chronically ill individuals become engaged partners and stewards of their own health care. A validated measure of patient activation is the Patient Activation Measure (PAM), which categorizes activation on 4 levels [38]. This dissertation was specifically interested in examining predictors of a patient's PAM score at hospital discharge, and then in identifying and characterizing activation trajectories that may influence readmissions and ER utilization outcomes after an ASC event. A retrospective analysis of longitudinal data from the NHLBI-funded Transitions, Risks, and Action in Coronary Events – Center for Outcomes Research and Education (TRACE-CORE) study was utilized to accomplish these aims. The TRACE-CORE cohort study included 2,186 ACS survivors who were admitted to the hospital between the study dates April 2011 and May 2013 at selected study sites in Massachusetts and Georgia.

Acute coronary syndrome is a complex disease which demands that patients take an active role in their chronic care as they transition from the hospital to a home care setting.[148] Aim 1 of this study revealed that more than half (58%) of this diverse ACS cohort reported being at the lowest patient activation levels (PAM score 1 & 2) at hospital discharge; 19% of these patients were at the lowest activation level. This number is alarming considering that the lowest activation levels are indicative of patients not maintaining the skills or knowledge to take an active role in their own chronic illness care which in turn may lead to a lack of ACS self-management post-discharge and poorer health outcomes.[51, 149] These findings indicate that identifying of patients at low activation at hospital discharge may be necessary to achieve effective ACS chronic disease management.

This study also identified associations between specific clinical and demographic correlates and low patient activation levels among an inpatient ACS population prior to hospital discharge. Higher levels of perceived stress and depression were correlated to lower levels of activation at hospital discharge among this patient population. This is not surprising given that previous research on patient activation in chronically ill cohorts has identified similar inverse relationships between depression, stress, and patient activation levels.[150] This literature has also reported that both increased stress and depression are influential in cardiovascular patients' decision not to participate in rehabilitation programs which aim to increase patient self-management. These findings are disconcerting given that inpatients with lower patient activation are also at higher risk of post-discharge 30-day hospital utilization.[59] The time before hospital discharge presents a vital opportunity in which to assess the ACS patient's activation level in an effort to gauge their ability to self-manage their own care. Tailored interventions that seek to increase patient activation at the time of hospital discharge may have the dual benefit of reducing stress and preventing early readmission in ACS patients.

In Aim 2 of this study, we identified and characterized three distinctive trajectories of patient activation over the 3-months post-hospital discharge in this same ACS population. These post-discharge trajectories took on three distinct courses including; the first of which, Trajectory 1, started out at low activation and remained low over time. Over 65% of the patients in our study cohort were characterized in this trajectory. This finding was not surprising given the high number of patients who were discharged from the hospital at low patient activation, but this trajectory does further demonstrate that a majority of patients start at low activation and continue at this level in the subsequent months. Trajectory 2 was defined by patients who started at high activation at hospital discharge and then sharply declined in the subsequent months to follow.

Sixteen percent of the study cohort had membership in Trajectory 2. While these patients were confident at discharge, over time their ability to be active partners in their own self-management declined underscoring the need for consistent, tailored interventions in the months subsequent to hospitalization and not just at hospital discharge. Both Trajectories 1 and 2 indicate that ACS patients have low activation at discharge or shortly thereafter; we know that people who measure at low activation tend to have little confidence in their ability to manage their own health because they feel overwhelmed, show poor problem-solving skills, don't understand what professionals are telling them, and, as a result, may not pay close attention to their own healthcare needs. Patient activation has been demonstrated to be amendable to interventions.[59] Our work identifying and characterizing trajectories of activation indicates that more interventions need to be implemented so that we can better understand how to effectively delegate resources and care to better support ACS patients' chronic condition self-management over time. Patients in the final trajectory (Trajectory 3) started out at low activation but showed an increase at 1-month post-hospitalization and remained high/stable through 3 months. While only 17% of our patients were in this trajectory, these patients would be more inclined to take an active role in the ACS chronic illness care over time.

This study also found patient characteristics associated with specific trajectory groups. Patients who reported moderate to high perceived stress at hospital discharge were significantly more likely to be in Trajectory 1. Patient self-reported older age and/or being non-Hispanic, Black in race were significant correlates associated with membership in both Trajectory 1 and/or 2. These findings correspond with those of previous activation research which found that when compared with the general population, minority patients were more likely to be characterized at PAM, level 1 (least activated).[151] Other evidence has suggested that the relationship between

race and patient activation may be significantly mediated by health literacy and level of education.[152] Our findings seem to indicate the opposite: when all variables were held constant, stress and race significantly drove which trajectory group our ACS patients belong to in the three months following hospital discharge. Patients who are activated to self-manage their own chronic care experienced improved health outcomes, yet African American patients are two times more likely than their white counterparts to die of preventable heart disease. [153] Previous literature has also underscored minority status as a predictor of low cardiac rehabilitation participation rates.[154] These disparities are persistent and tied to modifiable patient activation characteristics such as patient-physician communication and chronic ACS illness education, interventions that could be targeted toward minority patient populations in the future. Among minority patient populations, PAM could be used at both hospital discharge and over time to gauge activation levels so that systematic and integrated approaches to effective interventions can seek to increase ACS self-management in minority populations.

We found that the patient's age was also a predictor of membership in Trajectories 1 or 2. Older age has been associated with lower patient activation across multiple chronic illnesses.[155] Recent findings suggest that patient activation changes over time among elderly patients with chronic conditions. Most notably, declines in activation impact elderly ACS patients' engagement and self-management over time. The inverse association between older age and low patient activation is important to consider given that elderly patients with chronic conditions utilize a significant amount of healthcare resources and expenditures. [58] Integrating patient activation within standard processes of health care is important to assure that all patients, including the elderly, have the skills and tools to function adequately in self-managing their care in the months subsequent to hospitalization.[38] As with minority patient

populations, clinicians may want to consider utilizing the PAM instrument to monitor activation over time, so that timely interventions can be designed that seek to prevent decline and enhance patient self-management.

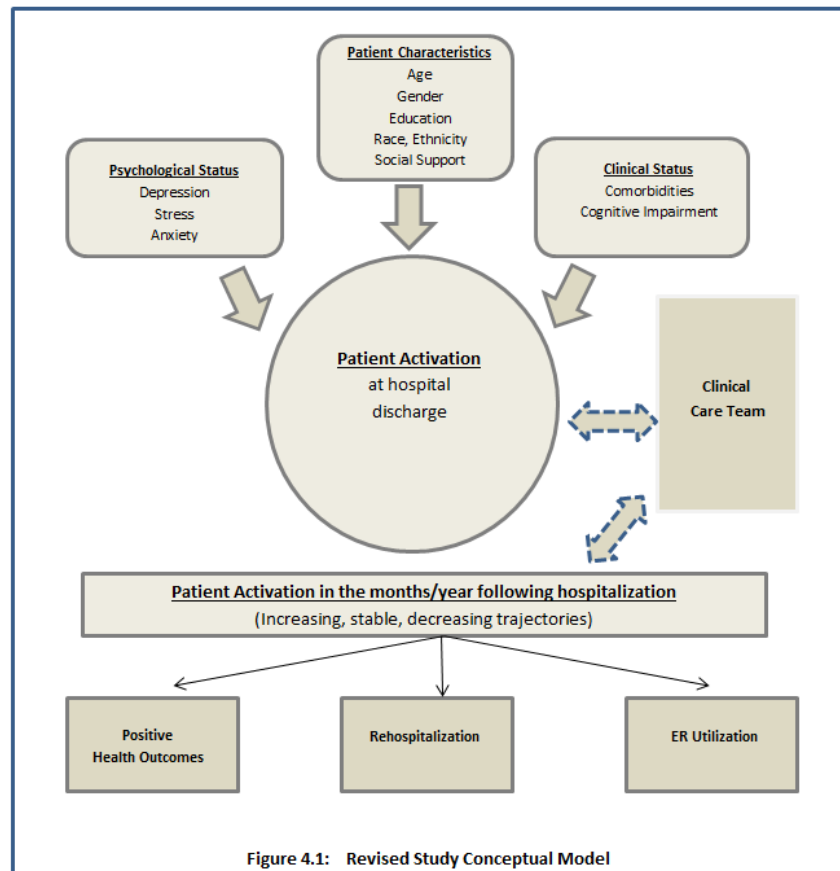
The last aim of this research examined patient activation level at baseline and its impact on health care utilization in the months subsequent to hospital discharge. Outcomes of specific interest included ED (Emergency Department) utilization and subsequent hospitalizations. The bivariate analyses indicated that activation was significantly correlated to ED utilization and hospitalization in the months subsequent to discharge, but when both clinical and demographic characteristics were accounted for in the final model, patient activation did not remain significant to the outcomes. Our findings suggested that self-reported moderate to severe depression is the most influential predictor of healthcare utilization in the months following hospital discharge among ACS patients. These findings are not surprising given that depression has been increasingly associated with heart disease, and has been established as a risk factor for both morbidity and mortality in these same patients. One in three ACS patients meet the criteria for minor depression [141], which may be sufficient to dramatically impact compliance with post-hospitalization therapies. However, the temporal relationship between patient activation and depression is still uncertain as prior research has reported mixed results. The majority of studies do agree that patient activation and depression have an inverse relationship; as patient activation decreases, depression increases or as depression decreases, patient activation increases.[150] Either way, as activation decreases so does the patient's ability to self-manage their chronic ACS care post-hospitalization, which may also influence ED and readmissions. More research is needed to better understand the relationship between patient activation and depression and the impact that both variables have on healthcare utilization, post-hospitalization.

This is the first study that we are aware of that examined the predictors of low patient activation at hospital discharge, activation trajectories, and utilization patterns in subsequent months among a large, racially and geographically diverse cohort of ACS patients. The majority of ACS patients leave the hospital with low patient activation and stay low (or decline) in subsequent months. This finding is imperative given that recent strategies to improve care have been focused on the patient's role in self-management, yet our findings indicate that most of these ACS patients do not have the skills, knowledge, or confidence to be active partners in their own care upon hospital discharge. Furthermore, this study identified a diagnosis of depression, being non-Hispanic Black in race, and older in age as predictors of low patient activation. Comprehension of the correlates of patient activation may assist in developing effective interventions for subpopulations of ACS patients. Lastly, this study demonstrated that a patient diagnosis of depression at hospital discharge was the strongest predictor of subsequent ED and/or readmissions. This finding suggests that more research is needed in the realm of patient activation, depression, and healthcare utilization in cardiovascular disease populations.

Lastly, our study findings reinforce our conceptual model which underscores the patient's "active" self-management of their own ACS chronic care is reliant on numerous sociodemographic, psychosocial, and clinical characteristics at hospital discharge. These baseline characteristics impact patient activation which in turn may lead to an increase or decrease risk in health care utilization and outcomes in the months/years subsequent to ACS hospital discharge. Our work indicates that there may be room to improve outcomes using some basic mechanisms: 1.) implementing strategies and resources which target patients who are at risk of low activation at discharge (e.g. depression diagnosis, stress); and 2.) the monitoring of activation trajectories over time for worsening signs or symptoms. Activation trajectories

provide an excellent tool for clinicians in effort to increase their ability to continue to identify and target ACS patients in need of resources and education in effort to increase the patient’s “active” participation in their own chronic care self-management. The PAM is a short measure which can be implemented costly-effectively and reliability by clinicians at designated time-points in the months following hospitalization and at follow-up clinical visits. Still, a more collaborative approach is

needed in increase outcomes and decrease healthcare utilization. As a result of these study findings, the study conceptual model has been revised [Figure 4.1] to underscore the essential collaborative relationship between the patient and the clinical team. Borrowing from the Chronic Care Model[156], the revised



model underscores the important nature of this patient/provider collaboration in chronic ACS management, including the months/years following an ACS event when a patient’s activation takes on a trajectory that defines the best time-points in which to intervene in effort to produce the most ideal health outcomes

Some limitations of this work should be noted. First, a potential weakness, the PAM-6 short form is a statistical derivation of original PAM-13 that has yet to be utilized widely throughout multiple disease populations; hence, there is always the possibility of measurement error in the measured outcome. The PAM-6 has 88% of the reliability of the PAM-13, which is a validated and reliable instrument in multiple disease and diverse populations. From this study cohort, we were able to identify three patient activation trajectories in an ACS population in the months following hospitalization. While we were only able to examine trajectories up to three months post-hospitalization, we believe this study provides a foundation for further research in the realm of patient activation trajectories. This work is limited by non-response bias, particularly among those patients who were loss to follow-up and did not complete the PAM-6 at all three time points and/or who we did not have on record health utilization data for the 12 months subsequent to hospitalization, which in turn, may make our findings less generalizable. Lastly, similar to all observational studies, this work is limited by non-response bias, although still the Inverse Probability Weighting (IPW) analysis produced similar results to the original study which establishes a foundation for future research.

Activation is a modifiable characteristic that leads to patients being more effective managers of their own ACS health and healthcare [86], post-hospitalization. These study findings add to the literature by identifying specific patient characteristics that are associated with low activation at hospital discharge. Furthermore, this analysis reported that over half the patients in this large, racially diverse ACS cohort leave the hospital at low activation. Low activation is indicative of patients not being prepared to take an active role in managing their own chronic care as they transition from hospital to home. Once patients are in a home care setting, our trajectory analysis demonstrated that the majority of these same patients continue to

remain at low or decline in activation in the months subsequent to discharge. Patients who identified as non-Hispanic black in race, of older age, and/or had a history of moderate to severe depression were more likely to report low levels of activation over time. These findings underscore the need to identify those ACS patients who are most likely at risk for low activation at hospital discharge so that healthcare care professionals can intervene with education and resources prior to discharge and extend such interventions in subsequent months, in an effort to improve outcomes. Lastly, while patient activation is associated with healthcare utilization in the months following an ACS event, patient self-reported depression was the stronger predictor of subsequent ED and hospitalization utilization among this ACS population. This last aim provides an important foundation on which to base future longitudinal studies that examine the relationships among patient activation, depression, and healthcare utilization. Given the complex nature of these relationships, work is still warranted in the realm of how to make meaningful reductions in readmissions and ED utilization following ACS hospital discharge.

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