ASSOCIATIONS OF FOUR PROMIS SELF-EFFICACY FOR MANAGING CHRONIC CONDITIONS MEASURES AND THE PATIENT ACTIVATION MEASURE (PAM) AMONG ACUTE STROKE SURVIVORS: AN ANALYSIS OF THE MICHIGAN STROKE TRANSITIONS TRIAL (MISTT) DATA

By

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ABSTRACT

ASSOCIATIONS OF FOUR PROMIS SELF-EFFICACY FOR MANAGING CHRONIC CONDITIONS MEASURES AND PATIENT ACTIVATION MEASURE (PAM) AMONG ACUTE STROKE SURVIVORS: AN ANALYSIS OF THE MICHIGAN STROKE TRANSITIONS TRIAL (MISTT) DATA

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BACKGROUND: Successful stroke transitions rely on effective self-management abilities to address stroke deficits and to prevent recurrent stroke. Patient activation and self-efficacy (confidence) are two behavioral constructs that influence successful self-management and are associated with healthier lifestyles and better health outcomes.

OBJECTIVE: This cross-sectional, secondary analysis of the Michigan Stroke Transitions Trial aimed to determine the associations between 4 PROMIS self-efficacy (SE) measures [managing medications and treatment, activities of daily living, emotions, and social interactions] and the Patient Activation Measure (PAM).

METHODS: Self-reported outcomes were collected 7-days after returning home. PAM measures skill, knowledge, and confidence to manage health and healthcare, while PROMIS SE measures confidence across 4 unique domains. Independent associations of patient characteristics with each PROMIS SE and PAM were determined using a staged multivariable regression model-building approach. Finally, multivariable regression between each PROMIS SE and PAM were explored along with confounding and interaction effects. Variables significantly associated with both SE and PAM were considered as confounders and moderators. Age and education were forced into all models.

RESULTS: For 180 patients mean PAM scores were 64.5 (SD: 16) and SE T-scores were near the standard mean of 50 except for SE for managing daily activities (43.5, SD: 7.5). PAM was positively correlated with each SE measure (r=0.28 to r=0.46). Only perceived emotional support and post-stroke disability were associated with both PAM and SE. Emotional support attenuated the association between all SE domains and PAM, whereas post-stroke disability only affected SE for managing daily activities. After adjusting for potential confounders, SE for managing daily activities was no longer associated with PAM. No significant interactions were found.

CONCLUSIONS: During acute stroke recovery, PROMIS SE and PAM are associated. It is important to account for perceived support and disability. Longitudinal MISTT analyses will explore mediation effects to help inform causal associations between demographic, clinical, and psychosocial factors, intervention effects, and outcomes.

This thesis is dedicated to the friends and family that have supported me throughout this journey.
Thank you for your encouragement and prayers.

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The MISTT study was successfully completed due to the many hours of hard work from the Investigator team, recruitment coordinators, case managers, data collectors, and data analysts. Thank you for your time and dedication to this important work.

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KEY TO ABBERVIATIONS

CAT = Computer Adaptive Testing

GCS = Glasgow Coma Scale

MISTT = Michigan Stroke Transitions Trial

NeuroQOL = Neurologic Quality-of-Life measurement system

NIHSS = National Institute for Health Stroke Scale

PAM = Patient Activation Measure

PHQ-9 = Patient Health Questionnaire, 9-item

PROMIS = Patient Reported Outcomes Measurement Information System

QOL = quality-of-life

RCT = Randomized Clinical Trial

SEMMT = Self-Efficacy for Managing Medications and Treatments

SEMDA = Self-Efficacy for Managing Daily Activities

SEME = Self-Efficacy for Managing Emotions

SEMSI = Self-Efficacy for Managing Social Interactions

s-mRS = Simplified Modified Rankin Scale

INTRODUCTION

Stroke is the second leading cause of disability worldwide, leaving survivors to manage complex care conditions in the face of physical, mental health, and social challenges. In the United States, stroke is the fifth leading cause of mortality and the leading cause of adult-onset disability.[1] Approximately 795,000 strokes occur annually in the United States, with nearly 75% of these being first-time (incident) strokes.[1] The majority of stroke survivors return to their pre-stroke communities, but many struggle with social and community reintegration.[2,3] Given the increase in years lived-with-disability among stroke survivors and the increasing stroke rates among adults <55 years old,[1] stroke survivorship will continue to significantly impact survivors' and caregivers' quality-of-life (QOL), communities, and healthcare systems.

Transitional care focuses on continuity of care and preventing poor outcomes for vulnerable, chronically ill patients moving from one level of care to another (i.e. from hospital to home).[4] During the transition period, some stroke survivors experience multiple transitions between care settings,[5] persistent functional decline, persistent unmet educational needs,[6] poor access to rehabilitation care,[7] and negative social consequences.[8-11] Successful stroke transitions are challenging because they require coordinated care across healthcare systems, community services, and informal caregivers (i.e. family) to manage a wide variety of treatments, lifestyle changes, and other ongoing needs. Core components that contribute to successful care transitions include patient and caregiver engagement, education, well-being, complexity and medication management, care continuity, and accountability.[12] Unfortunately, current systems of care lack good, quality coordination and communication among providers, community services, and patients. Thus, the success of post-stroke transitions rely heavily on the survivor's ability to manage their own care and advocate for themselves. This responsibility can be daunting, especially in the face of post-stroke deficits and uncertainty over how to navigate their health care through an unknown recovery trajectory.

Interventions to improve transitional care have included providing case management across service settings, discharge planning, shared access to information, self-management tools, and creating care pathways to better organize care.[13] Self-management is defined as taking responsibility for one's behavior and well-being to achieve a desired level of quality-of-life.[14] By encouraging patients to take an active role in their health, self-management is a key element in successfully managing chronic disease, achieving improved health outcomes, and promoting positive quality of life.[15-17] As such, it is a common element embraced in transitional care programs. Despite recent efforts to improve stroke transitions,[18-20] heterogeneous interventions targeting and measuring a wide range of self-management constructs have resulted in inconsistent or modest treatment effects thus leaving much uncertainty about optimal evidence-based transitional care recommendations.

This thesis begins to address some of the current research gaps in stroke transitional care through a secondary analysis of the Michigan Stroke Transitions Trial (MISTT) data. MISTT is a randomized clinical trial (RCT) that aimed to improve quality-of-life (QOL) and patient activation during the in-home transitional care period by supporting stroke survivors with a social worker-led case management program and an online informational resource.[21] The goals of this analysis involved understanding indicators of self-management in stroke survivors, specifically, the association among four self-efficacy measures and patient activation in an acute stroke population, as well as factors that may confound or moderate these relationships.

The following background section will provide information about self-efficacy and patient activation, the primary outcomes of interest for this thesis, followed by the specific aims and hypotheses. These measures will be discussed in the context of self-management strategies for improving disease management and ultimately health outcomes, which are also general goals in achieving successful transitions of care. Keywords used to search the literature include self-efficacy, patient activation, self-management, transitions-of-care / transitional care, care management, case management, and stroke.

References from systematic reviews and empirical articles were also used to target related work and to help supplement the literature search. When available, stroke-related literature will be discussed, but literature from other populations is presented where stroke evidence is limited.

BACKGROUND

Self-management and Transitions of Care

Self-management is a key element for successfully managing chronic disease, achieving improved health outcomes, and promoting quality of life. It extends beyond physical health to address maintaining wellness through medical, behavioral, emotional, and social role management.[14,16,22] Self-management incorporates a range of cognitive-behavioral constructs such as patient activation, self-efficacy, locus of control, motivation, empowerment, and readiness to change.[23] Interventions designed to influence components of self-management often target problem-solving, decision-making, resource utilization, collaboration with providers, and taking action.[16] Much of the initial self-management work was done by Lorig and colleagues through a series of studies using Arthritis patients. This work led to the development of the Stanford Chronic Disease Self-Management program which aimed to improve self-management for individuals with multiple chronic conditions[24,25] and has been applied to many populations. Case management interventions often incorporate self-management strategies, which are applied across the spectrum of health care including acute settings, rehabilitation facilities, home-health care, and ambulatory practices. Many interventions targeted toward improving transitions of care incorporate case management strategies focused on facilitating services, improving communication, and improving self-management to equip patients to advocate for themselves.[12] As such, transitions of care, case management, and self-management overlap in their use of self-efficacy and patient activation concepts and measures. Despite recent efforts to improve disease management and transitions of care for a range of chronic disease conditions, heterogeneous interventions targeting and measuring a wide range of self-management constructs have resulted in inconsistent, transient, or modest effects.[14,26-28]

Evidence regarding stroke self-management interventions is still emerging, and stroke brings its own unique challenges.[18,29] Stroke surfaces as an acute health crisis but transitions into a chronic condition that requires action to prevent stroke recurrence and ameliorate stroke-related physical and mental impairments. Stroke survivors often have concurrent chronic conditions such as hypertension, diabetes, cardiac disease, atrial fibrillation, and pre-existing cognitive and physical limitations. As such, self-management among stroke patients is particularly complex and multidimensional with its scope extending beyond traditional physical rehabilitation goals.[15,30]

Self-efficacy and patient activation are two critical constructs that influence chronic disease self-management. Self-efficacy is a socio-cognitive construct[31] defined as "…the belief that one can carry out a behavior necessary to reach a desired goal, even when a situation contains unpredictable and stressful elements;"[32] it is a measure of confidence. Patient activation is a broader concept than self-efficacy but includes self-efficacy (i.e., confidence) as an important dimension of its overall construct.[33] In addition to confidence, patient activation considers an individual's knowledge and skill related to managing their general health and health care.[23]

Because self-efficacy is largely task or behavior specific,[31] various self-efficacy measures have been used across studies, making direct between-study comparisons difficult. Some studies evaluate the direct relationship between self-efficacy and patient activation,[34-47] but many of these only look at simple correlations between the two constructs.[34-40] Largely, however, the two constructs are analyzed separately[48-50] and many studies assess only one or the other. Thus, there remains a gap in understanding what factors influence the association between self-efficacy and patient activation. Among acute stroke populations, data are even more limited. Clarity around the relationship between self-efficacy and patient activation can offer insight into potential causal mechanisms and pathways between the two, which may help refine stroke self-management interventions as well as inform selection of measures as assessment tools or outcomes in both the clinical and research settings. This thesis aims to understand the correlations between self-efficacy (defined by four measures from the PROMIS Self-Efficacy for Managing Chronic Conditions domain) and the Patient Activation Measure

(PAM), determine what factors are associated with each measure, and to identify confounding and moderating factors of the self-efficacy and PAM relationship.

Self-efficacy and Stroke

Self-efficacy is an important, foundational construct contributing to successful disease management, health outcomes, and healthy behaviors.[51-55] The construct emerged in the late 1970's from Bandura's Social Learning Theory.[31] Self-efficacy has been a popular research topic within many chronic diseases and stroke. This section will discuss self-efficacy instruments specific to stroke as well as scales originally intended for other conditions that have been applied to stroke populations. Select studies are provided as detailed examples of how self-efficacy concepts have been applied to or measured within stroke; studies were chosen based on their relevance to self-management and transitions of care.

Self-efficacy plays an important role in determining outcomes, and Lorig's work with the Chronic Disease Self-Management program provided empirical evidence that self-efficacy mediates self-management outcomes.[24] Due to self-efficacy's role in self-management,[16] it has not only been a popular target for interventions, but has also been utilized as a study outcome and independent covariate. In a 2006 review, Jones[51] reported that studies of chronic disease self-management containing interventions that either targeted self-efficacy or designated self-efficacy as the primary outcome were limited in stroke but much more common for arthritis, diabetes, and chronic obstructive pulmonary disease (COPD). A follow-up review in 2011[15] identified 18 studies of self-efficacy and post-stroke rehabilitation outcomes, summarizing that self-efficacy is associated with better post-stroke QOL, perceived health status, activities of daily living, physical function (to some extent), and less depression. The evidence for stroke self-management interventions was limited to four studies that provided some support for stroke-specific self-management. Overall, the authors suggest self-efficacy as an important factor in determining post-stroke outcomes, but determined additional research is needed to determine optimal content and delivery for stoke-specific self-management interventions.

Many self-efficacy scales exist, often targeted toward measuring behaviors or tasks within a specific domain (e.g., getting into bed, walking outside, cooking, knowing when and how to take medications, etc.). Self-efficacy measured in one domain does not imply the same level of confidence for another conceptually distinct domain.[56] Some scales have been developed specifically for stroke while others were originally intended for different conditions but have been applied to stroke with varying levels of testing for validity and reliability. Among stroke survivors, instruments to measure self-efficacy for falls and balance have been developed, largely to serve the needs of stroke rehabilitation research.[15] Two additional scales provide a more general measure of stroke-specific self-efficacy. The Stroke Self-Efficacy Questionnaire (SSEQ, developed by Jones, Partridge, and Reid) includes two subscales related to post-stroke activity function and self-management,[56,57] while the Daily Self-Efficacy Scale (DLSES, developed by Maujean et. al.) focuses on self-efficacy related to post-stroke activities of daily living and psychosocial functioning.[58]

Examples of self-efficacy measures that were developed for non-stroke populations but have been applied to stroke include self-efficacy scales for exercise,[59] memory,[60] self-care, and [61] recovery.[62] To the author's knowledge, only the Exercise Self-Efficacy Scale underwent psychometric testing for validity in stroke patients.[59]

The Generalized Self-Efficacy (GSE) scale (created by Schwarzer and Jerusalem),[63] the Stanford Self-Efficacy for Managing Chronic Disease (SSE) (created by Ritter and Lorig),[24] and the Perceived Health Competence Scale (created by M Smith, Walltson, and C Smith)[64,65] were developed to address broader concepts of self-efficacy that could be applied to various conditions and populations. These have been used in stroke studies but have not undergone psychometric or validity/reliability testing for stroke.

To facilitate comparisons across different conditions and populations, the PROMIS (Patient Reported Outcomes Information System) and NeuroQOL (Neurologic Quality-of-Life) measurement systems were created. They contain a wide-range of domain-specific measures that can be applied to any health condition or population.[66] Recently, Gruber-Baldini et al.[32] validated five PROMIS measures in the domain of Self-efficacy for Managing Chronic Conditions: self-efficacy for managing medications and treatments, self-efficacy for managing daily activities, self-efficacy for managing emotions, self-efficacy for managing social interactions, and self-efficacy for managing symptoms. Their work involved 150 people with general medical conditions as well as a large population (n=837) with chronic neurologic conditions including epilepsy (n=171), multiple sclerosis (n=166), neuropathy (n=163), Parkinson's disease (n=170), and stroke (n=167). Among the four self-efficacy scales used in the MISTT study (self-efficacy for managing medications and treatments, daily activities, emotions, and social interactions),[21] Gruber-Baldini found that higher self-efficacy was associated with patient characteristics of being female, white, employed, higher annual income (>$60,000), and having fewer comorbidities.[32] Overall, these measures had good internal consistency and good cross-sectional validity; however, no published data yet exists for these new instruments outside the initial validation work.

Strategies for improving stroke-related self-management skills have been tested in a limited number of stroke survivors approximately 1-12 months post-stroke. The largest studies enrolled 210[67] and 203[62] survivors in randomized controlled trials, whereas, two of the feasibility studies were very small and only included 25[68] and 10[69] stroke survivors. Although all of these interventions were grounded in theories related to self-efficacy, they ranged in their delivery methods from including workbooks[68,69] to group[67,70] or individual sessions. Typically multi-domain self-efficacy outcome measures were used, but measures varied across studies and included some non-validated measures, such as the Stroke Self-Efficacy Questionnaire (SSEQ),[68,69,71] Stanford Self-Efficacy measure (SSE),[68,70] General Self-Efficacy scale (GSE),[69] self-efficacy for recovery,[62] and self-efficacy for illness management.[67] Additionally, a variety of other outcomes were measured, including but not limited to quality-of-life, social integration, physical function, self-care, and work productivity. Overall, this small exemplar of studies provide some evidence that self-management interventions have a positive, short-term effect on self-efficacy in stroke patients, however, the long-term impact remains uncertain. Likewise, questions remain about self-efficacy's role as a mediator between interventions and various post-stroke outcomes.

In summary, these studies show that self-efficacy is an important aspect of stroke self-management, however, clarity is still needed on optimal intervention components, delivery methods, timing of initiation, and duration. The literature for stroke self-management interventions and self-efficacy outcomes is still limited and difficult to compare due to its heterogeneity.

Patient Activation

Patient activation is another central concept in behavior-changing interventions and has served as a primary and independent outcome for self-management intervention studies. One systematic review summarized[26] "patient activating interventions" (i.e. interventions designed to increase activation) into nine core strategies involving problem-solving, audit and feedback, individualized care plans, peer support/family, lay health advisor/community health worker, psychological counseling, theory-based counseling, and skill building. These strategies heavily overlap with core self-management goals and strategies which have also been identified as core transitional care components.[12] Additionally, many of these strategies are also used to increase self-efficacy.

Patient activation, a relatively new construct formally introduced by Hibbard in 2004, brings together established socio-cognitive behavioral theories to explain changes in health behaviors and self-management. These established theories, including health locus of control, empowerment, self-efficacy, and readiness to change, were often studied in isolation in the context of understanding single behaviors. Alternatively, Hibbard combined concepts to define patient activation as an individual's knowledge, skill, and confidence for managing their general health and health care.[23] Thus, patient activation is a broader construct than any of the previous theories and includes self-efficacy as one of three important dimensions of activation.[33] To measure this global concept of activation, Hibbard developed the self-reported Patient Activation Measure (PAM) using a national expert consensus panel, patient focus groups, and pilot testing.[23] During the development phase PAM was tested among a nationally representative sample of US adults where 21% reported having one chronic condition and 58% reported having two or more chronic conditions. The original 22-item measure[23] was reduced to 13-items and validated within the same population.[72] Of these 13 items, six directly ask about the respondent's confidence for completing certain tasks (i.e. seeking medical care, communicating with providers, problem solving new health situations, etc.), suggesting a direct reference to self-efficacy. Despite these confidence-related questions, PAM has been shown to be a unidimensional measure and does not contain separate subscales for confidence, skills, or knowledge. Additionally, the developers did not identify individual items as addressing any of the three specific underlying constructs.

Patient activation is a construct in which individuals move successively and progressively through distinct activation stages that reflect increasing and improved capacity around knowledge, skill, confidence, and action.[23] Responses from the 13 PAM questions are transformed into a continuous score ranging between 0-100 with higher scores indicating higher levels of activation. Although continuous scores are recommended for tracking individual change, scores can also be categorized into four levels that describe the patient's activation stage, thus operationalizing the continuous score along the continuum of activation. The levels are assigned by a proprietary algorithm from Insignia Health, but Table 1.1 provides an example of cut-off values. PAM levels are useful for informing optimal delivery of personalized health care by allowing for targeted strategies and interventions that appropriately support the patient's particular activation stage (Table 1.1).

Fortunately, improved PAM scores have been achieved within all four activation levels (although the magnitude of change may not be as large for those within the two highest PAM levels), showing that even highly activated individuals are responsive to improvement[73,74] and should not be disregarded.

Changes of 5-points or more have been suggested as clinically meaningful changes, however, to the author's knowledge robust analyses to define minimally important differences have not been established.[75] Additionally, one randomized control trial among 479 chronic diseased individuals found mean latent activation growth trajectories over a six-month time period as being stable or increasing activation levels, independent of intervention effects.[27] The "increasing" class had higher baseline activation and was associated with greater increases in 14 of 18 health behaviors over a 6-month period. Although the stable class showed activation increases from baseline to 3-months, they also experienced significant decreases from 3-months to 6-months. However, more work is needed to identify group characteristics associated with trajectories of overall decreasing activation trajectories. Identifying patient characteristics for these different trajectories may help further inform care strategies and tailored interventions and may help explain ineffective interventions.[76]

Table 1. 1: Description of the Patient Activation Measure (PAM) levels

PAM Level (score range)[77]	**Activation capacity**	**Examples of tailored strategies for a Diabetes Coaching intervention**[78]
Level 1 (≤47)	Individuals are unaware of their role in their own health and lack personal resources to engage	Build self-awareness and understanding of behavior patterns
Level 2 (47.1-55.1)	Individuals have some knowledge but struggle to engage and are only able to set simple goals	Make small changes in existing behaviors (i.e. reduce meal portions, take the stairs at work, read nutrition labels)
Level 3 (55.2-67.0)	Individuals understand improved health requires self-management and are engaged in goal-setting and building self-management skills	Adopt new skills (i.e. add exercise routine) and develop problem-solving skills
Level 4 (≥67.1)	Individuals advocate for themselves and have adopted new behaviors but may struggle to maintain these changes in times of stress or change	Relapse prevention and skills to handle new or challenging situations

PAM has been validated in both chronically ill and healthy individuals.[23,74,79] PAM scores/levels can change (increase and/or decrease) over time[27,73,80] and circumstances regardless of the baseline level.

As reported in summaries by Hibbard, PAM has been used in for a variety of functions, including as a measure of individual patient progress, quality performance, research outcome, and intervention assessment tool.[33,78] Recently, PAM has even been shown as a strong predictor of future healthcare utilization and outcomes.[81,82] In addition to its use as an outcome measure, PAM has been recommended as an assessment tool to risk-stratify persons for appropriate levels of care by informing individualized care plans and aiding development of tailored interventions.[33,78,83] Favorable outcomes such as improved diastolic blood pressure, LDL cholesterol levels, compliance with immunization and drug recommendations, and decreased hospitalizations and emergency department visits have been achieved in chronic disease populations when intervention content, delivery methods, and intensity were tailored to the patient's baseline PAM level,[78] often while simultaneously considering disease severity and burden. Healthcare systems may benefit through this strategy by allocating highly skilled, specialized personnel or resources to those patients with lower PAM levels needing greater assistance while utilizing less specialized personnel and more independent strategies for those with higher levels of activation. Likewise, provider capacity for delivering effective patient-centered care can be measured by capturing longitudinal changes in PAM. Several clinical guidelines directly endorse the importance of activating patients to participate in management of chronic conditions, including lower back pain,[84] atrial fibrillation,[85] and diabetes.[86,87] In other conditions (i.e., asthma), guidelines have not directly addressed patient activation but do discuss the role of self-management, which implies a role for an active and engaged patient.

Despite the large quantity of patient activation literature, meta-analyses focused on patient activation are rare (n=1),[26] and reviews often conclude that studies are heterogeneous in populations, study designs, the application of patient activation, and outcome measures. A meta-analysis of 138 diabetes-related studies explored the effect of patient activating interventions, defined as an intervention targeted to increase patient motivation, confidence, or skills in disease self-management, on type-2 diabetes outcomes (e.g., A1c, blood pressure, cholesterol).[26] The authors found small treatment effects on a range of clinical outcomes, but quality of the evidence was low. They reported that interventions were poorly described and results were difficult to combine due to inconsistent outcomes reporting or measure variability.

Higher activation, as indicated by higher PAM scores or levels, has been associated with a multitude of improved health outcomes, disease-specific self-management behaviors, improved QOL, lower healthcare utilization, and healthy lifestyle behaviors such as exercise, nutrition, and non-smoking as reported in numerous studies and summaries.[26,27,33,72,74,77,79,88] Randomized trials have explored both patient activating interventions[26] and patient activation as an outcome across diverse populations, including chronic illness (diabetes, COPD, celiac disease, heart failure, obesity, hypertension, etc.), cochlear implant patients, mental health and illness, bone density screening patients, employees, older adults, and adolescents. Similar to previous summaries, patient activation trials were heterogeneous in target populations, conditions, and intervention core elements and intensity. Most trials designed with PAM as an outcome tested interventions involving self-management programs or tools/strategies to facilitate self-management skills or actions.[39,50,89-109] Results of treatment effect on patient activation are mixed, and almost twice the number of studies lacked evidence of a significant treatment effect[39,89,94-99,101-105,108,109] rather than provided evidence[90-93,100,101,106,107] of a significant treatment effect associated with PAM. In many studies, sample sizes were limited (<100 participants), which highlights the exploratory nature of this work. Of the six trials that had samples sizes great than 100, only two showed positive treatment effect on PAM.[100,106] Post-hoc evidence suggests that interventions were effective in participants with lower baseline PAM levels, particularly when the intervention was tailored to the patient's activation level.[94,99]

PAM has also been included in secondary analyses of RCTs, where associations of treatment group, outcomes, and patient characteristics have been explored in relation to baseline PAM and delta PAM (i.e., change in PAM scores/levels).[39,74-76,109] Three studies[39,74,109] demonstrated that delta PAM was not associated with or different by treatment group, thus additional analyses were conducted using a cohort approach. Lack of association with treatment group provides evidence that patient activation was not a significant mediating variable between the relationship of the trials' intervention and outcomes. Generally, higher baseline PAM scores/levels were associated with better outcomes for cross-sectional and longitudinal change, and lower baseline PAM was associated with larger increases in patient activation over time. Although results from these secondary analyses help advance the understanding of patient activation, they remain exploratory and should be confirmed by testing a-priori hypotheses in future studies.

Many studies have explored patient factors association with PAM. Evidence from observational and controlled trials shows that greater activation is often associated with higher education and income, however, PAM predicts outcomes better than sociodemographic factors.[35,72,79] Across studies, inconsistent relationships exist for age, gender, comorbidities, and perceived health status.[73,74,110-112] Disease severity and depression, both important stroke-related considerations, have been negatively associated with PAM.[111,112] Depression has consistently been associated with lower activation, which in turn affects the ability to endorse health behaviors.[27,111] In a neurological sample (excluding stroke) higher PAM scores were correlated with better physical and mental health status and lifestyle indexes that account for diet, alcohol consumption, smoking, physical activity, and stress level.[79] Across studies, better quality-of-life has been positively associated with activation,[27,79] although the direction of causality is still uncertain. Due to the lack of stroke-related studies, predictive characteristics for PAM still need to be explored within stroke survivors.

Given the complexity around understanding causality of patient activation with various health, mental health, and psychosocial patient factors, there is a wide range of methodologies and applications of patient activation and PAM that contribute to much heterogeneity across studies and results.

Unfortunately, this heterogeneity creates challenges for comparing study results and combining data for meta-analyses. In addition, the patient activation literature is challenging because patient activation is often an underlying component of self-management or case management interventions, however, literature around these topics may or may not directly address or assess patient activation.

Patient Activation and Stroke

Most of the previous patient activation work with PAM has been performed in chronic disease populations such as diabetes, COPD, cardiac disease, cancer, depression, and asthma, with some work among healthy individuals. Despite PAM's success in measuring patient activation within chronic disease populations, its utility for acute and chronic stroke is less understood with limited evidence.[50,113] To the author's knowledge, only two stroke-related studies have utilized PAM in the context of self-management or transitions of care.[50,113] Both studies were very small, exploratory studies with a maximum of only 20 stroke participants, which limits the generalizability and reliability of their results.

Kidd et al.[113] found 17 of 20 stroke survivors (within 6-months post-stroke) reported level 4 PAM scores, indicating that they were highly activated individuals. Those who scored lower than PAM level 4 also reported physical stroke-related deficits. Qualitative focus groups highlighted that even highly activated stroke survivors (PAM level 4) experience unmet needs that aren't necessarily reflected by their PAM scores. These findings suggest that more information is needed about using PAM as a post-stroke assessment tool to determine level of care, particularly for community-based transitional care interventions.

In the other small pilot feasibility study, Kersten et. al.[50] used mixed methods to explore the feasibility of implementing a goal-setting rehabilitation intervention among individuals with stroke or multiple sclerosis >6-months following their diagnosis. Participants in the intervention group had significantly higher PAM and self-efficacy scores (measured by the General Self-Efficacy scale and Stanford Self-

Efficacy scale) at 6- and 12-weeks after the first intervention session. However, the sample size was severely limited (n=10 stroke, n=10 multiple sclerosis) and no between- or within-group comparisons were made, thus limiting the reliability of the results.

In summary, PAM has been found to be a useful tool in addressing chronic disease self-management and health behaviors with its ability to measure a single construct that encompasses self-efficacy, readiness to change, and empowerment. However, more work is needed to understand the utility of PAM in stroke survivors across the changing landscape of acute and long-term recovery and transitional care.

Relationships between Patient Activation and Self-Efficacy

Despite the fact that self-efficacy is reflected in the conceptualization of patient activation, studies that directly measure the association between these two constructs are uncommon. A literature search including the search terms “self-efficacy” AND “patient activation measure” returned 42 results where only 25 studies actually collected data on both self-efficacy and PAM measures. Furthermore, only 15 of these 25 analyzed the association between self-efficacy and PAM. Studies that did analyze the association between self-efficacy and PAM did so in the context of testing the convergent construct validity of PAM and the measure’s psychometrics among new populations (Table 1.2) or in intervention or observational studies (Table 1.3).

Self-Efficacy and Patient Activation Measure (PAM) in PAM Construct Validity Studies

Interestingly, although confidence (i.e. self-efficacy) is an important concept within patient activation, Hibbard’s original construct validity testing of PAM did not address self-efficacy. Instead, health measures (8-item Short Form Health Survey [SF-8]), utilization rates (office visits, emergency visits, and hospitalizations), general preventative behaviors, (i.e., health lifestyle behaviors), disease-specific self-management behaviors, and consumeristic behaviors (seeking health information, being persistent with providers, using performance scores to inform health decisions) were addressed in the PAM development testing.[23,72] In subsequent studies, correlations between PAM and self-efficacy measures have been generated for evaluating the convergent construct validity of PAM, particularly when the measure was applied to different populations and translated to additional languages.[34-38,40] Convergent construct validity tests whether two measures that have related underlying theoretic concepts correlate in the hypothesized direction as an indication of how strongly the measures themselves are related.[114] Among six PAM validation studies, Pearson correlation coefficients describing significant ($p<0.05$), positive associations between PAM and various self-efficacy scales ranged from $r=0.21$ to 0.65 (Table 1.2). Studies that involved chronic disease populations produced generally weaker coefficients[36,37,40] compared to those that didn't target a chronic disease population.[34,35,38] These results contribute evidence to support self-efficacy as an underlying concept of the unidimensional activation construct of PAM across different populations. Studies that used the General Self-efficacy Instrument (GSE) suggest that the strength of association may vary slightly by population, i.e., correlations range from $r=21$ to $r=47$.

To date, no validation or psychometric testing of PAM has been conducted among stroke survivors, and none of the previous construct validity studies have utilized the PROMIS domains of Self-Efficacy for Managing Chronic Conditions. This thesis aimed to contribute to this gap of understanding by exploring the construct validity of PAM's self-efficacy dimension among a population of acute stroke survivors using four measures from the PROMIS Self-Efficacy for Managing Chronic Conditions domain.

Table 1. 2: Correlations between Self-Efficacy measures and the Patient Activation Measure (PAM) in studies testing PAM construct validity (n=6 studies)				
Author, year	**Self-Efficacy Measure**	**Measure description**	**Study Population**	**Correlation coefficient with PAM, p-value**
Brenk-Franz[34] 2013	General Self-Efficacy (GSE) scale	General perceptions of self-efficacy or optimistic belief in oneself utilizing the Perceived Self-Efficacy construct, unidimensional	German translation among primary care patients, n=508	r=0.43
Magnezi[35] 2014			Hebrew translation among a nationally representative Israeli sample, n=203	r=0.47
Moreno-Chico[36] 2017			European-Spanish translation among chronic disease population from a large primary care center, n=208	r=0.21
Ngooi[37] 2017	Stanford Self-Efficacy for Managing Chronic Disease (SSE) scale	Multidimensional scale measuring confidence in self-management behaviors, manage disease, and achieve outcomes	Singapore population of outpatient individuals with cardiac conditions recruited cardiac clinics, n=270	r=0.39
Skolasky[38] 2009	Self-efficacy to participate in physical therapy	This instrument was customized from the Arthritis Self-efficacy scale	Patients undergoing elective lumbar spine surgery for degenerative disease at an academic specialty hospital in the United States, n=283	r=0.65
Stepleman[40] 2010	Multiple Sclerosis Self-Efficacy scale (MSSE)	Two subscales assessing confidence in achieving specific functions and controlling aspects of multiple sclerosis	Progressive and relapsing Multiple Sclerosis patients recruited from a United States academic specialty center during routine visits, n=199	r=0.50 function: r=0.41 control: r=0.49

Self-Efficacy and Patient Activation Measure (PAM) in Interventional and Observational Studies

Patient activation and self-efficacy theories are often discussed within the context of both interventional and observational studies, but few have collected both self-efficacy and PAM measures together, and even fewer have studied the direct association of these measures. Only 9 of the 15 studies identified as assessing the association between PAM and self-efficacy measures did so in the context of an interventional or observational study (Table 1.3). This leaves an obvious gap in understanding the magnitude of how activation and self-efficacy relate to one another and what factors affect their contribution to health-related outcomes.

Table 1.3 includes a summary of interventional and observational studies that explore associations between self-efficacy and PAM. These studies are heterogeneous in designs, populations, and outcomes, including two secondary analyses of data from randomized clinical trials, a quasi-experimental design, and six observational studies. Some studies used self-efficacy and PAM measures as primary or secondary outcomes, others as independent variables, or to explore mediation or effect modification. Mean age of participants ranged from 46 to 70 years except for one study conducted among women of childbearing age where the mean age was 28 years.

In a sub-set of studies, self-efficacy and PAM had consistent moderate to strong associations in both bivariate and multivariable analyses (Table 1.3).[39,41-47,108] These studies involved different populations, and the PAM associations were established with both general and domain-specific self-efficacy measures (i.e., pain, depression self-care, preventing pregnancy, etc.). Within studies that evaluated change, both self-efficacy and patient activation increased longitudinally, however, two studies evaluating intervention effects associated with patient activation and self-efficacy produced mixed results of the intervention effect on self-efficacy and PAM.[41,44]

Two studies explored mediation or moderation effects of self-efficacy and patient activation. Evidence suggests that patient activation mediates the relationship between self-efficacy and self-management behaviors among heart failure patients.[44] Furthermore, the same study showed that patient activation mediated the association between self-efficacy and self-care behaviors but only at low levels of self-management knowledge. Similarly, another study found that, among surgical patients with degenerative lumbar disease, patient activation may mediate or confound the association between self-efficacy and physical therapy attendance.[42] Interestingly, there was no evidence that patient activation affected the association between self-efficacy and the patient's level of engaging in rehabilitation activities (as measured by the Hopkins Rehabilitation Engagement Rating Scale).

In summary, there is clear and consistent evidence of positive associations between various self-efficacy measures and patient activation. However, it is also clear there is great complexity in how self-efficacy, patient activation, interventions, and various outcomes are related and impact one another across different populations. Longitudinal studies are still needed to help clarify the temporal relationships between self-efficacy and patient activation and to understand how they are related to different outcomes. Despite the ambiguity of how self-efficacy and patient activation interact with one another to affect outcomes, the consistent positive association between these two constructs gives evidence that clearly one affects the other and intervening on both can create a positive effect.

Table 1. 3: Intervention and Observational studies assessing the association between Self-Efficacy and the Patient Activation Measure (PAM) (n=9 studies)

Author, year	PAM use	Self-Efficacy measure and use	Study Population	Study Design and Objective	Results assessing the relationship between PAM & Self-Efficacy
Ackermans[41] 2018	Primary outcome	Pain Self-Efficacy Questionnaire: independent variable	Patients with hip or knee osteoarthritis, n=142	Quasi-experimental study testing an intervention of incorporating feedback from patient-reported outcome measures (PROM) into treatment-option consultations	Pain Self-efficacy was correlated with PAM: r=0.40, p<0.001 Pain self-efficacy was associated with PAM in an adjusted multiple regression (β=0.023, p=0.001)
McCusker[39] 2016	Primary outcome, and Independent variable	Self-efficacy for depression self-care: Primary outcome, and independent factor	Primary care patients with ≥1 chronic condition and depressive symptoms, n=223	Secondary analysis of RCT testing the effect of coaching and a Toolkit to improve depression self-care	Self-Efficacy for depression self-care was correlated with PAM: r=0.51 at baseline (n=215) and r=0.67 at 6-mo (n-158)
Skolasky[42] 2008	Independent variable	Self-Efficacy to participate in physical therapy: covariate	Surgical degenerative lumbar spinal patients from an academic center, n=65	Prospective cohort to assess role of activation for physical therapy adherence	Increasing self-efficacy was associated with increasing PAM quartiles (ANOVA p<0.001)

Table 1. 3 (cont'd)					
Young[44] 2017	Mediating factor	Self-care confidence scale (Subscale C from the Self-care of Heart Failure Index, SCHFI): Independent factor	Rural heart failure patients, n=100	Secondary analysis of RCT testing the feasibility of a 12-week in-home intervention for improving self-management behaviors	PAM and self-efficacy were correlated 3-mo post-intervention (r=0.71, p<0.001) and were significantly associated (β=0.75, p<0.001). PAM mediated the effect of self-efficacy on self-management behaviors in patients with low self-management knowledge
Masterson Creber[43] 2017	Primary outcome	Kansas City Cardiomyopathy Questionnaire, self-efficacy sub-scale: Independent variable	Hospitalized heart failure patients, n=96	Prospective, cross-sectional study to determine if PAM was associated with patient-reported outcomes	Mean self-efficacy was higher for those with higher PAM levels (3&4) vs lower PAM levels (1&2): SE mean 70.6 vs 82.9, t-test p=0.012) Self-efficacy trended toward a significant association with PAM in adjusted multivariable regression (β=9.2, p=0.052)
Bello[45] 2016	Independent variable	Self-Efficacy for preventing pregnancy: Primary outcome	Low income women of child-bearing age recruited from a community health center n=112	Cross-sectional survey to determine the relationship between patient activation and self-efficacy in avoiding pregnancy	High levels of self-efficacy were associated with high levels of patient activation (chi-squared p=0.017) Adjusted logistic regression revealed consistent results (OR=3.13 [95% CI: 1.11-8.78], p=0.031)

Table 1. 3 (cont'd)					
Munce[46] 2016	Independent variable	Moorong Self-Efficacy Scale (MSES) - functional, social, leisure and vocational activities post-spinal cord injury: Covariate	Spinal cord injury survivors in Canada n=99	Cross-sectional survey to determine characteristics associated with depression	Self-efficacy and PAM were positively and moderately correlated (r=0.39, p<0.001) In multivariable regression with both self-efficacy and PAM as covariates, only self-efficacy was associated with depression
Gruber[47] 2014	Dependent variable	Pain Self-Efficacy Questionnaire: Independent variable	Orthopedic surgical patients with hand and upper extremity conditions n=112	Prospective longitudinal study to determine if patient activation is correlated with fewer orthopedic symptoms and less hand and upper extremity disability	Baseline self-efficacy and PAM were moderately correlated (r=0.37, p<0.01) and significantly associated in multivariable regression (β=0.29, p<0.01)
Eikelenboom[108] 2015	Construct validity	SeMas self-efficacy dimension included two questions from the Perceived Competence Scale	Primary care patients with chronic conditions n=204	Cross-sectional survey for validating the Self-management Screening tool (SeMas), a measure to identify barriers to self-management	The SeMas self-efficacy dimension was moderately correlated with PAM (r=0.42, p<0.01) and was associated in multiple linear regression (β=16.43, p<0.001)

RCT=randomized clinical trial

Summary

Self-efficacy and patient activation remain two important constructs related to successful self-management. Patient activation is intended as a broad measure of one's skill, knowledge, and confidence to self-manage one's own health. Self-efficacy, on the other hand, measures how confident one is in accomplishing a specific task or behavior, which may be grouped into domains and may or may not be disease-specific. Because self-efficacy is one of the underlying dimensions of patient activation there is an expected positive association between the two concepts. Although these two theories are often discussed in the context of self-management studies, analyses exploring the direct relationships between self-efficacy and PAM are less common, particularly among stroke survivors. This thesis aims to contribute to the stroke survivor self-efficacy and PAM literature by identify patient characteristics associated with four new self-efficacy measures from the PROMIS Self-Efficacy for Managing Chronic Conditions domain and PAM, as well as to explore direct relationships between self-efficacy and PAM through correlation and multivariable modeling. These results may progress the understanding of whether PAM, a broad activation measure, is a sufficient or appropriate measure to consider for stroke self-management intervention work or whether domain specific self-efficacy measures are more informative than PAM.

Aims and Hypotheses

The overarching goal of this thesis was to explore indicators of self-management, specifically the cross-sectional relationships between four measures from the PROMIS Self-Efficacy for Managing Chronic Conditions domain and the patient activation measure (PAM), as well as factors that may confound or moderate these relationships among a population of acute stroke patients. This goal was accomplished through the following aims:

<u>Aim 1:</u> Examine the convergent construct validity of PAM and self-efficacy, one of the core PAM components, by comparing the correlation between PAM (transformed) scores and four different

measures of PROMIS Self-Efficacy for Managing Chronic Conditions: 1) self-efficacy for managing medications and treatments; 2) self-efficacy for managing daily activities; 3) self-efficacy for managing emotions; and 4) self-efficacy for managing social interactions. Additionally, perform a sensitivity analysis to further evaluate the construct validity of PAM by examining three sets of PAM raw, untransformed scores – one including all 13 questions (PAM-F), one restricted to the 6 confidence-related questions (PAM-CR), and one restricted to the 7 remaining questions that exclude the confidence-related questions (PAM-nonCR).

I hypothesize that all four PROMIS self-efficacy measures will be significantly and positively correlated with PAM scores, however, self-efficacy for managing medications and treatments and for managing daily activities will have a stronger correlation with PAM scores than either self-efficacy for managing emotions or for managing social interactions. In the sensitivity analysis I hypothesize that correlations will remain significantly and positively correlated with PAM-F, PAM-CR and PAM-nonCR, but that the magnitude of PAM-CR will be larger than PAM-F and in turn the magnitude of PAM-F will be larger than PAM-nonCR .

<u>Aim 2:</u> Identify independent statistical associations (factors) between sociodemographic (i.e., age, sex, race, education), support (i.e., living alone, caregiver status, informational, emotional, instrumental), disease-related (i.e. stroke type and severity, hospital/rehabilitation length-of-stay, discharge destination, stroke risk factors, disability, emotional and behavioral dyscontrol), general health factors (i.e., quality-of-life, health status, depression), and study-related factors (i.e., treatment group, recruitment site) and PAM scores using a multivariable linear model.

I hypothesize that that education, acute rehabilitation (IPR) discharge destination (compared to home or subacute rehabilitation), better QOL, and greater perceived health status will be positively associated with PAM, while older age, post-stroke disability, and depressive symptoms will be negatively associated with PAM.

Aim 3: Identify independent statistical associations (factors) between sociodemographic (i.e., age, sex, race, education), support (i.e., living alone, caregiver status, informational, emotional, instrumental), disease-related (i.e. stroke type and severity, hospital/rehabilitation length-of-stay, discharge destination, stroke risk factors, disability, emotional and behavioral dyscontrol), general health factors (i.e., quality-of-life, health status, depression), and study-related factors (i.e., treatment group, recruitment site) and each of the four PROMIS self-efficacy measures using a multivariable linear model.

Likewise, I hypothesize that,

- H1: Education, perceived informational support, emotional support, discharge to acute rehabilitation (vs home or subacute rehabilitation), QOL, and perceived health status will be positively associated with the four PROMIS self-efficacy measures
- H2: Age, living alone, stroke severity, post-stroke disability, stroke risk factors, and depressive symptoms will be negatively associated with self-efficacy measures
- H3: Discharge destination, stroke risk factors, and post-stroke disability will be more strongly associated with self-efficacy for managing medications and treatment and for managing daily activities.
- H4: Living alone and depressive symptoms will be more strongly associated with self-efficacy for managing emotions and for managing social interactions.

Aim 4: Identify the independent relationships between each of the four different PROMIS self-efficacy measures and PAM score after controlling for confounding variables and testing for interaction effects involving each self-efficacy measure. Variables explored as confounders and effect modifiers will be informed by the results of Aim 2 and Aim 3.

I hypothesize that discharge destination, depressive symptoms, and QOL will be significantly associated with both PAM and self-efficacy in Aims 2 and 3 and will be explored confounders and effect modifiers. After controlling for the confounding variables of age, education level, discharge destination, depression, and QOL, I hypothesize that significant associations between each self-efficacy measure and PAM will remain, however, the magnitude of these associations will be attenuated (reduced). I also hypothesize that self-efficacy for managing emotions and social interactions will continue to have weaker associations with PAM than self-efficacy for managing medications and treatments and managing daily activities.

Regarding interaction effects, I hypothesize that no significant interaction effects will be detected with self-efficacy and each of the following factors – age, education, discharge destination, depressive symptoms, and QOL.

METHODS

Study Overview

The Michigan Stroke Transitions Trial (MISTT) was a pragmatic 3 armed- parallel design randomized clinical trial (RCT) that aimed to improve patient and caregiver outcomes related to the in-home transitional care experience.[21] MISTT tested usual care for acute post-stroke transitions against two other interventions: a social work case management program with or without access to the MISTT website, an online information and support resource. Details of the design and conduct of MISTT, including additional details about the intervention, can be found in the previously published MISTT protocol.[21]

This thesis work is a cross-sectional, secondary-analysis of MISTT data collected 7-days after patients returned home. It aims to 1) examine convergent construct validity of self-efficacy for the Patient Activation Measure (PAM); 2) identify sociodemographic, support, disease-related, general health, and MISTT study-related factors that are associated with PAM; 3) identify sociodemographic, support, disease-related, general health, and MISTT study-related factors that are associated with each of four PROMIS Self-efficacy for Managing Chronic Condition domains; and 4) identify factors that confound or moderate the relationships between each of the four PROMIS self-efficacy domains and PAM.

Study Design

MISTT, a pragmatic, open, randomized, 3-group parallel superiority clinical trial, tested whether social work case management alone or with a complementary online education and support intervention (MISTT website) was superior to usual care, and whether a cumulative response existed across the two intervention groups.

Study Setting and Time Frame

MISTT recruited 320 acute stroke subjects between January 2016 and July 2017 from three acute care hospitals in two regions of mid-Michigan: Sparrow Hospital (Lansing), St. Joseph Mercy Health System (Ann Arbor), and University of Michigan Health System (Ann Arbor). Two of the hospitals were comprehensive stroke centers (Sparrow, University of Michigan) and one a primary stroke center (St. Joseph). Data collection culminated in November 2017.

Participants

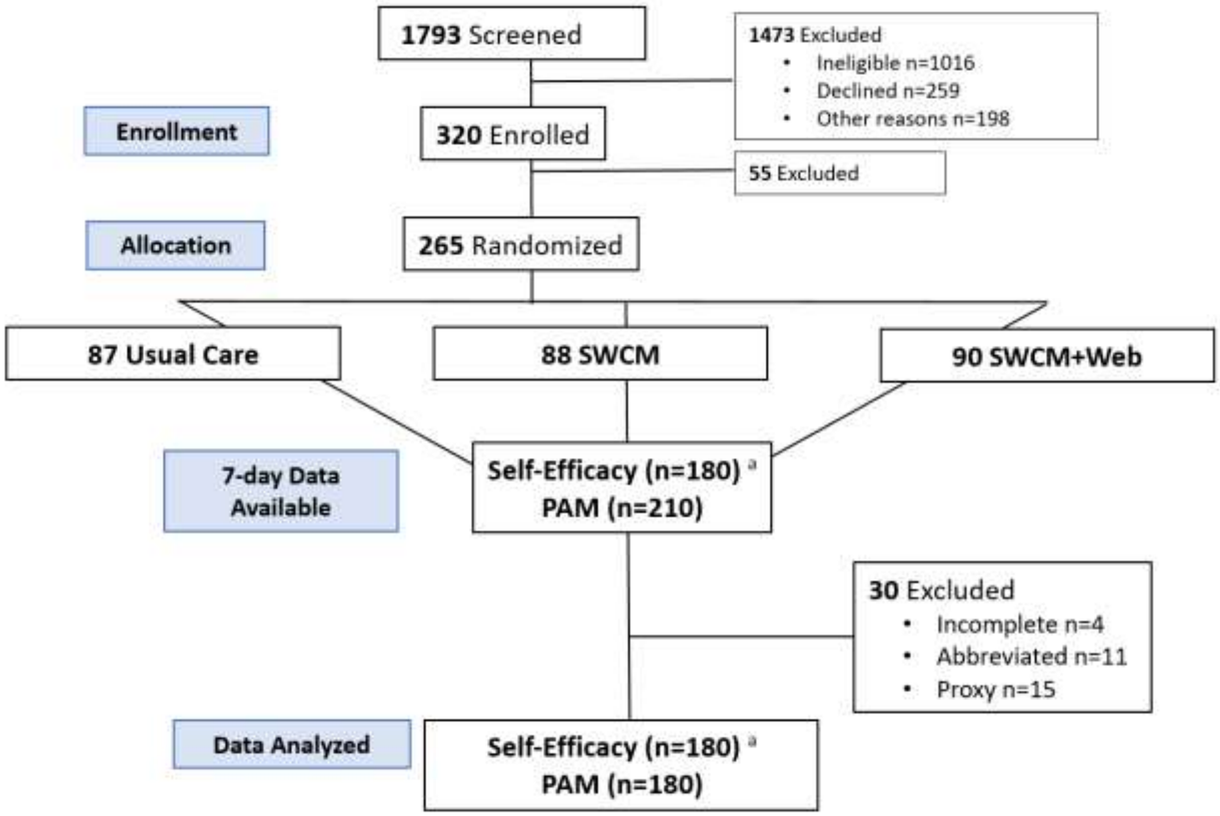
The MISTT target population was adult, acute stroke patients returning home within one month of hospital discharge. Patients were eligible to participate if they had a final confirmed hospital diagnosis of acute ischemic or hemorrhagic stroke, were living at home in the community prior to their stroke, and if they were either discharged directly home or were discharged to a rehabilitation facility but expected to return home within one month of hospital discharge (Table 2.1). Patients had to exhibit stroke-related symptoms upon admission (National Institute of Health Stroke Severity [NIHSS] score of >=1) and have functional deficits (Modified Rankin Score [mRS] >=1) or recommendations for post-discharge rehabilitative therapy upon hospital discharge. Patients were excluded if they lived greater than 50-miles from the hospital; were non-English speaking; discharged to hospice care or a facility for long-term care; did not have a proxy available for consent [if required due to a failed cognitive screen (Six-item Screener [SIS] score <=4), cognitive impairment or stroke-related deficits]; were enrolled in another acute stroke intervention trial that likely had significant impact on the post-acute period; life expectancy less than 6-months; or had a significant medical comorbidity likely to impact completion of the study (e.g. metastatic cancer, end-stage renal failure, etc.). Participants were recruited by hospital study coordinators and research assistants who were trained in MISTT recruitment and enrollment protocols.

Table 2. 1: Study Patient Inclusion and Exclusion Criteria
Patient Inclusion Criteria: i) A final confirmed hospital diagnosis of acute stroke (ischemic or hemorrhagic). ii) Patient living at home pre-stroke. iii) Presence of stroke-related deficits at admission (defined as a National Institute of Health Stroke Severity score of >=1). iv) Presence of functional limitations at discharge (defined as a modified Rankin score [mRS] score of >=1 or therapy ordered). v) Discharged directly home (includes patient's residence or that of a family member), or discharged to a rehabilitation facility with the expectation of return to home within 4 weeks Patient Exclusion Criteria: i) Patients who live more than 50 miles from the hospital (for reasons related to the home visits). ii) Patients discharged to hospice care, nursing home for long term care, or long term care hospital (LTCH). iii) Patients who have clinically documented cognitive deficits or stroke-related impairments including aphasia sufficient to impact the consent process and for whom a proxy respondent is not available. iv) Patients who fail the 6-item Cognitive Screen for cognitive function (score <=4) and for whom a proxy respondent is not available. v) Patients enrolled in another acute stroke intervention trial that has a significant impact on the post-acute period (i.e., intensive data collection required of patient during follow-up). vi) Limited life expectancy (< 6 months) or significant medical comorbidity likely to impact completion of the study (e.g., severe mental illness, drug or alcohol abuse, metastatic cancer). vii) Does not speak English. viii) Completed abbreviated or proxy interview[a]

[a] Specific to thesis study criteria

The MISTT study enrolled 320 acute stroke patients (Figure 2.1). Of 1,793 patients screened, 1,016 (57%) were excluded because they did not meet eligibility criteria. Primary reasons for ineligibility involved patients not returning home or an expectation that they would not return home within four weeks of discharge to a rehabilitation facility (n=247, 24%), lack of stroke symptoms upon admission (National Institute of Health Stroke Scale [NIHSS] <1) (n=223, 22%), significant comorbidity likely to interfere with study follow-up (n=164, 16%), and lack of functional deficit upon acute hospital discharge (Modified Rankin Score [mRS] <1 or no rehabilitation services recommended) (n=154, 15%), final diagnosis not stroke (n=76, 8%), and other reasons (n=152, 15% - not living at home or within 50 miles of the recruitment hospital, life expectancy <6-months, and non-English speaking) (Circ CVO paper in press).

Among the 777 patients who were eligible 259 (33%) declined participation, and 198 (25%) did not make a decision about study participation before they were discharged; this resulted in a consent rate of 41.2% [320/777] (Figure 2.1). Randomization of treatment assignment did not occur until the patient returned home, thus 55 consented patients were excluded before randomization, largely due to rehabilitation stays that extended beyond 1 month. A total of 265 patients were randomized: 87 to group 1, 88 to group 2, and 90 to group 3 (Figure 2.1).



[a] Except Self-efficacy for managing social interactions (SEMSI) n=178

Figure 2. 1: MISTT Patient Participant Flow Diagram

Treatment Group Allocation and MISTT Interventions

On the day of discharge to home (either from acute hospitalization or from a rehabilitation stay), patients were randomized to one of the three treatment groups 1) Usual Care, 2) Social Work Case Management (SWCM) program, or 3) SWCM program plus MISTT website access.

The SWCM program was delivered by Masters-level trained social workers who contacted patients within 24-48 hours after returning home to schedule an in-home biopsychosocial assessment. On average, assessments were completed within 9 days of returning home (SD=9.2, median=6 days IQR=4, 12), at which time those assigned to the MISTT website also received their website training and orientation. Minimal intervention activities occurred before the assessment visit, but were intended to identify, address, and support the many psychosocial needs that stroke survivors experience during their in-home transition. Details of the SWCM intervention were previously published.[115]

In-hospital Data Collection

Basic demographic data, contact information, and clinical data were collected from the medical record for consented patients. Clinical data included admission date, stroke type, pre-stroke function and ambulatory status, stroke severity (NIHSS or Glasgow Coma Score [GCS]), discharge dates and destination(s), history of stroke-related risk factors (i.e., history of transient ischemic attack [TIA], stroke, myocardial infarction, hypertension, atrial fibrillation, diabetes, coronary artery disease, hyperlipidemia, depression, smoking status, and heavy alcohol use), stroke symptom duration, in-hospital acute stroke treatment(s), major hospital complications, discharge modified Rankin Score (mRS), discharge destination (home, in-patient rehabilitation facility [IRF], skilled nursing facility [SNF]) as well as recommendations for out-patient rehabilitation or home health care. Finally, a complete copy of the discharge summary was obtained which included a comprehensive medication list. Additional self-reported patient characteristics collected during the 7-day outcomes interview included marital status, education level, living arrangements, history of pre-stroke depression, and pre-stroke ambulatory status.

Outcomes Data Collection

MISTT patient-reported outcomes were collected via telephone interview 7-days and 90-days after patients returned home either directly from their acute stroke hospitalization or following a rehabilitation stay (Figure 2.2).[21] Outcomes were collected for all treatment groups and were completed independently from the SWCM program assessments. Measurement domains were informed by stakeholder focus groups, and measures were chosen after extensive review of available instruments relevant to post-stroke functional recovery, disability, handicap, and quality-of-life (QOL). Validated, psychometrically robust PROMIS (Patient-Reported Outcomes Measurement System) and Neuro-QOL (QOL in Neurological Disorders) measures were chosen for their ability to compare results across diseases, conditions, and settings as well as for their flexibility in creating custom short forms and utilizing Computer Adaptive Testing (CAT) methods to reduce responder burden.[66,116,117] MISTT primary outcomes included PROMIS Global-10 Quality-of-Life physical health and mental health subscales and the Patient Activation Measure (PAM). Secondary outcomes included depressive symptoms (PHQ-9), NeuroQOL anxiety, hospital readmissions and emergency department visits, stroke recurrence, and 90-day home time.[21]

Trained research assistants conducted calls from a toll-free study phone number. For the 7-day interview, each participant had a 15-day window that they were eligible for data collection (days 5-21), after which time the interview was regarded as missing. On average, 4 calls were required to successfully complete an interview, which occurred an average of 11 days (SD=5.7, median=9 days IQR= 7.0, 13.5) after returning home.

Full patient interviews took approximately 40 minutes to complete, but abbreviated or proxy interviews were offered as alternatives for patients who were unable or unwilling to complete the full interview. The alternative interviews contained the primary RCT outcome measures (PROMIS Global-10 QOL and PAM) but drastically reduced interviewer time and burden by excluding many of the other measures.

Reasons for missing interviews were documented based on known information and categorized as no contact (i.e., never answered), refused to complete the interview (e.g., too busy or uninterested, or health-related reasons (e.g., readmission). Withdrawals from follow-up were confirmed or clarified with social workers, hospital staff, or patients/caregivers as needed and then finalized by the project manager. Patients wishing to withdraw from the study intervention (SWCM or SWCM+Web) were asked permission to be contacted for outcomes data collection.

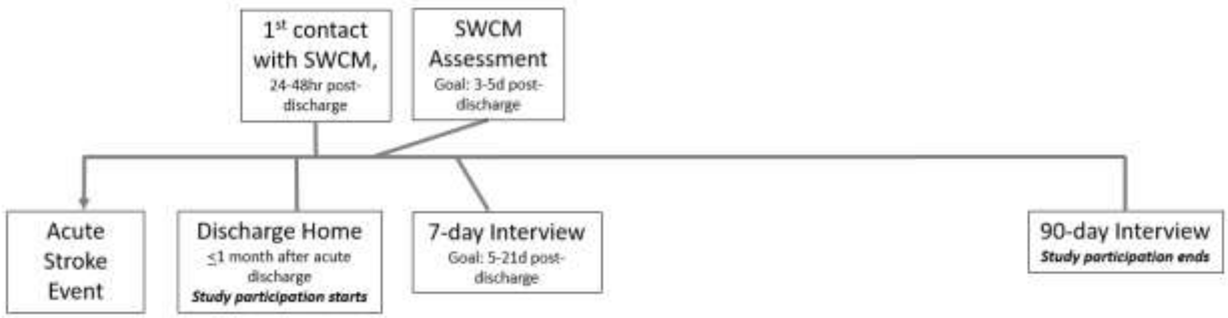


Figure 2. 2: MISTT study timeline

Thesis Data Sources and Outcome

This secondary analysis utilized cross-sectional data collected at the 7-day interview along with patient characteristics collected from medical records during the acute hospitalization (Table 2.2). Since the focus was on outcomes collected at the beginning of the intervention period, treatment group effects were not assessed. In addition to MISTT criteria, patients who completed abbreviated or proxy versions of their 7-day outcomes interviews were excluded because these alternative interviews did not contain the PROMIS self-efficacy measures utilized in this analysis.

Table 2. 2: MISTT Outcome Measures utilized in a cross-sectional, secondary analysis of self-efficacy and patient activation

	Variable type	Number of questions	Data collection source
OUTCOMES			
Patient Activation Measure (PAM)	Continuous transformed sum score and raw sums	13	7-day interview
Self-efficacy for managing medications and treatment	Continuous T-score	5	7-day interview
Self-efficacy for managing daily activities	Continuous T-score	CAT,[a] mean 4-6	7-day interview

Table 2. 2 (cont'd)			
Self-efficacy for managing emotions	Continuous T-score	CAT, mean 4-6	7-day interview
Self-efficacy for managing social interactions	Continuous T-score	4	7-day interview
SOCIODEMOGRAPHIC DOMAIN VARIABLES			
Age	Continuous years	n/a	Hospital medical record
Sex	Binary: male, female	n/a	Hospital medical record
Race	Binary: white, non-white	n/a	Hospital medical record
Education level	Categorical: High school or less, some college, college degree	1	7-day interview
SUPPORT DOMAIN VARIABLES			
Living alone	Binary: yes, no	1	7-day interview
Caregiver consented to MISTT	Binary: yes, no	n/a	Hospital medical record
PROMIS Informational support	Continuous T-score	4	7-day interview
PROMIS Emotional support	Continuous T-score	4	7-day interview
PROMIS Instrumental support	Continuous T-score	4	7-day interview
DISEASE DOMAIN VARIABLES			
Stroke type	Binary: ischemic, hemorrhagic	n/a	Hospital medical record
Stroke severity[b]	Categorical: mild, moderate, severe	n/a	Hospital medical record
Stroke risk factors[c]	Categorical: no risk factors, 1 factor, $\geq$2 factors	n/a	Hospital medical record
Discharge destination	Categorical: home, in-patient rehab (IPR), subacute rehab (SAR)	n/a	Hospital medical record
Cumulative length-of-stay[d]	Continuous days	n/a	Hospital medical record
Self-reported post-stroke disability, simplified modified Rankin Score (s-mRS)	Binary: mild (score $\leq$2), moderate/severe (3-5)	1-4	7-day interview
Neuro-QOL emotional and behavioral dyscontrol	Continuous T-score	CAT, mean 4-6	7-day interview
GENERAL HEALTH DOMAIN VARIABLES			
Depressive symptoms, Patient Health Questionnaire (PHQ-9)	Continuous sum score	9	7-day interview
quality-of-life (PROMIS Global-10 QOL, global02)	Continuous raw score	1	7-day interview
Perceived health status (PROMIS Global-10 QOL, global01)	Continuous raw score	1	7-day interview

Table 2. 2 (cont'd)			
MISTT DOMAIN VARIABLES			
Recruitment site	Categorical: Sparrow, St. Joseph, University of Michigan	n/a	Hospital medical record
Randomization treatment group	Categorical: Usual Care, SWCM, SWCM+Web	n/a	Hospital medical record

[a] Computer Adapted Testing
[b] Mild: NIHSS=1-5 or GCS=13-15, Moderate: NIHSS=6-13 or GCS=5-12, Severe: NIHSS=14-42 or GCS=3-4
[c] Factors include history of transient ischemic attack [TIA], stroke, myocardial infarction, hypertension, atrial fibrillation, diabetes, coronary artery disease, and hyperlipidemia
[d] Calculated by subtracting the stroke admission date from the discharge to home date. This reflects the total time hospitalized and in an acute or subacute rehabilitation facility, if applicable.

Patient Characteristics

Patient demographic, clinical, and psychosocial characteristics were grouped into five domains: sociodemographic characteristics, perceived support, disease-specific characteristics, general health characteristics, and MISTT study variables (Table 2.2). Sociodemographic information consisted of age (continuous), sex (male, female), race (white, non-white), and education level (high school or less, some college, college degree) which was used as a proxy for socioeconomic status. Several variables were grouped into a support domain that represented different types of social support the patient perceived having or potentially had access to. These variables included living alone (binary), whether the patient has a caregiver who consented to the MISTT study (binary), and perceived informational, emotional, and instrumental support (continuous). Perceived support was measured using three PROMIS support instruments - informational support (short form 4a),[118] emotional support (short form 4a),[119] and instrumental support (custom short form)[120] – which measure support provided by others as resources of helpful information or advice, being cared for and valued, and providing practical help, respectively. Continuous T-scores, with higher scores indicating more perceived support as measured by PROMIS instruments, were standardized to a mean of 50 (SD=10) using a general population. Table 2.3 reports the description and exact questions for each measure.

Table 2. 3: PROMIS Support short forms[a]
PROMIS Informational Support, short form 4a – measures perceived availability of helpful information or advice[118]
1. I have someone to give me good advice about a crisis if I need it. 2. I have someone to turn to for suggestions about how to deal with a problem. 3. I have someone to give me information if I need it. 4. I get useful advice about important things in life.
PROMIS Emotional Support, short form 4a – measures perceived feelings of being cared for and valued[119]
1. I have someone who will listen to me when I need to talk. 2. I have someone to confide in or talk to about myself or my problems. 3. I have someone who makes me feel appreciated. 4. I have someone to talk with when I have a bad day.
PROMIS Instrumental Support, custom short form – measures perceived availability of assistance with material, cognitive, or task performance[120]
1. Is someone available to help you if you need it? 2. Do you have someone to take you to the doctor if you need it? 3. Do you have someone to help you with your daily chores if you are sick? 4. Do you have someone to run errands if you need it?

[a] Response options: 1=never, 2=rarely, 3=sometimes, 4=usually, 5=always

Disease-related variables included stroke type (ischemic, hemorrhagic), stroke severity (mild, moderate, severe based on NIH-Stroke Scale [NIHSS] or Glasgow Coma Scale [GCS]), stroke risk factors (no risk factors, one, or greater than two), discharge destination (home, in-patient rehabilitation [IPR], or subacute rehabilitation [SAR]), cumulative length-of-stay (sum of acute hospitalization and rehabilitation stay, continuous), and 7-day self-reported measures of post-stroke disability measured by the simplified modified Rankin Score (s-mRS, binary) and Neuro-QOL emotional and behavioral dyscontrol (continuous). Stroke severity was categorized as mild if NIHSS=1-5 or GCS=13-15, as moderate if NIHSS=6-13 or GCS=5-12, and as severe if NIHSS=14-42 or GCS=3-4. The NIHSS is a 15-item measure of stroke severity ranging from 0-42 with higher scores indicating more severe stroke.[121] NIHSS assesses the severity/intensity of deficit in different areas affected by stroke including ataxia, aphasia, limb weakness, visual deficits, etc. and is commonly used in clinical practice, especially for suspected ischemic stroke cases. The GCS is a scale to assess trauma and may be used in cases with suspected hemorrhagic stroke. GCS ranges from 3-15 with higher scores indicating less severity.[122] Both the NIHSS and GCS are performed by clinicians or other trained staff. Stroke risk factors served as proxy for a comorbidity index and was created by categorizing if the patient had confirmed history of any of the following stroke risk factors: transient ischemic attack [TIA], stroke, myocardial infarction, hypertension, atrial fibrillation, diabetes, coronary artery disease, or hyperlipidemia. The number of confirmed stroke risk factors was counted (range 0-8) and categorized into 0, 1, or ≥2 factors. Cumulative length-of-stay was calculated by subtracting the index stroke admission date from the date the patient discharged home (from either their acute hospitalization or rehabilitation stay). The s-mRS is validated measure used to assess post-stroke functional status.[123] Responses are scored 0-5 on an ordinal scale with higher scores indicating worse function. For this analysis scores were dichotomized into levels of mild=≤2 or moderate/severe=3-5. Neuro-QOL emotional and behavior dyscontrol is a measure of emotional lability, irritability, disinhibition, and impulsiveness that was administered using CAT methods.[124] Continuous T-scores were standardized to a clinical population (mean=50, standard deviation=10) with higher T-scores indicating more dyscontrol.

General health variables included current depressive symptoms measured by the PHQ-9 (continuous), quality-of-life [QOL] (a single item question from PROMIS Global-10 QOL [global02], continuous), and perceived health status (a single item question from PROMIS Global-10 QOL [global01], continuous). The Patient Health Questionnaire (PHQ-9)[125,126] is a commonly used validated 9-item instrument measuring severity of depression symptoms using a four-point Likert scale. Response items were summed (range 0-27) with higher scores indicating more depressive symptoms.[127] QOL and perceived health status are two single-item questions from the PROMIS Global-10 QOL measure.[128] Responses to both the QOL question (global02) "*in general, would you say you say your quality of life is"* and the health status question (global01) "*in general, would you say your health is"* span from poor to excellent (score 1-5, respectively) with higher scores reflecting better QOL and health status. Rather than T-scores, raw scores ranging from 1-5 were generated from Likert response scales with higher scores indicating better QOL and health status.

MISTT variables included recruitment site (Sparrow, St. Joseph, University of Michigan) and randomized treatment group (UC, SWCM, SWCM+MISTT Website).

Outcome Measures

In this analysis, PAM served as the primary, dependent variable for Aims 1, 2, and 4. PAM is a 13-item measure of global activation that evaluates the ability to self-manage one's own health through concepts of skill, knowledge, and confidence (Table 2.4).[72] Patient activation is an important construct in successful chronic disease self-management and patient engagement. Five-point Likert response options were converted into a scale ranging from 0-100 using a proprietary algorithm (https://www.insigniahealth.com/account/login). Validation work has shown average PAM scores around 62 and standard deviation of 13 with a five-point change thought to represent meaningful clinical change.[75] In addition to the transformed scores, raw sums (range 13-52) were used in a construct validity sensitivity analysis between self-efficacy and PAM (Aim 1) because the algorithm that produces transformed scores auto-calculates values for missing questions which prevents the ability to obtain a transformed score that only represents a subset of questions. Thus, raw sums were calculated for the full 13 PAM questions (PAM-F) as well as two restricted sums: PAM-CR sums included only six confidence-related questions while PAM-nonCR sums included the remaining seven questions that did not directly address confidence (Table 2.4). Responses were re-coded to ensure higher raw sums reflected higher levels of activation.

Table 2. 4: Patient Activation Measure[a]		
PAM-13 Questions	**PAM-CR**	**PAM-nonCR**
1. When all is said and done, I am the person who is responsible for taking care of my health.		X
2. Taking an active role in my own health care is the most important thing that affects my health.		X
3. I am confident I can help prevent or reduce problems associated with my health.	X	
4. I know what each of my prescribed medications do.		X
5. I am confident that I can tell whether I need to go to the doctor or whether I can take care of a health problem myself.	X	
6. I am confident that I can tell a doctor concerns I have even when he or she does not ask.	X	
7. I am confident that I can follow through on medical treatments I may need to do at home.	X	
8. I understand my health problems and what causes them.		X
9. I know what treatments are available for my health problems.		X
10. I have been able to maintain (keep up with) lifestyle changes, like eating right or exercising.		X
11. I know how to prevent problems with my health.		X
12. I am confident I can figure out solutions when new problems arise with my health.	X	
13. I am confident that I can maintain lifestyle changes, like eating right and exercising, even during times of stress.	X	

[a] Response options: 1=strongly agree, 2=agree, 3=disagree, 4=strongly disagree, 5=n/a

Four different self-efficacy instruments, which measure a range of self-management behaviors and activities, served as the main independent variables for Aims 1 and 4 of this thesis analysis as well as the main dependent outcome for Aim 3. These measures come from the PROMIS Self-Efficacy for Managing Chronic Conditions domain and include: 1) self-efficacy for managing medications and treatments, 2) self-efficacy for managing daily activities, 3) self-efficacy for managing emotions, and 4) self-efficacy for managing social interactions (Table 2.5). Five-point Likert response options (ranging from 1=I am not confident at all to 5=I am very confident) were converted into a T-score that has been standardized among a chronic disease population to a mean T-score of 50 and standard deviation of 10 using the HealthMeasures Scoring System (https://www.assessmentcenter.net/ac_scoringservice).[32] Two of the instruments, self-efficacy for managing daily activities, and self-efficacy for managing emotions were administered using a computer adaptive testing (CAT) method. CAT minimizes respondent burden by utilizing questions most applicable to the individual respondent; CAT pulls questions from the entire item bank (35 in self-efficacy for managing daily activities and 25 in self-efficacy for managing emotions[119]), but typically administers an average of 4-6 questions per participant. Since question selection is based on the answer to the previous question, the specific questions used varies between individuals; example items are shown in Table 2.6 and the full bank of questions are included in Appendix A and Appendix B. Self-efficacy for managing medications and treatments was a 5-item custom short form while self-efficacy for managing social interactions was a 4-item custom short form, taken from item banks consisting of 26 and 23 items, respectively (Table 2.6). Custom short forms were chosen because CATs were unavailable at the time of measurement selection, and it allowed the selection of questions that were most relevant to the intervention goals.

Table 2. 5: Self-efficacy concepts addressed in each of four self-efficacy outcome measures from the PROMIS Self-Efficacy for Managing Chronic Conditions domain

PROMIS Self-Efficacy instruments	**Assessment of**
Self-Efficacy for managing medications and treatment (SEMMT)	Confidence in managing different levels of medications and treatments in everyday and challenging situations
Self-Efficacy for managing daily activities (SEMDA)	Confidence in performing ADL and IADLs without assistance along with activities such as exercise, travel, and managing things in the face of challenging situations
Self-Efficacy for managing emotions (SEME)	Confidence to manage symptoms of anxiety, depression, helplessness, discouragement, frustration, disappointment, and anger
Self-Efficacy for Managing Social Interactions (SEMSI)	Confidence participating in social activities, seeking help, and communicating with peers and healthcare professionals

Table 2. 6: PROMIS Self-Efficacy custom short forms and examples from CAT item banks[a]
PROMIS Self-Efficacy for Managing Medications and Treatments (SEMMT), custom short form
1. Current level of confidence I know when and how to take my medications 2. Current level of confidence I can find information to learn more about my treatment 3. Current level of confidence I can get help when I am not sure how to take my medicine 4. Current level of confidence I can follow a full treatment plan (including medication, diet, physical activity) 5. Current level of confidence I can list my medications, including the doses and schedule
PROMIS Self-Efficacy for Managing Daily Activities (SEMDA), example CAT items
1. Current level of confidence I can go shopping and run errands 2. Current level of confidence I can manage my clothes when I use the toilet 3. Current level of confidence I can walk around inside my house 4. Currently level of confidence I can maintain a regular exercise program
PROMIS Self-Efficacy for Managing Emotions (SEME), example CAT items
1. Current level of confidence I can handle negative feelings 2. Current level of confidence I can find ways to manage stress 3. Current level of confidence I can avoid feeling discouraged 4. Current level of confidence I can keep emotional distress from interfering with things I want to do
PROMIS Self-Efficacy for Managing Social Interactions (SEMSI), custom short form
1. Current level of confidence I have someone to help me plan and make decisions related to my illness 2. Current level of confidence I can keep in touch with family and friends 3. Current level of confidence I can ask for help when I don't understand something 4. Current level of confidence I can maintain my usual social activities

CAT = computer adaptive testing
[a] Response options: 1=I am not confident at all, 2=I am a little confident, 3=I am somewhat confident, 4=I am quite confident, 5=I am very confident

Analytical and Statistical Approaches

Data were collected in REDCap[129] and exported to SAS 9.4 for data preparation and analyses. Responses from PROMIS and Neuro-QOL measure that were not collected using CAT methods were submitted to the HealthMeasures scoring center to obtain T-scores and standard errors. Likewise, raw PAM data were submitted to Insignia Health to obtain transformed PAM scores.

Aim 1 involved exploring the convergent construct validity of PAM related to self-efficacy, which tests if the primary measure (PAM) actually measures one of the underlying constructs that it claims to measure (self-efficacy). First, scatterplots were generated to ensure utilizing a Pearson correlation method was appropriate. Pearson correlation coefficients (r-values) were then generated to test the strength of the linear association existing between PAM and each of the four PROMIS self-efficacy domains - managing medications and treatments, managing daily activities, managing emotions, and managing social interactions. Correlations were considered significant at $p<0.05$, thereby rejecting the null hypothesis that the two outcomes are not related (H_0: r=0), and classified as strong, moderate, or weak if r-values were >0.6, 0.4-0.6, or <0.4, respectively. A sensitivity analysis was performed to further understand if the six PAM questions that addressed one's "confidence" accounted for the hypothesized positive correlations between self-efficacy and PAM; Pearson correlation coefficients were generated for each self-efficacy measure using the raw sums for PAM-13 (i.e., all PAM questions), PAM-CR (a restricted sum only including six confidence-related questions), and PAM-nonCR (a restricted sum excluding the six confidence-related questions).

Aim 2 and Aim 3 both involved a staged approach to building multivariable linear regression models to explore sociodemographic, support, disease-related, general health, and MISTT study factors associated with PAM and self-efficacy, respectively (Table 2.2, Figure 2.3). The dependent variable for Aim 2 was the transformed PAM score, while the dependent variables for Aim 3 were each of the four PROMIS self-efficacy measure T-scores. First, bivariate associations between individual variables from the sociodemographic, support, disease, general health, and MISTT domains (Table 2.2) and each dependent variable were assessed using simple linear regression. Variables with significant bivariate associations of $p<0.1$ were then entered into a single multivariable domain-specific sub-model (i.e. one model per domain) for their associated domain. Additionally, age and education were identified a-priori as important factors to consider in relation to self-efficacy and patient activation and were forced into the sub-models regardless of their significance. Variables that remained significant ($p<0.05$) in the domain-specific multivariable sub-models were carried forward and combined into a full multivariable model for each outcome measure. A final parsimonious multivariable model was determined using backward stepwise selection where variables no longer significant were dropped one at a time in order of least significance, i.e. largest p-value first (Figure 2.3). Point estimates, explained variance (R^2), degrees of freedom, and the type 3 p-value were reported for each domain-specific sub-model and the final model of each outcome.

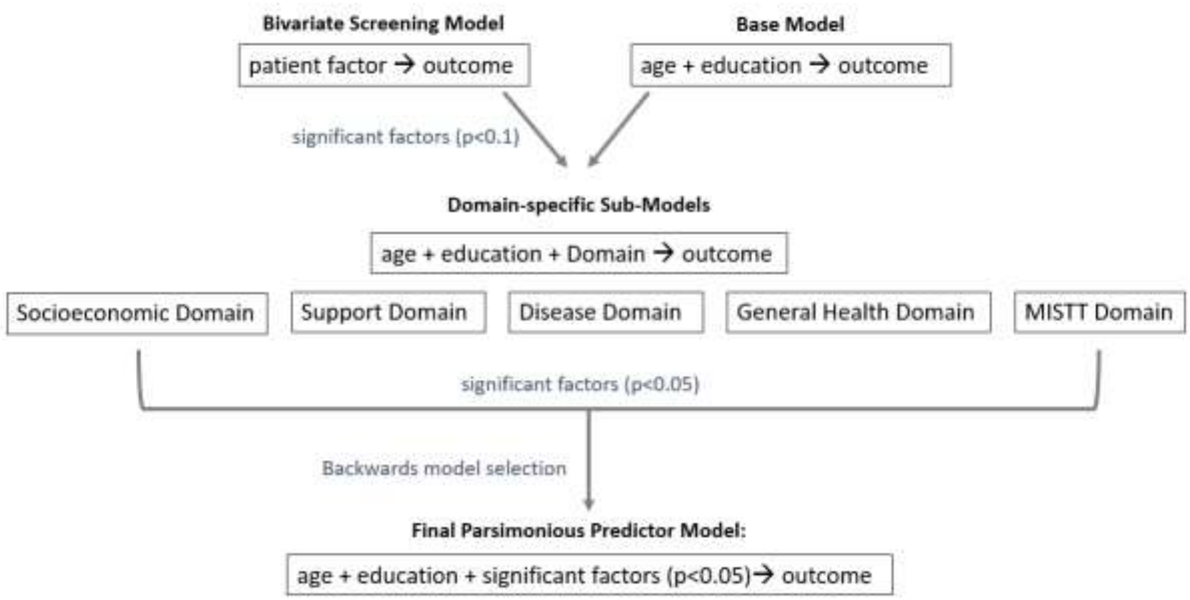


Figure 2. 3: Model building strategy for determining parsimonious multivariable models for Patient Activation Measure (PAM) and four Self-Efficacy outcomes.

Aim 4 involved building two sets of multivariable linear regression models - one to explore the relationships between each of the four PROMIS self-efficacy measures and PAM while controlling for confounding variables (Figure 2.4) and one to determine moderation by investigating interaction terms(Figure 2.5). Variables considered in the confounding models were limited to those that were statistically associated with both PAM and self-efficacy, as indicated by their significance ($p<0.05$) in the final models from Aims 2 and 3. First, a base model that included self-efficacy as the independent variable and PAM as the outcome variable was built adding a-priori confounders of age and education. Next, a series of sub-models examined the effect of each individual potential confounding factor on the magnitude and direction of the association between each of the four self-efficacy measures and PAM by adding the variable of interest to the base model. Evidence of confounding was inferred by attenuation >10% of the self-efficacy beta coefficient for changed in the sub-models. The potential confounders were then entered into a full model (Figure 2.4) to determine the independent relationship between self-efficacy and PAM as revealed by the magnitude, direction, and significance of self-efficacy's β coefficient, after adjusting for these factors.

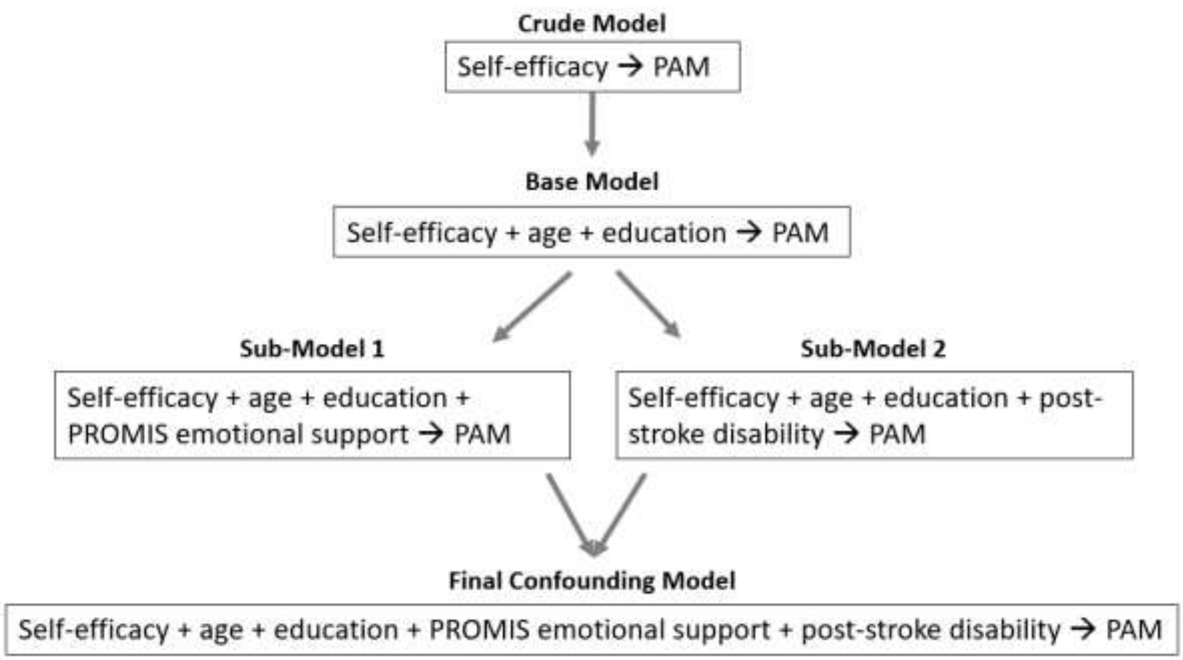


Figure 2. 4: Model building strategy for identifying factors that confound the association between Self-Efficacy and Patient Activation Measure (PAM)

The covariates retained in the confounding models were then tested for significant interaction effects with self-efficacy to determine if they moderated the associations of self-efficacy and PAM (Figure 2.5). A series of multivariable models were built for each self-efficacy measure to test the interaction effect with each covariate that was retained in the final confounding model. Moderation was inferred if the interaction term was statistically significant at $p<0.05$.

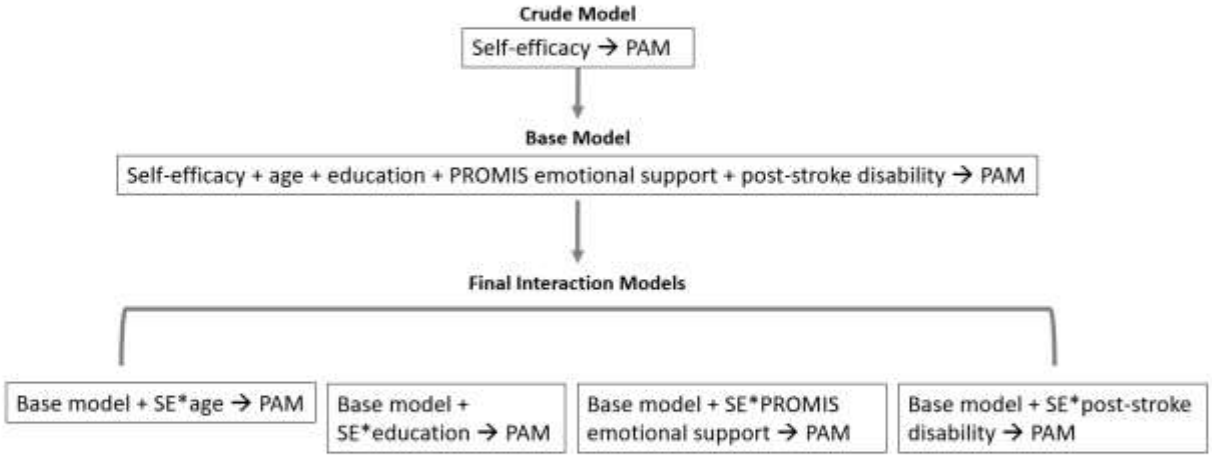


Figure 2. 5: Model building strategy to test factors for effect modification (interaction) of the association between Self-Efficacy and PAM

RESULTS

One hundred eighty patients completed a full 7-day interview and were eligible for this analysis (Figure 2.1). Of these 180 participants, 107 (59%) discharged from one hospital site (Sparrow), while 49 (27%) discharged from St. Joseph Mercy and 24 (13%) from University of Michigan (Table 3.1). Fifty-six (31%) had been randomized to Usual Care, 62 (34%) to SWCM, and 62 (34%) to SWCM+MISTT Website. Patient-reported interviews were conducted, on average, 10-days (range 4-28 days, inter-quartile range 7-12-days) after patients returned home. Patient characteristics, collected from the medical record and during the 7-day interview, are shown in Table 3.1. The mean patient age was 66 years (range 27-90 years with 19% <55 years old), 49% were female, and 18% non-white. Level of education was evenly distributed with 34% having a high school degree or less, 36% completing some college, and 28% completing a 4-year or advanced college degree. Twenty-six percent lived alone while 64% had a caregiver who also enrolled in the MISTT study. Perceived instrumental, emotional, and informational support were all above the general population's standard mean of 50. Eighty-eight percent of patients experienced an ischemic stroke, and stroke severity was classified as mild (defined as NIHSS 1-5, or Glasgow Coma Score [GCS] 13-15) in 74% of all cases. Forty-seven percent of patients were discharged directly home from the hospital, 44% to inpatient rehabilitation (IPR), and 9% to a subacute rehabilitation facility. The average cumulative length of stay (LOS) from hospital admission to returning home (including rehabilitation LOS where applicable) was 12 days. Mean acute hospitalization was 4.5 (SD=3.4) days, whereas, mean rehabilitation stay was 7.7 (SD=9.1) days.

Stroke risk factors were quantified by the number of following conditions as documented in the medical record - history of transient ischemic attack (TIA), stroke, myocardial infarction, hypertension, atrial fibrillation, diabetes, coronary artery disease, and hyperlipidemia. Seventeen percent of patients had no stroke risk factors documented, 27% had only one, and 56% had two or more.

At the time of the 7-day interview, 58% of patients reported mild disability (s-mRS ≤2). Neuro-QOL emotional and behavioral T-scores were 44, just over a half standard deviation lower (indicating less self-reported dyscontrol) than the standard mean T-score of 50 as determined from a clinical population.[124] The average PHQ-9 score (5.7, SD=5.0) indicated a mild level of depressive symptoms (PHQ-9 score of 5-9); however 20% scored ≥10 indicating moderate to severe depressive symptoms.[130] Single-item QOL and perceived health status questions had mean raw scores of 3.2 (SD=0.9) and 3.1 (SD=0.9) respectively, based on a 1-5 Likert response scale where 1=poor, 2=fair, 3=good, 4=very good, 5=excellent.

Table 3. 1: Patient sociodemographic, psychosocial, and health characteristics by mean PAM score for 180 acute stroke survivors

Variable[a]	**n (%) mean (SD)**	**Mean (SD) 7-day PAM score**
Number of patients	180 (180/265=67.9%)	64.5 (16.1)
SOCIODEMOGRAPHIC DOMAIN VARIABLES		
Age (mean years, SD)	66.1 (12.4)	
Age		
-<55 years	35 (19.4%)	62.7 (14.1)
-55-75 years	102 (56.7%)	67.2 (17.0)
->75 years	43 (23.9%)	59.7 (14.3)
Sex		
-Female	88 (48.9%)	66.1 (16.5)
-Male	92 (51.1%)	63.1 (15.7)
Race		
-White	148 (82.2%)	64.7 (16.4)
-Non-white	32 (17.8%)	63.5 (14.7)
Education level		
-High school or less	62 (34.4%)	62.9 (15.2)
-Some college	66 (36.7%)	64.2 (15.9)
-College/advanced degree	52 (28.9%)	66.9 (17.5)
SUPPORT DOMAIN VARIABLES		
Living alone[b]		
-Yes	46 (25.7%)	65.6 (18.0)
-No	133 (74.3%)	64.1 (15.5)
Consented caregiver		
-Yes	115 (63.9%)	62.4 (15.0)
-No	65 (36.1%)	68.3 (17.3)
PROMIS Informational support (mean T-score, SD)	59.0 (8.8)	

Table 3. 1 (cont'd)		
PROMIS Emotional support (mean T-score, SD)[c]	56.0 (7.8)	
PROMIS Instrumental support (mean T-score, SD)	57.8 (6.8)	
DISEASE DOMAIN VARIABLES		
Stroke type		
-Ischemic	158 (87.8%)	64.2 (16.1)
-Hemorrhagic	22 (12.2%)	66.9 (15.9)
Stroke Severity[d]		
-Mild	134 (74.4%)	65.4 (16.1)
-Moderate	38 (21.1%)	61.1 (15.7)
-Severe	8 (4.4%)	66.6 (17.8)
Discharge destination		
-Home	84 (46.7%)	65.9 (16.3)
-Inpatient rehabilitation (IPR)	80 (44.4%)	64.6 (16.2)
-Subacute rehabilitation (SAR)	16 (8.9%)	56.8 (13.2)
Complete LOS (days from admission to discharge home)	12.3 (10.0)	
Stroke Risk Factors[e]		
-None	27 (15.0%)	64.3 (16.5)
-One	49 (27.2%)	63.0 (15.5)
-Two or more	104 (57.8%)	65.3 (16.4)
Post-stroke disability (s-mRS)[b]		
-Mild (score $\leq$2)	103 (57.5%)	67.5 (16.7)
-moderate/severe (score >2)	76 (42.5%)	60.5 (14.5)
NeuroQOL emotional & behavioral dyscontrol (mean T-score, SD)	44.0 (9.4)	
GENERAL HEALTH DOMAIN VARIABLES		
Depressive symptoms (PHQ-9 mean score, SD)[b]	5.7 (5.0)	
Depressive symptoms[b]		
-Yes (PHQ-9 score $\geq$10)	35 (19.6%)	59.2 (14.3)
-No (PHQ-9 score <10)	144 (80.5%)	66.0 (16.3)
Quality-of-Life (PROMIS Global02; mean raw score, SD)[b]	3.2 (0.9)	
Perceived Health status (PROMIS Global01; mean raw score, SD)	3.1 (0.9)	
MISTT STUDY DOMAIN VARIABLES		
MISTT Treatment Group		
-Usual Care	56 (31.1%)	66.7 (17.2)
-SWCM	62 (34.4%)	62.2 (14.6)
-SWCM+MISTT website	62 (34.4%)	64.9 (16.5)
MISTT Study Site		
-Sparrow	107 (59.4%)	63.3 (16.1)
-St. Joseph Mercy	49 (27.2%)	66.1 (17.0)
-University of Michigan	24 (13.3%)	67.2 (14.2)

[a] Variables were collected at baseline from hospital data or during the 7-day interview; n=180 unless noted
[b] n=179
[c] n=178
[d]mild: NIHSS=1-5 or GCS=13-15, moderate: NIHSS=6-13 or GCS=5-12, severe: NIHSS=14-42 or GCS=3-4
[e]factors include history of transient ischemic attack [TIA], stroke, myocardial infarction, hypertension, atrial fibrillation, diabetes, coronary artery disease, and hyperlipidemia

Descriptive Data for the Patient Activation Measure (PAM)

Among the 180 stroke patients included in this analysis, mean PAM scores were 64.5 with a standard deviation of 16.1 (Table 3.1); scores ranged from 30.4 to 100.0 with a median of 60.6 (IQR: 51.0, 73.5) (Figure 3.1). Mean PAM scores were lowest for the elderly (>75 years old, PAM=59.7, SD: 14.3) and patients discharged to subacute rehabilitation facilities (PAM=56.8, SD: 13.2). Patients who did not have a caregiver that consented to the MISTT study had the highest mean PAM scores (PAM=68.3, SD: 17.3) along with those who were 55-75 years old (PAM=67.2, SD: 17.0), had mild post-stroke disability (PAM=67.5, SD: 16.7), and were recruited from University of Michigan Hospital (PAM=67.2, SD: 14.2).

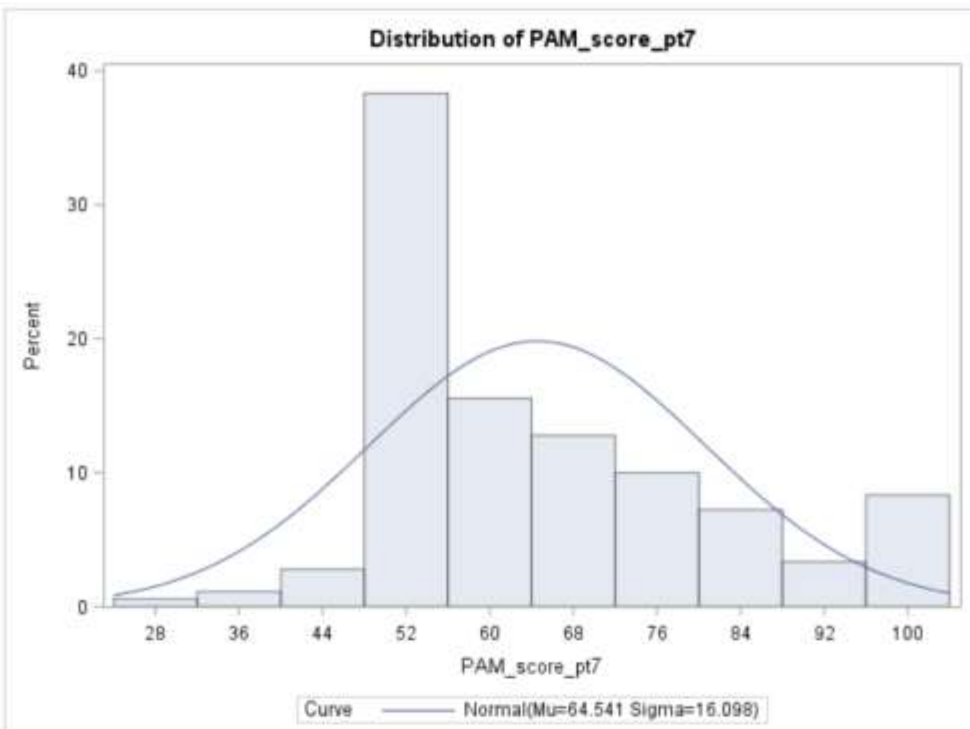


Figure 3. 1: Distribution of PAM scores

Descriptive Data for PROMIS Self-Efficacy Measures

Mean T-scores for the four PROMIS self-efficacy for managing chronic conditions measures are shown in Table 3.2. Self-efficacy for managing daily activities had the lowest mean T-score (43.5, SD: 7.5), while self-efficacy for managing medications and treatments, managing emotions, and managing social interactions among this stroke population were similar to the standardized mean of 50.

Table 3. 2: Mean T-scores of four PROMIS self-efficacy for managing chronic conditions measures among 180 stroke patients		
Outcome Measure	**n**	**Mean T-score (SD)**
Self-efficacy for managing medications and treatments (SEMMT)	180	47.0 (8.4)
Self-efficacy for managing daily activities (SEMDA)	180	43.5 (7.5)
Self-efficacy for managing emotions (SEME)	180	50.2 (8.9)
Self-efficacy for managing social interactions (SEMSI)	178	49.8 (7.4)

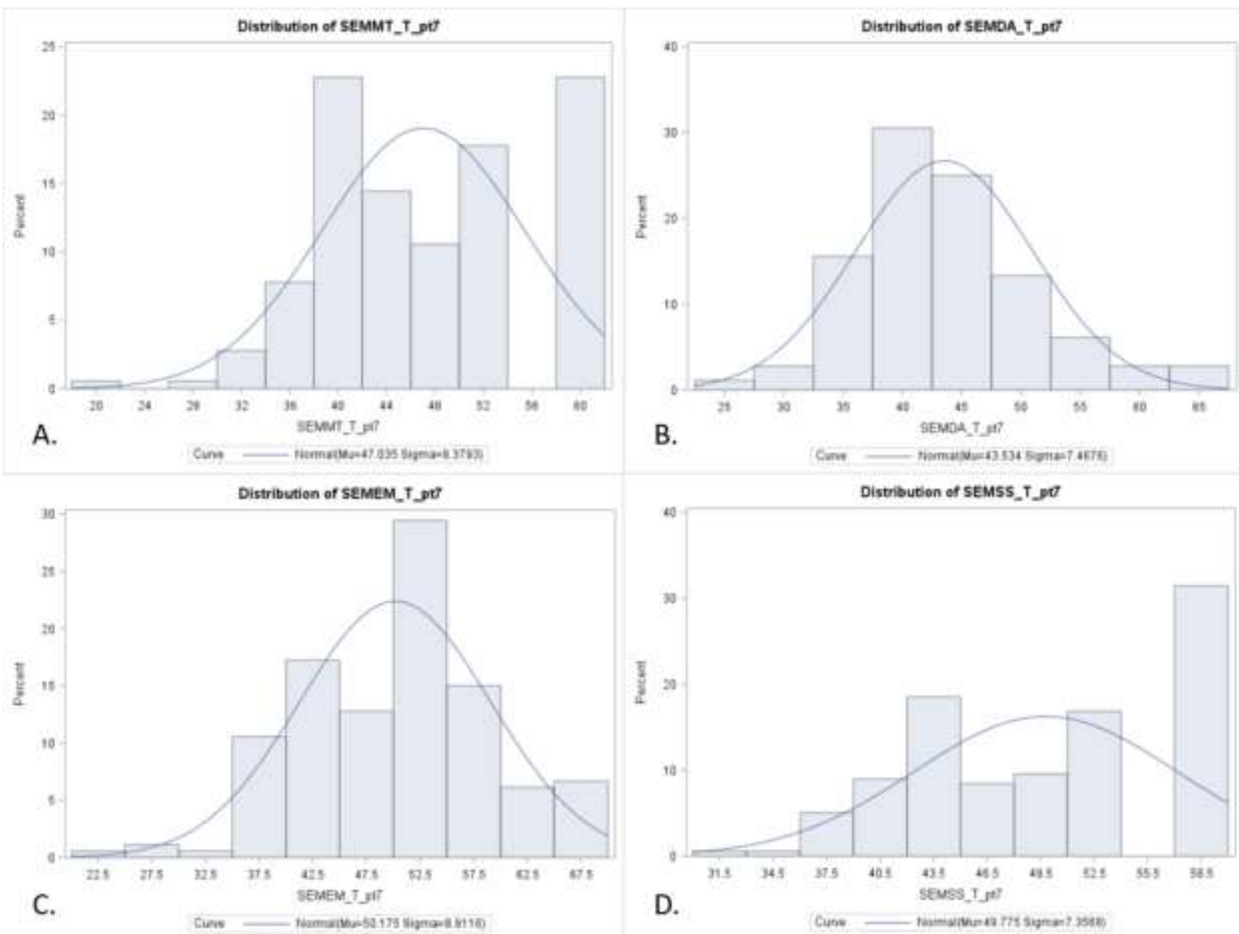


Figure 3. 2: Distribution of PROMIS Self-efficacy T-scores – A. PROMIS Self-Efficacy for Managing Medications and Treatments (SEMMT); B. PROMIS Self-Efficacy for Managing Daily Activities (SEMDA); C. PROMIS Self-Efficacy for Managing Emotions (SEME); D. Self-Efficacy for Managing Social Interactions (SEMSI)

AIM 1: Correlations between Patient Activation Measure (PAM) and PROMIS Self-efficacy Measures

As hypothesized, PAM was positively and significantly correlated to PROMIS self-efficacy for managing medications and treatments (SEMMT) (r=0.46, p<0.0001), managing daily activities (SEMDA) (r=0.28, p=0.0001), managing emotions (SEME) (r=0.38, p<0.0001), and managing social interactions (SEMSI) (r=0.28, p<0.0001) (Table 3.3). The strength of these relationships vary across self-efficacy domains with SEMMT having a moderate correlation (0.4<r<-0.59) and SEMDA, SEME, and SEMSI having weak relationships (r<0.4). Raw sums of PAM-F, PAM-CR, and PAM-nonCR were strongly and positively correlated to one another and transformed PAM scores, with correlation coefficients ranging from r=0.79 to r=0.96. Similar to the magnitude of correlations found between PAM scores and PROMIS self-efficacy measures, the raw PAM sums had significant, positive relationships with self-efficacy. Again, SEMMT had moderate strength with each raw PAM sum (r=0.45 to r=0.49), whereas, SEMDA (r=0.29 to 0.30), SEME (r=0.33 to r=0.43), and SEMSI (r=0.28 to r=0.30) revealed weaker correlations. Unexpectedly, the magnitude of correlation coefficients were similar across the full and restricted PAM sums (Table 3.3) indicating that the self-efficacy dimension is equally correlated with PAM questions that do and do not directly address confidence.

Table 3. 3: Pearson Correlations of Self-Efficacy with PAM score and PAM full and restricted raw sums[a,b]

	PAM transformed score	SEMMT T-score	SEMDA T-score	SEME T-score	SEMSI T-score	PAM-F raw sum	Restricted PAM-CR[a] raw sum	Restricted PAM-nonCR[b] raw sum
PAM transformed score	1.0							
SEMMT T-score	r=0.46 (p<0.0001)	1.0						
SEMDA T-score	r=0.28 (p=0.0001)	r=0.42 (p<0.0001)	1.0					
SEME T-score	r=0.38 (p<0.0001)	r=0.56 (p<0.0001)	r=0.55 (p<0.0001)	1.0				
SEMSI T-score	r=0.28 (p=0.0001)	r=0.49 (p<0.001)	r=0.32 (p<0.0001)	r=0.47 (p<0.0001)	1.0			
PAM-F raw sum	r=0.94 (p<0.0001)	r=0.49 (p<0.0001)	r=0.30 (p<0.0001)	r=0.40 (p<0.0001)	r=0.30 (p<0.0001)	1.0		
Restricted PAM-CR[a] raw sum	r=0.89 (p<0.0001)	r=0.49 (p<0.0001)	r=0.29 (p<0.0001)	r=0.43 (p<0.0001)	r=0.28 (p=0.0001)	r=0.94 (p<0.0001)	1.0	
Restricted PAM-nonCR[b] raw sum	r=0.90 (p<0.0001)	r=0.45 (p<0.0001)	r=0.29 (p<0.0001)	r=0.33 (p<0.0001)	r=0.29 (p<0.0001)	r=0.96 (p<0.0001)	r=0.79 (p<0.0001)	1.0

SEMMT = self-efficacy for managing medications & treatments; SEMDA = self-efficacy for managing daily activities; SEME = self-efficacy for managing emotions; SEMSI = self-efficacy for managing social interactions

[a] Restricted PAM-CR includes questions starting with "I am confident"

[b] Restricted PAM-nonCR excludes questions starting with "I am confident"

Aim 2: Patient Factors Associated with the Patient Activation Measure (PAM)

Multivariable linear regression models were built to determine the set of variables that were independently associated with PAM scores among this population of acute stroke patients. The list of potential variables was selected from significant ($p<0.1$) bivariate simple linear regression analyses (Table 3.4). Age and education were chosen a-priori and forced into all models regardless of significance in bivariate analyses. The following nine variables had significant ($p<0.1$) bivariate associations with PAM: emotional support, informational support, instrumental support, single-item QOL(global02), and perceived health (global01) were all positively associated with PAM, while having a consented caregiver, post-stroke disability, emotional and behavioral dyscontrol, and depressive symptoms were negatively associated with PAM. Results from the multivariable model building are shown in Table 3.5. Step one involved creating a series of separate, domain-specific multivariable models by adding variables that were significant in the bivariate analysis to the base model that included age and education (Figure 2.3). Next, variables that remained significant in these models were then entered into a full model; these included consented caregiver status, PROMIS emotional support, post-stroke disability (s-mRS), and NeuroQOL emotional & behavioral dyscontrol. A final, parsimonious model was identified using backwards selection where non-significant variables were dropped one at a time in order of largest to smallest p-value. The final multivariable model for PAM included the following three statistically significant ($p<0.05$) variables: consented caregiver status, PROMIS emotional support, and post-stroke disability. The model's overall F-test, testing the null hypothesis that all coefficients were equal to zero was highly statistically significant ($p<0.0001$). The R^2 for the model was 0.175, meaning the variables accounted for 17.5% of PAM's variance. Greater post-stroke disability (β=-5.5 [95% CI: -10.1, -0.87]) and having a consented caregiver (β=-7.2 [95% CI: -11.9, -2.4]) were negatively associated with PAM meaning PAM scores were 5.5 points lower in patients with moderate/severe disability (s-mRS 3-5) compared to those with mild disability (s-mrs $\leq$2) and 7.2 points lower in patients who had a MISTT-consented caregiver compared to those with no consented caregiver. Emotional support, on the other hand, was positively associated with PAM (β=0.66 [95% CI: 0.36, 0.95]); for every 1-unit increase in emotional support T-score, PAM score increased by 0.66 points.

Table 3. 4: Bivariate associations between sociodemographic, support, disease, general health, and MISTT study domain factors and the Patient Activation Measure (PAM) score

Variable[a]	**PAM score**
	Estimate [CI], p-value[b]
SOCIODEMOGRAPHIC DOMAIN VARIABLES	
Age (years)	-0.092 [-0.28, 0.099]; p=0.34
Sex	
-Female	3.0 [-1.8, 7.7]; p=0.22
-Male	Ref
Race[c]	
-White	Ref
-Non-white	-1.4 [-7.6, 4.8]; p=0.66
Education level	Overall p=0.41
-High school or less	Ref
-Some college	1.3 [-4.4, 6.9]; p=0.67
-College degree or more	4.0 [-2.0, 10]; p=0.19
SUPPORT DOMAIN VARIABLES	
Living alone[c]	
-Yes	1.5 [-4.0, 6.9]; p=0.60
-No	Ref
Consented caregiver	
-Yes	**-5.9 [-11, -1.1]; p=0.017**
-No	Ref
PROMIS Informational support	**0.38 [0.12, 0.64]; p=0.005**
PROMIS Emotional support[d]	**0.49 [0.20, 0.79]; p=0.0012**
PROMIS Instrumental support	0.37 [0.020, 0.71]; p=0.38
DISEASE DOMAIN VARIABLES	
Stroke Severity[e]	Overall p=0.33
-Mild	Ref
-Moderate	-4.3 [-10, 1.5]; p=0.15
-Severe	1.2 [-10, 13]; p=0.84
Discharge destination	Overall p=0.11
-Home	Ref
-Inpatient rehabilitation (IPR)	-1.3 [-6.2, 3.6]; p=0.60
-Subacute rehabilitation (SAR/SNF)	**-9.1 [-18, -0.52]; p=0.038**
Complete LOS (admission to discharge home)	-0.018 [-0.26, 0.22]; p=0.89

Table 3. 4 (cont'd)	
Stroke Risk Factors[f] -None -One -Two or more	Overall: p=0.71 Ref -1.2 [-8.9, 6.4]; p=0.75 1.1 [-5.8, 8.0]; p=0.76
Post-stroke disability (s-mRS)[c] -Mild (≤2) -moderate/severe (3-5)	 Ref **-7.0 [-12, -2.3]; p=0.0037**
NeuroQOL emotional & behavioral dyscontrol	**-0.41 [-0.65, -0.16]; p=0.0014**
GENERAL HEALTH DOMAIN VARIABLES	
Depressive symptoms (PHQ-9)[c]	**-0.70 [-1.2, -0.24]; p=0.0032**
Quality-of-Life (PROMIS Global02)[c]	**5.2 [2.7, 7.8]; p<0.0001**
Perceived Health status (PROMIS Global01)	**4.6 [2.0, 7.1]; p=0.0006**
MISTT DOMAIN VARIABLES	
MISTT Treatment Group -Usual Care -SWCM -SWCM+MISTT website	Overall p=0.31 Ref -4.5 [-10, 1.4]; p=0.13 -1.7 [-7.6, 4.1]; p=0.56
MISTT Study Site -Sparrow -St. Joseph Mercy -University of Michigan	Overall p=0.42 Ref 2.8 [-2.7, 8.3]; p=0.31 3.6 [-3.3, 11]; p=0.29

[a] n=180 except where noted
[b] Bold results indicate significance at p<0.1
[c] n=179
[d] n=178
[e] mild: NIHSS=1-5 or GCS=13-15, moderate: NIHSS=6-13 or GCS=5-12, severe: NIHSS=14-42 or GCS=3-4
[f] factors include history of transient ischemic attack [TIA], stroke, myocardial infarction, hypertension, atrial fibrillation, diabetes, coronary artery disease, and hyperlipidemia

Table 3. 5: Multivariable linear regression models for factors associated with the Patient Activation Measure (PAM)				
Variable	**Estimate [CI]; p-value[a]**	**R^2**	**Overall p-value**	**Degrees of Freedom (df)**
PAM: Base model (n=180)				
Age (years)	-0.10 [-0.30, 0.10]; p=0.33	R^2=0.015	p=0.43	df=3
Education level (ref=high school or less)				
Some college	0.49 [-5.3, 6.3]; p=0.87			
College degree	3.8 [-2.2, 9.8]; p=0.21			
PAM Sub-MODEL 1: Support domain (n=178)				
Age (years)	-0.14 [-0.32, 0.05]; p=0.15	R^2=0.154	p=0.0002	df=7
Education level (ref=high school or less)				
Some college	0.63 [-4.8, 6.1]; p=0.82			
College degree	**5.9 [-0.25, 11.6]; p=0.041**			
Consented caregiver (yes vs no)	**-8.6 [-13.4, -3.8]; p=0.0005**			
PROMIS Informational Support	0.16 [-0.26, 0.57]; p=0.46			
PROMIS Emotional Support	**0.50 [0.11, 0.90]; p=0.013**			
PROMIS Instrumental Support	0.06 [-0.43, 0.55]; p=0.81			
PAM Sub-MODEL 2: Disease domain (n=179)				
Age (years)	-0.11 [-0.31, 0.09]; p=0.26	R^2=0.119	p=0.0026	df=7
Education level (ref=high school or less)				
Some college	1.5 [-4.2, 7.2]; p=0.60			
College degree	3.4 [-2.4, 9.2]; p=0.24			
Discharge destination (ref=home)				
IPR (inpatient rehabilitation)	1.2 [-3.9, 6.3]; p=0.64			
SAR (subacute rehabilitation)	-5.9 [-14.8, 3.0]; p=0.19			
Post-stroke disability (s-mRS 3-5 vs $\leq$2)	**-5.5 [-10.4, -0.6]; p=0.027**			
NeuroQOL emotional & behavioral dyscontrol	**-0.37 [-0.62, -0.12]; p=0.0036**			

Table 3. 5 (cont'd)				
PAM Sub-MODEL 3: General Health domain (n=178)				
Age (years)	-0.12 [-0.32, 0.08]; p=0.24			df=6
Education level (ref=high school or less)				
Some college	0.78 [-4.8, 6.4]; p=0.78			
College degree	2.7 [-3.1, 8.5]; p=0.36	R^2=0.115	p=0.0017	
Depressive symptoms (PHQ9)	-0.44 [-0.97, 0.09]; p=0.10			
QOL (PROMIS global02)	3.1 [-0.1, 6.2]; p=0.057			
Perceived health status (PROMIS global01)	1.6 [-1.6, 4.8]; p=0.33			
PAM FINAL MODEL (n=177)				
Age (years)	-0.14 [-0.33, 0.05]; p=0.14			df=6
Education level (ref=high school or less)				
Some college	0.82 [-4.6, 6.2]; p=0.77			
College degree	4.9 [-0.70, 10.6]; p=0.086	R^2=0.175	p<0.0001	
Consented caregiver (yes vs no)	**-7.2 [-11.9, -2.4]; p=0.0035**			
PROMIS Emotional Support	**0.66 [0.36, 0.95]; p<0.0001**			
Post-stroke disability (s-mRS 3-5 vs ≤2)	**-5.5 [-10.1, -0.87]; p=0.020**			

PAM = Patient Activation Measure

[a] Bold results indicate significance at p<0.05 and were advanced to the final model in addition to age and education

Aim 3: Patient Factors Associated with Self-efficacy

Utilizing the same statistical approach as in Aim2, multivariable linear regression models were built to determine the set of variables that were independently associated with each of four PROMIS self-efficacy measures (Figure 2.3). The list of potential variables was selected from significant ($p<0.1$) bivariate simple linear regression analyses (Table 3.6). Again, age and education were forced into the models regardless of significance. Significant variables from domain-specific sub-models were advanced into a full multivariable model. Backwards selection where non-significant variables were dropped one at a time in order of largest to smallest p-value was used to identify the final, parsimonious models of significant variables. Results are presented for each outcome measure.

Table 3. 6: Bivariate associations between sociodemographic, support, disease, general health, and MISTT study domain factors and the T-scores of four PROMIS Self-Efficacy measures

Variable[a]	**SEMMT**	**SEMDA**	**SEME**	**SEMSI**
		Estimate [CI], p-value[b]		
SOCIODEMOGRAPHIC DOMAIN				
Age (years)	-0.078 [-0.18, 0.022]; p=0.13	-0.022 [-0.11, 0.066]; p=0.62	-0.06 [-0.17, 0.044]; p=0.25	0.044 [-0.045, 0.13]; p=0.34
Sex				
-Female	-1.4 [-3.9, 1.0]; p=0.25	**-3.2 [-5.4, -1.1]; p=0.0036**	**-3.9 [-6.4, -1.3]; p=0.0033**	-0.83 [-3.0, 1.3]; p=0.45
-Male	Ref	Ref	Ref	Ref
Race[c]				
-White	Ref	Ref	Ref	Ref
-Non-white	-2.1 [-5.4, 1.1]; p=0.19	**-2.5 [-5.3, 0.39]; p=0.09**	-1.1 [-4.5, 2.4]; p=0.54	-1.7 [-4.6, 1.2]; p=0.25
Education level	Overall p=0.65	Overall p=0.072	Overall p=0.79	Overall p=0.035
-High school or less	Ref	Ref	Ref	Ref
-Some college	-0.15 [-3.1, 2.8]; p=0.92	0.93 [-1.7, 3.5]; p=0.48	-0.041 [-3.2, 3.1]; p=0.98	-1.6 [-4.2, 0.92]; p=0.21
-College degree or more	1.2 [-1.9, 4.3]; p=0.45	**3.2 [0.41, 5.9]; p=0.025**	0.98 [-2.3, 4.3]; p=0.56	**-3.6 [-6.3, -0.88]; p=0.009**
SUPPORT DOMAIN				
Living alone[c]				
-Yes	-0.66 [-3.5, 2.2]; p=0.65	-1.8 [-4.3, 0.74]; p=0.17	-1.5 [-4.5, 1.5]; p=0.32	**-2.1 [-4.5, 0.40]; p=0.099**
-No	Ref	Ref	Ref	Ref
Consented caregiver				
-Yes	-0.80 [-3.4, 1.8]; p=0.54	-0.60 [-2.9, 1.7]; p=0.61	-1.4 [-4.2, 1.3]; p=0.30	0.54 [-1.7, 2.8]; p=0.64
-No	Ref	Ref	Ref	Ref
PROMIS Informational support	**0.26 [0.12, 0.39]; p=0.0002**	**0.14 [0.012, 0.26]; p=0.031**	**0.25 [0.11, 0.40]; p=0.0007**	**0.46 [0.36, 0.57]; p<0.0001**
PROMIS Emotional support[d]	**0.26 [0.10, 0.41]; p=0.0013**	0.077 [-0.064, 0.22]; p=0.28	**0.28 [0.12, 0.44]; p=0.0008**	**0.48 [0.36, 0.60]; p<0.0001**
PROMIS Instrumental support	**0.26 [0.085, 0.44]; p=0.0040**	**0.14 [-0.022, 0.30]; p=0.090**	**0.23 [0.040, 0.42]; p=0.018**	**0.46 [0.31, 0.61]; p<0.0001**

Table 3. 6 (cont'd)				
DISEASE DOMAIN				
Stroke Severity[e] -Mild -Moderate -Severe	Overall p=0.73 Ref -0.0072 [-3.1, 3.0]; p=1.0 -2.4 [-8.5, 3.6]; p=0.43	Overall p=0.60 Ref -0.30 [-3.0, 2.4]; p=0.83 -2.7 [-8.1, 2.6]; p=0.32	Overall p=0.42 Ref 0.36 [-2.9, 3.6]; p=0.83 -4.1 [-11, 2.3]; p=0.20	Overall p=0.71 Ref -0.0071 [-2.7, 2.7]; p=1.0 2.4 [-3.3, 8.0]; p=0.4`
Discharge destination -Home -Inpatient rehab (IPR) -Subacute rehab (SAR/SNF)	Overall p=0.0042 Ref -0.92 [-3.4, 1.6]; p=0.47 **-7.5 [-11.9, -3.1]; p=0.0010**	Overall p<0.0001 Ref **-4.8 [-7.0, -2.7]; p<0.0001** **-6.7 [-11, -2.9]; p=0.0006**	Overall p=0.0023 Ref -0.80 [-3.5, 1.9]; p=0.56 **-8.4 [-13, -3.7]; p=0.0005**	Overall p=0.26 Ref -0.22 [-2.5, 2.1]; p=0.85 -3.3 [-7.4, 0.73]; p=0.11
Complete LOS (admission to discharge home)	-0.037 [-0.16, 0.087]; p=0.55	-0.31 [-0.41, -0.21]; p<0.0001	-0.049 [-0.18, 0.083]; p=0.47	-0.0066 [-0.12, 0.10]; p=0.91
Stroke Risk Factors[f] -None -One -Two or more	Overall p=0.86 Ref 0.51 [-3.5, 4.5]; p=0.80 -0.30 [-3.9, 3.3]; p=0.87	Overall p=0.61 Ref -0.51 [-4.1, 3.0]; p=0.78 -1.4 [-4.6, 1.8]; p=0.38	Overall p=1.0 Ref 0.18 [-4.1, 4.4]; p=0.93 0.052 [-3.8, 3.8]; p=0.98	Overall p=0.55 Ref 1.9 [-1.6, 5.4]; p=0.28 1.1 [-2.1, 4.2]; p=0.50
Post-stroke disability (s-mRS)[c] -Mild (<u><</u>2) -moderate/severe (3-5)	Ref **-3.6 [-6.1, -1.2]; p=0.0039**	Ref **-7.4 [-9.4, -5.5]; p<0.0001**	Ref **-4.6 [-7.2, -2.0]; p=0.0006**	Ref **-2.5 [-4.7, 0.28]; p=0.027**
NeuroQOL emotional & behavioral dyscontrol	**-0.26 [-0.39, -0.14]; p<0.0001**	**-0.24 [-0.35, -0.13]; p<0.0001**	**-0.51 [-0.63, -0,39]; p<0.0001**	**-0.25 [-0.36, -0.14]; p<0.0001**
GENERAL HEALTH DOMAIN				
Depressive symptoms (PHQ-9)[c]	**-0.65 [-0.88, -0.42]; p<0.0001**	**-0.57 [-0.78, -0.37]; p<0.0001**	**-0.96 [-1.2, -0.73]; p<0.0001**	**-0.49 [-0.70, -0.29]; p<0.001**
Quality-of-Life (PROMIS global02)[c]	**2.0 [0.70, 3.4]; p=0.0032**	**2.8 [1.6, 4.0]; p<0.0001**	**2.8 [1.4, 4.2]; p=0.0001**	**2.2 [0.98, 3.4]; p=0.0004**
Perceived Health status (PROMIS global01)	**2.4 [1.0, 3.7]; p=0.0006**	**3.4 [2.3, 4.5]; p<0.0001**	**2.8 [1.4, 4.2]; p=0.0001**	1.0 [-0.20, 2.22]; p=0.10
MISTT STUDY DOMAIN				
MISTT Treatment Group -Usual Care -SWCM -SWCM+MISTT website	Overall p=0.42 Ref -2.0 [-5.1, 1.0]; p=0.19 -0.93 [-4.0, 2.1]; p=0.55	Overall p=0.84 Ref 0.81 [-1.9, 3.5]; p=0.56 0.36 [-2.4, 3.1]; p=0.79	Overall p=0.97 Ref 0.35 [-2.9, 3.6]; p=0.83 0.30 [-3.0, 3.6]; p=0.86	Overall p=0.73 Ref -0.90 [-3.6, 1.8]; p=0.52 0.036 [-2.7, 2.7]; p=0.98

Table 3. 6 (cont'd)				
MISTT Study Site	Overall p=0.11	Overall p=0.55	Overall p=0.39	Overall p=0.082
-Sparrow	Ref	Ref	Ref	Ref
-St. Joseph Mercy	1.86 [-0.98, 4.7]; p=0.20	1.1 [-1.5, 3.6]; p=0.41	0.93 [-2.1, 3.6]; p=0.55	**2.8 [0.34, 5.3]; p=0.026**
-Univ of Michigan	3.6 [-0.1, 7.3]; p=0.056	1.5 [-1.8, 4.9]; p=0.37	2.7 [-1.3, 6.7]; p=0.18	0.49 [-2.8, 3.7]; p=0.77

SEMMT = self-efficacy for managing medications & treatments; SEMDA = self-efficacy for managing daily activities; SEME = self-efficacy for managing emotions; SEMSI = self-efficacy for managing social interactions

[a] n=180 except where noted

[b] Bold results indicate significance at p<0.1

[c] n=179

[d] n=178

[e]mild: NIHSS=1-5 or GCS=13-15, moderate: NIHSS=6-13 or GCS=5-12, severe: NIHSS=14-42 or GCS=3-4

[f]factors include history of transient ischemic attack [TIA], stroke, myocardial infarction, hypertension, atrial fibrillation, diabetes, coronary artery disease, and hyperlipidemia

Self-Efficacy for Managing Medications and Treatments (SEMMT)

Bivariate analyses revealed that the three PROMIS informational, emotional, and instrumental support measures, single-item QOL, and perceived health were positively and significantly ($p<0.10$) associated with SEMMT, while discharge to subacute rehabilitaiton (SAR), moderate/severe post-stroke disability, NeuroQOL emotional and behavioral dyscontrol, and PHQ9 (depressive symptoms) were negatively and significantly ($p<0.10$) associated with SEMMT(Table 3.6). Step 1 of the multivariable model building involved creating domain-specific sub-models using covariates that were significant in the bivariate screening analysis. Discharge destination, post-stroke disability, NeuroQOL emotional & behavioral dyscontrol, and depressive symptoms retained significance in the domain-specific models and were then moved forward to the full model; age and education were retained regardless of significance (Table 3.7). Of the 10 variables that were significant in bivariate analyses, only three variables retained significant associations with SEMMT in the final model. Every 1-year increase in age ($\beta=-0.13$ [95% CI: -0.23, -0.03]) was associated with a 0.13 decrease in SEMMT T-score, meaning older patients were less confident in managing their medications and treatment. Similarly, for every 1-unit increase in PHQ9 score ($\beta=-0.68$ [95% CI: -0.91, -0.46]), SEMMT T-scores decreased by 0.68, indicating that those with more depressive symptoms were also less confident. Discharge destination was also independently associated with SEMMT and had an overall type 3 significance of $p=0.046$; discharging to subacute rehabilitation (SAR) vs home was associated with a 5.2 decrease in SEMMT ($\beta=-5.2$ [95% CI: -9.4, -1.0]). Although significant, neither age nor depressive symptoms had a large effect on SEMMT scores. The final multivariable model accounted for 22.9% of the variance in SEMMT the overall F-test p-value was <0.0001, rejecting the null hypothesis that all coefficients were equal to zero.

Table 3. 7: Multivariable linear regression models for factors associated with mean T-scores of PROMIS Self-Efficacy for Managing Medications and Treatments (SEMMT)				
Variable	**Estimate [CI]; p-value[a]**	**R^2**	**Overall p-value**	**Degrees of Freedom (df)**
SEMMT Base model (n=180)				
Age (years)	-0.09 [-0.19, 0.01]; p=0.088	R^2=0.021	p=0.29	df=3
Education level (ref=high school or less)				
Some college	-0.84 [-3.9, 2.2]; p=0.58			
College degree	1.1 [-2.0, 4.2]; p=0.50			
SEMMT Sub-MODEL 1: Support domain (n=178)				
Age (years)	**-0.11 [-0.21, -0.01]; p=0.033**	R^2=0.113	P=0.0021	df=6
Education level (ref=high school or less)				
Some college	-0.85 [-3.8, 2.1]; p=0.57			
College degree	2.2 [-0.87, 5.2]; p=0.16			
PROMIS Informational Support	0.16 [-0.06, 0.4]; p=0.15			
PROMIS Emotional Support	0.26 [-0.05, 0.37]; p=0.14			
PROMIS Instrumental Support	0.02 [-0.24, 0.28]; p=0.89			
SEMMT Sub-MODEL 2: Disease domain (n=179)				
Age (years)	-0.09 [-0.19, 0.01]; p=0.078	R^2=0.169	p<0.0001	df=7
Education level (ref=high school or less)				
Some college	-0.35 [-3.2, 2.5]; p=0.81			
College degree	0.67 [-2.3, 3.6]; p=0.65			
Discharge destination (ref=home)				
IPR (inpatient rehabilitation)	0.44 [-2.1, 3.0]; p=0.74			
SAR (subacute rehabilitation)	**-4.8 [-9.3, -0.31]; p=0.036**			
Post-stroke disability (s-mRS 3-5 vs ≤2)	**-2.5 [-5.0, -0.08]; p=0.043**			
NeuroQOL emotional & behavioral dyscontrol	**-0.25 [-0.37, -0.12]; p=0.0001**			

Table 3. 7 (cont'd)				
SEMMT Sub-MODEL 3: General Health domains (n=178)				
Age (years)	**-0.15 [-0.24, -0.05]; 0.0037**			df=6
Education level (ref=high school or less)				
Some college	-0.71 [-3.5, 2.1]; p=0.61			
College degree	0.87 [-2.0, 3.8]; p=0.55	R^2=0.205	P<0.0001	
Depressive symptoms (PHQ9)	**-0.67 [-0.93, -0.41]; p<0.0001**			
QOL (PROMIS global02)	-0.08 [-1.6, 1.5]; p=0.92			
Perceived health status (PROMIS global01)	0.76 [-0.81, 2.3]; p=0.34			
SEMMT FINAL MODEL (n=178)				
Age (years)	**-0.13 [-0.23, -0.03]; p=0.010**			df=6
Education level (ref=high school or less)				
Some college	-0.48 [-3.2, 2.3]; p=0.73			
College degree	0.93 [-1.9, 3.7]; p=0.51	R^2=0.229	P<0.0001	
Discharge destination (ref=home)[b]				
IPR (inpatient rehabilitation)	-0.33 [-2.7, 2.0]; p=0.78			
SAR (subacute rehabilitation)	**-5.2 [-9.4, -1.0]; p=0.015**			
Depressive symptoms (PHQ9)	**-0.68 [-0.91, -0.46]; p<0.0001**			

SEMMT = self-efficacy for managing medications & treatments

[a] Bold results indicate significance at p<0.05 and were advanced to the final model in addition to age and education

[b] Type 3 significance level: p=0.046

Self-Efficacy for Managing Daily Activities (SEMDA)

Bivariate screening analyses revealed 11 variables that were significantly ($p<0.1$) associated with self-efficacy for managing daily activities (SEMDA): sex, race, education level, perceived emotional and instrumental support, discharge destination, post-stroke disability, NeuroQOL emotional and behavioral dyscontrol, depressive symptoms, QOL, and perceived health status (Table 3.6). In domain-specific sub-modeling, sex, discharge destination, post-stroke disability, NeuroQOL emotional & behavioral dyscontrol, PHQ9 (depressive symptoms), and perceived health status retained significance and contributed to the final model along with age and education (Table 3.8). The final multivariable model with eight degrees of freedom detected (significance of $p<0.0001$) overall F-test, thus rejecting the null hypothesis that all covariates were equal to zero. The model explained 43.3% of the variance in self-efficacy for managing daily activities. Variables that retained significance ($p<0.05$) and were negatively associated with this outcome included discharge destination, post-stroke disability, and PHQ9 (depression). Discharging to rehabilitation rather than home was associated with a decrease in SEMDA T-score - compared to discharging home scores were 3.3 units worse when discharged to acute rehabilitation (acute [IPR]: β=-3.3 [95% CI: -5.3, -1.4]) and 3.8 units worse when discharged to subacute rehabilitation [SAR]: β=-3.8 [95% CI: -7.1, -0.43]). SEMDA was also lower by 5.0 units in patients reporting moderate/severe post-stroke disability compared to those with mild disability (β=-5.0 [95% CI: -6.8, -3.1]), and with each 1-unit increase of PHQ-9 scores, SEMDA T-scores decreased by 0.35 indicating less self-efficacy among those with more depressive symptoms (β=-0.35 [95% CI: -0.55, -0.15]). Additionally, perceived health status was positively associated with SEMDA (β=1.8 [95% CI: 0.78, 2.9]); each unit increase in perceived health was associated with an increase of 1.8 in SEMDA T-score. In summary, the variables with the strongest association were discharge destination and post-stroke disability.

Table 3. 8: Multivariable linear regression models for factors associated with mean T-scores of PROMIS Self-Efficacy for Managing Daily Activities (SEMDA)				
Variable	**Estimate [CI]; p-value**[a]	**R^2**	**Overall p-value**	**Degrees of Freedom (df)**
SEMDA Base model (n=180)				
Age (years)	-0.02 [-0.12, 0.07]; p=0.59	R^2=0.031	p=0.14	df=3
Education level (ref=high school or less)				
Some college	0.74 [-1.9, 3.4]; p=0.59			
College degree	**3.1 [0.36, 5.9]; p=0.027**			
SEMDA Sub-MODEL 1: Sociodemographic domain (n=180)				
Age (years)	-0.02 [-0.11, 0.07]; p=0.68	R^2=0.084	P=0.0086	df=5
Education level (ref=high school or less)				
Some college	0.85 [-1.8, 3.5]; p=0.52			
College degree	**3.0 [0.32, 5.7]; p=0.029**			
Sex (female vs male)	**-2.8 [-5.0, -0.65]; p=0.011**			
Race (non-white vs white)	-2.2 [-5.0, -0.66]; p=0.13			
SEMDA Sub-MODEL 2: Support domain (n=180)				
Age (years)	-0.03 [-0.12, 0.06]; p=0.50	R^2=0.069	P=0.028	df=5
Education level (ref=high school or less)				
Some college	0.80 [-1.8, 3.4]; p=0.55			
College degree	**3.7 [0.97, 6.5]; p=0.0084**			
PROMIS Informational support	0.14 [-0.03, 0.32]; p=0.11			
PROMIS Instrumental support	0.04 [-0.19, 0.27]; p=0.73			
SEMDA Sub-MODEL 3: Disease domain (n=179)				
Age (years)	0.001 [-0.08, 0.08]; p=0.99	R^2=0.353	P<0.0001	df=7
Education level (ref=high school or less)				
Some college	1.7 [-0.55, 3.9]; p=0.14			
College degree	2.2 [-0.14, 4.5]; p=0.066			
Discharge destination (ref=home)				
IPR (inpatient rehabilitation)	**-3.0 [-5.0, -0.98]; p=0.0038**			
SAR (subacute rehabilitation)	**-4.2 [-7.8, -0.71]; p=0.019**			
Post-stroke disability (s-mRS 3-5 vs $\leq$2)	**-5.8 [-7.7, -3.9]; p<0.0001**			
NeuroQOL emotional & behavioral dyscontrol	**-0.19 [-0.29, -0.09]; p=0.0003**			

Table 3. 8 (cont'd)				
SEMDA Sub-MODEL 4: General Health domain (n=178)				
Age	-0.05 [-0.13, 0.04]; p=0.26			df=6
Education level (ref=high school or less)				
Some college	0.81 [-1.6, 3.2]; p=0.50			
College degree	2.4 [-0.11, 4.9]; p=0.06	R^2=0.250	p<0.0001	
Depressive symptoms (PHQ9)	**-0.42 [-0.64, -0.19]; p=0.0004**			
QOL (PROMIS global02)	0.75 [-0.61, 2.1]; p=0.28			
Perceived health status (global01)	**1.8 [0.47, 3.2]; p=0.0086**			
SEMDA FINAL MODEL (n=178)				
Age (years)	-0.008 [-0.08, 0.07]; p=0.84			df=8
Education level (ref=high school or less)				
Some college	1.5 [-0.66, 3.6]; p=0.18			
College degree	1.6 [-0.63, 3.8]; p=0.16			
Discharge destination (ref=home) [b]				
IPR (inpatient rehabilitation)	**-3.3 [-5.3, -1.4]; p=0.0006**	R^2=0.433	p<0.0001	
SAR (subacute rehabilitation)	**-3.8 [-7.1, -0.43] = p=0.027**			
Post-stroke disability (s-mRS 3-5 vs $\leq$2)	**-5.0 [-6.8, -3.1]; p<0.0001**			
Depressive symptoms (PHQ9)	**-0.35 [-0.55, -0.15]; p=0.0005**			
Perceived health status (global01)	**1.8 [0.78, 2.9]; p=0.0008**			

SEMDA = self-efficacy for managing daily activities

[a] Bold results indicate significance at p<0.05 and were advanced to the final model in addition to age and education

[b] Type 3 significance level: p=0.0016

Self-Efficacy for Managing Emotions (SEME)

Significant bivariate associations for self-efficacy for managing emotions (SEME) included sex, perceived informational, emotional and instrumental support, discharge to SAR, moderate/severe post-stroke disability, NeuroQOL emotional and behavioral dyscontrol, depressive symptoms, QOL, and perceived health status (Table 3.6). The four variables that advanced to the final model, in addition to age and education, were sex, discharge destination, post-stroke disability, NeuroQOL emotional & behavioral dyscontrol, and PHQ9 (Table 3.9). The overall F-test for the final multivariable model was significant ($p<0.0001$), rejecting the null hypothesis that all covariates were equal to zero. The model used eight degrees of freedom and accounted for 44.8% of the variance in self-efficacy for managing emotions. Five variables were significantly ($p<0.05$) and negatively associated with this outcome: age, sex, discharge destination, NeuroQOL emotional & behavioral dyscontrol, and PHQ9 (depression). With each 1-year age increase, SEME T-scores decreased by 0.12 units ($\beta=-0.12$ [95% CI: -0.21, -0.03]). Females were less confident than males by a difference of 2.4 T-score units ($\beta=-2.4$ [95% CI: -4.4, -0.29]). Discharge destination was independently associated with SEME ($p=0.023$); compared to discharging home, those who discharged to subacute rehabilitation scored 5.1 units lower on SEME (subacute [SAR]: $\beta=-5.1$ [-8.9, -1.3]). With every 1-unit increase in NeuroQOL emotional & behavioral dyscontrol T-score, SEME T-scores decreased 0.33 units ($\beta=-0.33$ [95% CI: -0.47, -0.20]), and with every 1-unit increase in PHQ9 score, SEME decreased 0.58 units ($\beta=-0.58$ [95% CI: -0.84, -0.32]). In summary, being female, discharging to SAR, having more emotional & behavioral dyscontrol, and more depressive symptoms were associated with less confidence to manage emotions. The strongest association was found among those discharging to SAR.

Table 3. 9: Multivariable linear regression models for factors associated with mean T-scores of PROMIS Self-Efficacy for Managing Emotions (SEME)				
Variable	**Estimate [CI]; p-value[a]**	**R^2**	**Overall p-value**	**Degrees of Freedom (df)**
SEME Base model (n=180)				
Age (years)	-0.07 [-0.18, 0.04]; p=0.21	R^2=0.012	p=0.56	df=3
Education level (ref=high school or less)				
Some college	-0.58 [-3.8, 2.6]; p=0.72			
College degree	0.87 [-2.5, 4.2]; p=0.61			
SEME Sub-MODEL 1: Sociodemographic domain (n=180)				
Age (years)	-0.05 [-0.17, 0.05]; p=0.32	R^2=0.054	p=0.044	df=4
Education level (ref=high school or less)				
Some college	-0.52 [-3.7, 2.6]; p=0.75			
College degree	0.62 [-2.6, 3.9]; p=0.71			
Sex (female vs male)				
Female	**-3.7 [-6.3, -1.1]; p=0.0055**			
SEME Sub-MODEL 2: Support domain (n=178)				
Age (years)	-0.09 [-0.19, 0.02]; p=0.10	R^2=0.097	p=0.0071	df=6
Education level (ref=high school or less)				
Some college	-0.33 [-3.4, 2.8]; p=0.83			
College degree	2.0 [-2.3, 5.2]; p=0.23			
PROMIS Informational Support	0.17 [-0.07, 0.40]; p=0.16			
PROMIS Emotional Support	0.21 [-0.02, 0.43]; p=0.069			
PROMIS Instrumental Support	-0.05 [-0.32, 0.22]; p=0.72			

Table 3. 9 (cont'd)				
SEME Sub-MODEL 3: Disease domain (n=179)				
Age (years)	**-0.09 [-0.18, -0.0003]; p=0.049**	R^2=0.375	p<0.0001	df=7
Education level (ref=high school or less)				
Some college	0.35 [-2.3, 3.0]; p=0.79			
College degree	0.70 [-2.0, 3.4]; p=0.61			
Discharge destination (ref=home)				
IPR (inpatient rehabilitation)	0.78 [-1.6, 3.1]; p=0.52			
SAR (subacute rehabilitation)	**-5.6 [-9.8, -1.5]; p=0.0083**			
Post-stroke disability (s-mRS 3-5 vs ≤2)	**-2.8 [-5.1, -0.56]; p=0.015**			
NeuroQOL emotional & behavioral dyscontrol	**-0.49 [-0.61, -0.38]; p<0.0001**			
SEME Sub-MODEL 4: General Health domain (n=178)				
Age (years)	**-0.14 [-0.24, -0.05]; p=0.0032**	R^2=0.334	p<0.0001	df=6
Education level (ref=high school or less)				
Some college	-0.55 [-3.3, 2.2]; p=0.69			
College degree	0.81 [-2.0, 3.6]; p=0.57			
Depressive symptoms (PHQ9)	**-0.98 [-1.2, -0.72]; p<0.0001**			
QOL (PROMIS global02)	0.35 [-1.2, 1.9]; p=0.65			
Health status (PROMIS global01)	0.30 [-1.2, 1.8]; p=0.70			
SEME FINAL MODEL (n=179)				
Age (years)	**-0.12 [-0.21, -0.03]; p=0.011**	R^2=0.448	p<0.0001	df=8
Education level (ref=high school or less)				
Some college	0.11 [-2.4, 2.6]; p=0.93			
College degree	0.78 [-1.8, 3.3]; p=0.54			
Sex (female vs male)	**-2.4 [-4.4, -0.29]; p=0.026**			
Discharge destination (ref=home)[b]				
IPR (inpatient rehabilitation)	0.04 [-2.2, 2.1]; p=0.97			
SAR (subacute rehabilitation)	**-5.1 [-8.9, -1.3]; p=0.0090**			
NeuroQOL emotional & behavioral dyscontrol	**-0.33 [-0.47, -0.20]; p<0.0001**			
Depressive symptoms (PHQ9)	**-0.58 [-0.84, -0.32]; p<0.0001**			

SEME = self-efficacy for managing emotions

[a] Bold results indicate significance at p<0.05 and were advanced to the final model in addition to age and education

[b] Type 3 significance level: p=0.023

Self-Efficacy for Managing Social Interactions (SEMSI)

Among significant ($p<0.1$) bivariate screening results, perceived informational, emotional, and instrumental support, QOL, and St. Joseph Mercy recruitment hospital were positively associated with self-efficacy for managing social interactions (SEMSI). On the other hand, having a college degree, living alone, moderate/severe post-stroke disability, NeuroQOL emotional and behavioral dyscontrol, and depressive symptoms were negatively associated with the outcome (Table 3.6). Variables that retained significance ($p<0.05$) in the domain-specific sub-models and were advanced to the final multivariable model included PROMIS informational support, PROMIS emotional support, post-stroke disability, NeuroQOL emotional & behavioral dyscontrol, PHQ9, and MISTT study site (Table 3.10).

The final multivariable model accounted for 44.7% of the variance in self-efficacy for managing social interactions. It included seven degrees of freedom and the overall F-test was significant ($p<0.0001$), thus the null hypothesis that all covariates were equal to zero was rejected. Informational support ($\beta=0.28$ [95% CI: 0.15, 0.41]) and emotional support ($\beta=0.24$ [95% CI: 0.09, 0.38]) were both positively associated with SEMSI resulting in a 0.28 and 0.24 increase in SEMSI T-scores, respectively, with each 1-unit increase of support T-scores. Education was independently associated with SEMSI ($p=0.044$), and having a college degree compared to a high school degree or less was associated with a 2.7 decrease in SEMSI ($\beta=-2.7$ [95% CI: -4.8, -0.59]). Reporting moderate/severe post-stroke disability compared to mild disability was associated with a 2.3 lower SEMSI T-score ($\beta=-2.3$ [95% CI: -4.0, -0.49]) and with each 1-unit increase in PHQ9 scores, SEMSI T-scores decreased by 0.32 units ($\beta=-0.32$ [95% CI: -0.49, -0.14]). The largest effect sizes were from PAM's associations with education, and post-stroke disability.

Table 3. 10: Multivariable linear regression models for factors associated with mean T-scores of PROMIS Self-Efficacy for Managing Social Interactions (SEMSI)				
Variable	**Estimate [CI]; p-value[a]**	**R^2**	**Overall p-value**	**Degrees of Freedom (df)**
SEMSI Base model (n=178)				
Age (years)	0.04 [-0.05, 0.13]; p=0.38	R^2=0.042	p=0.058	df=3
Education level (ref=high school or less)				
Some college	-1.3 [-3.9, 1.3]; p=0.33			
College degree	**-3.5 [-6.2, -0.82]; p=0.011**			
SEMSI Sub-MODEL 1: Support domain (n=177)				
Age (years)	0.01 [-0.06, 0.09]; p=0.75	R^2=0.365	p<0.0001	df=7
Education level (ref=high school or less)				
Some college	-1.2 [-3.4, 1.0]; p=0.29			
College degree	-2.1 [-4.4, 0.17]; p=0.070			
Living alone (yes vs no)	-0.79 [-3.0, 1.4]; p=0.48			
PROMIS Informational Support	**0.30 [0.14, 0.47]; p=0.0004**			
PROMIS Emotional Support	**0.24 [0.08, 0.40]; pp=0.0028**			
PROMIS Instrumental Support	0.02 [-0.17, 0.22]; p=0.82			
SEMSI Sub-MODEL 2: Disease domain (n=177)				
Age (years)	0.03 [-0.06, 0.11]; p=0.53	R^2=0.164	p<0.0001	df=5
Education level (ref=high school or less)				
Some college	-1.1 [-3.5, 1.4]; p=0.40			
College degree	**-3.9 [-6.5, -1.4]; p=0.0029**			
Post-stroke disability (s-mRS 3-5 vs $\leq$2)	**-2.2 [-4.3, -0.15]; p=0.036**			
NeuroQOL emotional & behavioral dyscontrol	**-0.23 [-0.34, -0.12]; p<0.0001**			
SEMSI Sub-MODEL 3: General Health domain (n=176)				
Age (years)	0.01 [-0.07, 0.10]; p=0.76	R^2=0.175	p<0.0001	df=5
Education level (ref=high school or less)				
Some college	-1.2 [-3.7, 1.3]; p=0.33			
College degree	**-3.8 [-6.4, -1.3]; p=0.0037**			
Depressive symptoms (PHQ9)	**-0.39 [-0.62, -0.16]; p=0.0009**			
QOL (PROMIS global02)	1.4 [0.16, 2.7]; p=0.27			

Table 3. 10 (cont'd)				
SEMSI Sub-MODEL 4: MISTT domain (n=178)				
Age (years)	0.01 [-0.05, 0.13]; p=0.41			df=5
Education level (ref=high school or less)				
Some college	-1.7 [-4.4, 0.93]; p=0.20			
College degree	**-3.5 [-6.3, -0.78]; p=0.012**	R^2=0.069	P=0.031	
MISTT study site (ref=Sparrow)				
St. Joseph Mercy	**2.8 [0.29, 5.3]; p=0.029**			
University of Michigan	1.3 [-2.0, 4.6]; p=0.44			
SEMSI FINAL MODEL (n=176)				
Age (years)	-0.01 [-0.08, 0.06]; p=0.79			df=7
Education level (ref=high school or less)[b]				
Some college	-1.1 [-3.2, 0.89]; p=0.27			
College degree	**-2.7 [-4.8, -0.59]; p=0.013**	R^2=0.447	p<0.0001	
PROMIS Informational Support	**0.28 [0.15, 0.41]; p<0.001**			
PROMIS Emotional Support	**0.24 [0.09, 0.38]; p=0.0018**			
Post-stroke disability (s-mRS 3-5 vs $\leq$2)	**-2.3 [-4.0, -0.49]; p=0.012**			
Depressive symptoms (PHQ9)	**-0.32 [-0.49, -0.14]; p=0.0006**			

SEMSI = self-efficacy for managing social interactions

[a] Bold results indicate significance at p<0.05 and were advanced to the final model in addition to age and education

[b] Type 3 significance level: p=0.044

In summary of the final models, several variables were significantly associated with more than one domain of self-efficacy, however, only increased depressive symptoms was associated with all self-efficacy measures (Table 3.11). In partial support of my hypothesis, age was negatively associated with SEMMT and SEME, but effect sizes were small and similar for both. Regardless, these small effect sizes could result in meaningful differences between stroke survivors at opposite ends of the age spectrum. Contrary to my hypothesis, sex was associated with SEME where females had a modestly lower confidence. Unexpectedly, education was only associated with self-efficacy for managing social interactions (SEMSI) where being highly educated (college degree) was associated with lower self-efficacy compared to those who had a high school education or less. PROMIS informational support and emotional support were both independently associated with SEMSI, although effect size was small, whereas PROMIS instrumental support was not significantly associated with any of the self-efficacy domains. As expected, discharging to subacute rehabilitation (SAR) was independently associated with lower SEMMT, SEMDA and SEME when compared to those discharging home, however, discharging to acute rehabilitation (IPR) was also independently associated with lower SEMDA, in opposite direction of the hypothesized effect. Post-stroke disability was only associated with two self-efficacy domains – SEMDA and SEMSI. It was negatively associated with both domains but, as expected, had a larger effect for SEMDA (β=-5.0) than for SEMSI (β=-2.3). NeuroQOL emotional & behavioral dyscontrol was negatively associated with SEME only. As hypothesized, increasing depressive symptoms was independently associated with lower self-efficacy for all four domains and produced small effect sizes ranging from -0.32 to -0.68. Perceived health status was only associated with SEMDA with a positive, modest effect size. Contrary to my hypotheses, living alone, stroke severity, stroke risk factors, and QOL were not associated with self-efficacy. Patient factors that were not associated with any of the self-efficacy measures included race, living alone, stroke severity, stroke risk factors, MISTT treatment group, and MISTT study site.

Table 3. 11: Summary of the independent variables significantly associated with each outcome in the final Aim 2 and Aim 3 multivariable linear regression models					
Variable	**PAM**	**SEMMT**	**SEMDA**	**SEME**	**SEMSI**
Age (years)		-		-	
Sex (female vs male)				-	
Race (non-white vs white)					
Education level (college degree vs high school or less)					-
Living alone (yes vs no)					
Consented caregiver (yes vs no)	-				
PROMIS Informational support					+
PROMIS Emotional support	+				+
PROMIS Instrumental support					
Stroke Severity					
Discharge destination (IPR vs home, SAR vs home)		SAR: -	IPR: - SAR: -	SAR: -	
Complete LOS (days)					
Stroke Risk Factors					
Post-stroke disability (s-mRS 3-5 vs $\leq$2)	-		-		-
NeuroQOL emotional & behavioral dyscontrol				-	
Depressive symptoms (PHQ9)		-	-	-	-
Quality-of-Life (PROMIS global02)					
Perceived Health status (PROMIS global01)			+		
MISTT Treatment Group					
MISTT Study Site					

PAM = Patient Activation Measure; SEMMT = self-efficacy for managing medications & treatments; SEMDA = self-efficacy for managing daily activities; SEME = self-efficacy for managing emotions; SEMSI = self-efficacy for managing social interactions
IPR = acute rehabilitation; SAR = subacute rehabilitation
LOS = length of stay
+ indicates statistically significant positive association with the outcome in final multivariable model
- indicates statistically significant negative association with the outcome

Aim 4: Associations between Self-Efficacy and Patient Activation (PAM): Exploration of Confounding and Effect Moderation

To understand the associations between four measures from the PROMIS Self-Efficacy for Managing Chronic Conditions domain and PAM, results from the final models in Aim 2 and Aim 3 were used to build multivariable models exploring confounding and effect moderation.

Confounding

This aim was achieved by building a series of models. Variables that were significant in the final multivariable regression models of both PAM (Aim 2) and self-efficacy (Aim 3) were considered as potential confounders (Table 3.11). PROMIS emotional support and post-stroke disability were the only two variables that fulfilled this criteria.

First, simple linear regression was performed to document the crude relationships between each PROMIS self-efficacy measure and PAM as the dependent variable (Table 3.12). In these bivariate models, all associations between self-efficacy and PAM were positive and significant ($p<0.05$), although small in magnitude given that each increase in self-efficacy T-score was associated with less than a 1-unit change in PAM. Self-efficacy for managing medications and treatments (SEMMT) accounted for the most variation in PAM (20.8%), followed by self-efficacy for managing emotions (SEME) (13.8%), self-efficacy for managing social interactions (SEMSI) (8.0%), and self-efficacy for managing daily activities (SEMDA) (7.8%).

Table 3. 12: Bivariate associations between Self-Efficacy and Patient Activation (PAM)

Variable	Estimate [CI]; p-value	R^2	Overall p-value	Degrees of Freedom (df)
SEMMT	0.88 [0.62, 1.1]; p<0.001	R^2=0.208	p<0.0001	df=1
SEMDA	0.60 [0.30, 0.91]; p=0.0001	R^2=0.078	p=0.0001	df=1
SEME	0.67 [0.42, 0.92]; p<0.0001	R^2=0.138	p<0.0001	df=1
SEMSI	0.62 [0.30, 0.93]; p=0.0001	R^2=0.080	p=0.0001	df=1

SEMMT = self-efficacy for managing medications & treatments; SEMDA = self-efficacy for managing daily activities; SEME = self-efficacy for managing emotions; SEMSI = self-efficacy for managing social interactions

Next, a-priori variables of age and education were introduced, and these “base models” served as the comparison model to determine confounding by PROMIS emotional support and post-stroke disability variables. Model 1 was simply the addition of post-stroke disability to the base model, while model 2 was the addition of PROMIS emotional support to the base model. The final model included self-efficacy, age, education, post-stroke disability, and PROMIS emotional support. Confounding was considered if the self-efficacy β coefficient was attenuated >10% when comparing models 1 and 2 to the base model (Figure 2.3). These steps were repeated, separately, for each PROMIS self-efficacy measure to determine their relationship with PAM. Results for each series of self-efficacy and PAM models are shown in Tables 3.13-3.16.

Adding a-priori variables of age and education (base model in Tables 3.13-3.16) resulted in minimal shifts of the self-efficacy β coefficients for all models except SEMSI which had a 13% change (Table 3.16). Entering age and education into the SEMSI model separately revealed that education was solely responsible for the confounding effect (data not shown).

Post-stroke disability (s-mRS) was identified as a confounding variable only in the model examining the association between SEMDA and PAM. Self-efficacy remained significant but was 19% attenuated when post-stroke disability was entered into the model (Table 3.14, sub-model 1). Adjusting for post-stroke disability (s-mRS) had no confounding impact in model 1 for SEMMT (Table 13.13), SEME (Table 13.15), or SEMSI (13.16). The regression coefficients for post-stroke disability (s-mRS) were significantly associated with PAM in the final models of SEME (Table 13.15) and SEMSI (Table 13.16) after controlling for self-efficacy, age, education, and PROMIS emotional support. Post-stroke disability was not significantly associated with PAM in the final models of SEMMT (Table 3.13) and SEMDA (Table 3.14).

Perceived emotional support, on the other hand, was a confounding factor in all self-efficacy and PAM analyses. Adding perceived emotional support to the base model resulted in attenuations of 12%, 17%, 17%, and 21% for SEMMT, SEMDA, SEME, and SEMSI coefficients, respectively (model 2, Tables 13.13-13.16). After controlling for self-efficacy, age, education, and post-stroke disability in each final model, the PROMIS emotional support β coefficient remained significantly associated with PAM.

The final models, adjusted for confounding effects of age, education, post-stroke disability, and perceived emotional support resulted in attenuation of the relationship between all four self-efficacy domains and PAM, in the magnitude of 16% for SEMMT (Table 3.13), 43% for SEMDA (Table 3.14), 27% for SEME (Table 3.15), and 37% for SEMSI (Table 3.16). Despite substantial attenuation, self-efficacy remained significantly associated with PAM for all domains except SEMDA, which was marginally non-significant after adjustment. Additionally, final models accounted for little of the variation in PAM, with R^2 values ranging from 0.15 (15%) to 0.25 (25%).

Table 3. 13: Self-Efficacy for managing medications and treatments (SEMMT) and Patient Activation (PAM) multivariable regression confounding analysis

Variable	Estimate [CI]; p-value	R^2	Overall p-value	Degrees of Freedom (df) and Comments
SEMMT & PAM Crude (bivariate) model (n=180)				
SEMMT	**0.88 [0.62, 1.1]; p<0.001**	R^2=0.208	p<0.0001	df=1
SEMMT & PAM BASE MODEL (n=180)				
SEMMT Age (years) Education level (ref=high school or less) Some college College degree	**0.86 [0.61, 1.1]; p<0.0001** -0.02 [-0.20, 0.16]; p=0.81 1.2 [-4.0, 6.4]; p=0.65 2.9 [-2.5, 8.3]; p=0.29	R^2=0.213	p<0.0001	df=4 2% attenuation of SEMMT β coefficient from crude model
SEMMT & PAM Sub-MODEL 1: Post-stroke Disability (n=179)				
SEMMT Age (years) Education level (ref=high school or less) Some college College degree Post-stroke disability (s-mRS 3-5 vs ≤2)	**0.83 [0.57, 1.1]; p<0.0001** -0.03 [-0.20, 0.15]; p=0.78 1.6 [-3.6, 6.8]; p=0.55 2.7 [-2.7, 8.1]; p=0.32 -3.8 [-8.3, 0.57]; p=0.088	R^2=0.231	p<0.0001	df=5 3% attenuation of SEMMT β coefficient from base model
SEMMT & PAM Sub-MODEL 2: Emotional Support (n=178)				
SEMMT Age (years) Education level (ref=high school or less) Some college College degree PROMIS Emotional support	**0.76 [0.50, 1.0]; p<0.0001** -0.06 [-0.24, 0.12]; p=0.54 1.3 [-3.9, 6.5]; p=0.63 4.0 [-1.4, 9.3]; p=0.15 **0.33 [0.04, 0.61]; p=0.024**	R^2=0.232	p<0.0001	df=5 12% attenuation of SEMMT β coefficient from base model
SEMMT & PAM FINAL MODEL (n=177)				
SEMMT Age (years) Education level (ref=high school or less) Some college College degree Post-stroke disability (s-mRS 3-5 vs ≤2) PROMIS Emotional support	**0.72 [0.44, 0.99]; p<0.0001** -0.06 [-0.24, 0.12]; p=0.50 1.6 [-3.6, 6.7]; p=0.55 3.7 [-1.7, 9.1]; p=0.18 -4.3 [-8.7, 0.18]; p=0.060 **0.36 [0.07, 0.64]; p=0.015**	R^2=0.251	p<0.0001	df=6 16% attenuation of SEMMT β coefficient from base model

Table 3. 14: Self-Efficacy for managing daily activities (SEMDA) and Patient Activation (PAM) multivariable regression confounding analysis				
Variable	**Estimate [CI]; p-value**	**R^2**	**Overall p-value**	**Degrees of Freedom (df) and Comments**
SEMDA & PAM Crude (bivariate) model (n=180)				
SEMDA	**0.60 [0.30, 0.91]; p=0.0001**	R^2=0.078	p=0.0001	df=1
SEMDA & PAM BASE MODEL (n=180)				
SEMDA	**0.58 [0.26, 0.89]; p=0.0004**	R^2=0.085	p=0.0037	df=4
Age (years)	-0.09 [-0.28, 0.11]; p=0.38			
Education level (ref=high school or less)				3% attenuation of SEMDA β coefficient from crude model
Some college	0.06 [-5.6, 5.7]; p=0.98			
College degree	2.0 [-3.8, 7.9]; p=0.50			
SEMDA & PAM Sub-MODEL 1: Post-stroke Disability (n=179)				
SEMDA	**0.47 [0.11, 0.83]; p=0.010**	R^2=0.093	p=0.0044	df=5
Age (years)	-0.09 [-0.28, 0.11]; p=0.38			
Education level (ref=high school or less)				19% attenuation of SEMDA β coefficient from base model
Some college	0.38 [-5.3, 6.1]; p=0.89			
College degree	2.1 [-3.8, 7.9]; p=0.49			
Post-stroke disability (s-mRS 3-5 vs $\leq$2)	-3.3 [-8.7, 2.1]; p=0.22			
SEMDA & PAM Sub-MODEL 2: Emotional Support (n=178)				
SEMDA	**0.48 [0.17, 0.79]; p=0.0029**	R^2=0.134	p=0.0001	df=5
Age (years)	-0.13 [-0.32, 0.06]; p=0.18			
Education level (ref=high school or less)				17% attenuation of SEMDA β coefficient from base model
Some college	**0.18 [-5.3, 5.7]; p=0.05**			
College degree	3.6 [-2.2, 9.4]; p=0.22			
PROMIS Emotional support	**0.50 [0.21, 0.79]; p=0.0009**			
SEMDA & PAM FINAL MODEL (n=177)				
SEMDA	0.33 [-0.03, 0.69]; p=0.069	R^2=0.149	p<0.0001	df=6
Age (years)	-0.13 [-0.32, 0.06]; p=0.18			
Education level (ref=high school or less)				43% attenuation of SEMDA β coefficient from base model
Some college	0.53 [-5.0, 6.0]; p=0.85			
College degree	3.7 [-2.1, 9.4]; p=0.22			
Post-stroke disability (s-mRS 3-5 vs $\leq$2)	-4.6 [-9.8, 0.70]; p=0.089			
PROMIS Emotional support	**0.54 [0.24, 0.83]; p=0.0005**			

Table 3. 15: Self-Efficacy for managing emotions (SEME) and Patient Activation (PAM) multivariable regression confounding analysis

Variable	Estimate [CI]; p-value	R^2	Overall p-value	Degrees of Freedom (df) and Comments
SEME & PAM Crude (bivariate) model (n=180)				
SEME	**0.67 [0.42, 0.92]; p<0.0001**	R^2=0.138	p<0.0001	df=1
SEME & PAM BASE MODEL (n=180)				
SEME Age (years) Education level (ref=high school or less) Some college College degree	**0.66 [0.41, 0.91]; p<0.001** -0.05 [-0.24, 0.13]; p=0.58 0.87 [-4.6, 6.3]; p=0.75 3.2 [-2.3, 8.8]; p=0.25	R^2=0.147	p<0.0001	df=4 1% attenuation of SEME β coefficient from crude model
SEME & PAM Sub-MODEL 1: Post-stroke Disability (n=179)				
SEME Age (years) Education level (ref=high school or less) Some college College degree Post-stroke disability (s-mRS 3-5 vs ≤2)	**0.61 [0.33, 0.86]; p<0.0001** -0.05 [-0.24, 0.13]; p=0.57 1.1 [-4.3, 6.6]; p=0.68 2.9 [-2.7, 8.6]; p=0.30 -4.0 [-8.7, 0.65]; p=0.091	R^2=0.161	p<0.0001	df=5 8% attenuation of SEME β coefficient from base model
SEME & PAM Sub-MODEL 2: Emotional Support (n=178)				
SEME Age (years) Education level (ref=high school or less) Some college College degree PROMIS Emotional support	**0.55 [0.29, 0.81]; p<0.0001** -0.09 [-0.28, 0.09]; p=0.33 0.77 [-4.6, 6.1]; p=0.78 4.4 [-1.2, 10.0]; p=0.12 **0.38 [0.08, 0.68]; p=0.012**	R^2=0.171	p<0.0001	df=5 17% attenuation of SEME β coefficient from base model
SEME & PAM FINAL MODEL (n=177)				
SEME Age (years) Education level (ref=high school or less) Some college College degree Post-stroke disability (s-mRS 3-5 vs ≤2) PROMIS Emotional support	**0.48 [0.21, 0.75]; p=0.0006** -0.10 [-0.28, 0.09]; p=0.30 1.0 [-4.4, 6.4]; p=0.71 4.0 [-1.5, 9.6]; p=0.16 **-4.8 [-9.4, -0.12]; p=0.044** **0.42 [0.12, 0.72]; p=0.0059**	R^2=0.191	p<0.0001	df=6 27% attenuation of SEME β coefficient β coefficient from base model

Table 3. 16: Self-Efficacy for managing social interactions (SEMSI) and Patient Activation (PAM) multivariable regression confounding analysis				
Variable	**Estimate [CI]; p-value**	**R^2**	**Overall p-value**	**Degrees of Freedom (df) and Comments**
SEMSI & PAM Crude (bivariate) model (n=178)				
SEMSI	**0.62 [0.30, 0.93]; p=0.0001**	R^2=0.080	p=0.0001	df=1
SEMSI & PAM BASE MODEL (n=178)				
SEMSI Age (years) Education level (ref=high school or less) Some college College degree	**0.70 [0.39, 1.0]; p=0.0001** -0.13 [-0.32, 0.06]; p=0.18 1.5 [-4.1, 7.1]; p=0.59 **6.9 [1.1, 12.7]; p=0.020**	R^2=0.118	p=0.0002	df=4 13% inflation of SEMSI β coefficient from crude model
SEMSI & PAM Sub-MODEL 1: Post-stroke Disability (n=177)				
SEMSI Age (years) Education level (ref=high school or less) Some college College degree Post-stroke disability (s-mRS 3-5 vs $\leq$2)	**0.65 [0.33, 0.97]; p<0.0001** -0.12 [-0.31, 0.06]; p=0.19 1.7 [-3.8, 7.3]; p=0.53 **6.3 [0.45, 12.2]; p=0.035** -4.4 [-9.1, 0.28]; p=0.065	R^2=0.138	p<0.0001	df=5 7% attenuation of SEMSI β coefficient from base model
SEMSI & PAM Sub-MODEL 2: Emotional Support (n=178)				
SEMSI Age (years) Education level (ref=high school or less) Some college College degree PROMIS Emotional support	**0.55 [0.19, 0.91]; p=0.0032** -0.14 [-0.33, 0.04]; p=0.13 1.3 [-4.2, 6.8]; p=0.64 **6.9 [1.1, 12.6]; p=0.020** 0.29 [-0.04, 0.63]; p=0.085	R^2=0.133	p=0.0001	df=5 21% attenuation of SEMSI β coefficient from base model
SEMSI & PAM FINAL MODEL (n=177)				
SEMSI Age (years) Education level (ref=high school or less) Some college College degree Post-stroke disability (s-mRS 3-5 vs $\leq$2) PROMIS Emotional support	**0.44 [0.07, 0.82]; p=0.020** -0.14 [-0.33, 0.04]; p=0.14 1.5 [-4.0, 7.0]; p=0.60 **6.0 [0.21, 11.8]; p=0.042** **-5.4 [-10.1, -0.66]; p=0.026** **0.36 [0.02, 0.71]; p=0.038**	R^2=0.160	p<0.0001	df=6 37% attenuation of SEMSI β coefficient from base model

Moderation

Lastly, two-way interactions were explored between each self-efficacy measure and age, education, post-stroke disability, and perceived emotional support with PAM score as the dependent outcome (Figure 2.5). No significant interactions were detected ($p<0.05$) (Table 3.17). In conclusion, none of the variables that were explored for interaction effects serve as moderators of the associations between self-efficacy and patient activation.

Table 3. 17: Moderation analysis of Self-Efficacy and the Patient Activation Measure (PAM) – Interaction effects of four self-efficacy measures with age, education, post-stroke disability, and perceived emotional support

Interaction Term	Type III p-value[a]	Degrees of Freedom (df)
7-day Self-Efficacy for Managing Medications & Treatments (SEMMT)		
SEMMT*age (years)	p=0.90	df=1
SEMMT*education level (ref=high school or less)	p=0.22	df=2
SEMMT*post-stroke disability (s-mRS $\leq$2 vs 3-5)	p=0.49	df=1
SEMMT*PROMIS emotional support	p=0.32	df=1
7-day Self-Efficacy for Managing Daily Activities (SEMDA)		
SEMDA*age (years)	p=0.19	df=1
SEMDA*education level (ref=high school or less)	p=0.20	df=2
SEMDA*post-stroke disability (s-mRS $\leq$2 vs 3-5)	p=0.88	df=1
SEMDA*PROMIS emotional support	p=0.42	df=1
7-day Self-Efficacy for Managing Emotions (SEME)		
SEME*age (years)	p=0.28	df=1
SEME*education level (ref=high school or less)	p=0.09	df=2
SEME*post-stroke disability (s-mRS $\leq$2 vs 3-5)	p=0.81	df=1
SEME*PROMIS emotional support	p=0.31	df=1
7-day Self-Efficacy for Managing Social Interactions (SEMSI)		
SEMSI*age (years)	p=0.86	df=1
SEMSI*education level (ref=high school or less)	p=0.47	df=2
SEMSI*post-stroke disability (s-mRS $\leq$2 vs 3-5)	p=0.71	df=1
SEMSI*PROMIS emotional support	p=0.47	df=1

SEMMT = self-efficacy for managing medications & treatments; SEMDA = self-efficacy for managing daily activities; SEME = self-efficacy for managing emotions; SEMSI = self-efficacy for managing social interactions

DISCUSSION

Stroke transitions of care are often challenging for survivors who face a variety of medical and psychosocial needs that change over the recovery period. Achieving successful transitions from hospital to home and attaining community reintegration involves engagement, health management, education, well-being, continuity of care, and accountability.[12] Effective self-management is a key contributor to addressing multiple transitional care components and ultimately achieving better long term control of stroke deficits, addressing modifiable risk factors, and improving stroke prevention strategies. Self-efficacy and patient activation are distinct yet related constructs important to successful self-management and care transitions. Self-efficacy measures an individual's confidence to perform a specific task or activity,[32] whereas patient activation is a broader construct measuring an individual's knowledge, skill, and confidence for managing their general health and health care.[23] The overarching goal of this secondary analysis of MISTT data was to explore indicators of self-management, specifically the cross-sectional relationships between four measures from the PROMIS Self-Efficacy for Managing Chronic Conditions domain and the patient activation measure (PAM), as well as factors that may confound or moderate these relationships among a population of acute stroke patients.

Patient Activation

In this population of ischemic or hemorrhagic stroke survivors returning back to their communities, the mean PAM score obtained shortly after patients returned home was 64.5 (SD: 16.1; range 30.4 to 100.0). Higher PAM scores indicate greater activation. Mean scores in the MISTT population are a few points higher than the mean score of 62 (SD: not reported) derived from a large national US population (n=1,469); however, perfect scores of 100 were excluded when generating that population estimate in an attempt to control for socially desirable response bias.[72] Dropping the 15 MISTT patients with PAM scores of 100 results in a mean PAM score of 61.3 (SD: 12.5), clearly closer to the mean score from Hibbard's nationally representative sample. Studies conducted among specific patient populations have shown mean PAM scores in the range of 57 to 72; these means were calculated by including the entire spectrum of possible scores from 0 to 100. For example, two studies of diabetics had mean baseline PAM scores of 64.1 (SD: 15.0)[48] and 71.5 (SD: 12.8),[49] respectively, while another produced a mean of 57 (SD: not reported);[81] chronically ill individuals with concurrent depression had average baseline scores of about 60 (intervention: 60.2 [SD: 13.2]; control: 58.2 [SD: 13.9]);[39] and the mean PAM scores for patients prior to undergoing lumbar spinal surgery was 58.5 (SD: 15.1).[42] Among employees that were not selected for disease condition, mean scores were 69 (SD: 15.4).[75] The range in mean scores across studies is clinically meaningful, but not statistically different due to overlapping standard deviations. One study suggests that a 5-point change in PAM indicates a clinically meaningful change in healthier behaviors,[75] but to the author's knowledge no other estimates of minimally clinical important differences have been established for PAM. Insignia Health, the company that now owns rights to PAM, also claims that even a 1-point change in PAM can be considered meaningful.[81]

Only two exploratory studies have assessed PAM among stroke survivors. The median PAM scores (60.6 [IQR: 51.0, 73.5]) obtained in this MISTT analysis are lower than median PAM scores of 75.3 (IQR: 69, 80) derived from a small group (n=20) of stroke survivors, measured 1-12 months post-stroke.[113] In another small [50] study of stroke survivors (n=10) and Multiple Sclerosis patients (n=10) who had been diagnosed for at least 6-months and were undergoing neuro-rehabilitation, median PAM scores at baseline were 56.4 (IQR: 52.9, 63.9) and 63.0 (IQR: 51.5, 71.3) in control and intervention groups. Due to the small sample sizes and exploratory nature of these two studies, reliability and generalizability of these data are very limited.

PROMIS Self-Efficacy Domains

PROMIS self-efficacy responses are converted into a T-score, which is standardized to a mean of 50 and standard deviation of 10. Standardization for the PROMIS Self-Efficacy for Managing Chronic Conditions domain was established with a clinical population consisting of individuals with a wide range of general and neurologic chronic conditions, including angina, arthritis, asthma, cancer, coronary artery disease, diabetes, myocardial infarction, COPD, congestive heart failure, HIV/AIDS, renal disease, hepatic disease, migraines, epilepsy, multiple sclerosis, neuropathy, Parkinson's disease, spinal cord injury, or stroke.[32] Although the number of stroke survivors within the general chronic conditions population were not reported, only 20% (167/837) of the chronic neurologic participants were stroke survivors. In this MISTT analysis, mean T-scores for three of the PROMIS self-efficacy domains are similar to standardized means of 50 (SD=10): self-efficacy for managing medications and treatments (SEMMT) T-score = 47.0 (SD: 8.4), self-efficacy for managing emotions (SEME) T-score = 50.2 (SD: 8.9), and self-efficacy for managing social interactions (SEMSI) T-score = 49.8 (SD: 7.4). However, the self-efficacy for managing daily activities (SEMDA) T-score was 43.5 (7.5), which is more than half a standard deviation (i.e., $\geq$5 points) lower than the standardized mean which may be considered a clinically meaningful difference. Daily activities includes functional tasks related to bathing, grooming, dressing, ambulating, cooking, etc. Functional deficits are common consequences of stroke. They often directly impact daily activities, are easily identified immediately post-stroke, and are an important focus of stroke recovery and rehabilitation. As such, patients with newly acquired functional deficits may be acutely aware of their deficits and have less confidence in their ability to perform associated daily tasks. It is possible that the time point of our data collection, which occurred within the first week and a half following return to home, actually reflects a time point where patients are more aware of functional challenges and have not yet developed or experienced awareness of emotional or social challenges associated with community re-integration. Thus, our results of patients having lower confidence in SEMDA might reflect this greater awareness and immediate impact of functional deficit. On the other hand, patients may not have been home long enough to recognize or experience challenges related to independently managing medications, managing emotions, or managing social interactions. Alternatively, and regardless of when data were collected in relation to the stroke event, acute stroke may have greater impact on daily activities but similar impact on medication management, emotions, and social interactions as experienced by the chronically ill clinical population used to standardize mean PROMIS self-efficacy T-scores.

Associations between PROMIS Self-Efficacy and Patient Activation

The following sections will discuss the meaning and relevance of the results generated from each Aim of this thesis analysis. The goals of Aim 1 were to establish correlation coefficients to explore construct validity of the underlying theory that the patient activation construct involves a component of self-efficacy. Aims 2 and 3 were focused on identifying patient factors associated with patient activation and self-efficacy, respectively, among acute stroke survivors. Aim 4 then explored if any of the identified factors from Aims 2 and 3 confounded or moderated the relationships between each PROMIS self-efficacy measure and PAM.

Aim 1: Correlation between PROMIS Self-Efficacy and Patient Activation

Concurrent with previous studies supporting the theory that self-efficacy and patient activation are related constructs,[34-38,40] Pearson correlation coefficients generated in Aim 1 of this analysis were positive and significant, revealing that modest linear relationships exist between PROMIS self-efficacy measures and PAM. As hypothesized, PAM was most strongly correlated with SEMMT (r=0.46), likely because the two measures share similar questions pertaining to one's confidence in medication management. Medication knowledge, adherence, and access are critically important aspects to successful transitions of care and disease self-management, but are certainly not the sole contributors to patient activation. Both SEMDA and SEMSI had weaker correlations with PAM (both r=0.28), while SEME had a slightly stronger correlation (r=0.38). Unexpectedly, SEMDA had a weaker correlation with PAM than SEME and had identical results as SEMSI. Correlation coefficients remained stable in the sensitivity analysis when raw PAM sums, rather than transformed scores, were used to form two restricted sub-scales – one containing six confidence-related questions (PAM-CR) and one containing the remaining seven questions (PAM-nonCR). The results support an underlying conceptualization that confidence is part of the PAM construct, which holds true across multiple self-efficacy domains. Correlations between the self-efficacy measures and the two PAM sub-scales (PAM-CR and PAM-nonCR) were very similar, suggesting that self-efficacy is a concept associated with all PAM questions, regardless of whether or not the question explicitly addresses one's confidence. These results refute my hypothesis that questions directly addressing confidence (PAM-CR) would have greater correlation with self-efficacy compared to correlations between self-efficacy and PAM questions that did not directly address confidence (PAM-nonCR). Despite psychometric testing that supports PAM as a unidimensional measure,[23] other authors have suggested that PAM may actually be multidimensional, indicating there are discrete, distinct constructs within PAM that should be reported as sub-scales.[37,38,79,131] Confirming dimensionality is outside the scope of simple correlations, thus future work with MISTT data, including more advanced statistical methods such as factor analysis or latent class analysis, might shed further light on the underlying conceptual structure of PAM and on the underlying relationships and constructs between PROMIS self-efficacy measures and PAM.[114] Future studies designed to establish construct validity of PAM using other self-efficacy measures, in addition to the PROMIS self-efficacy measures, are also warranted.

Aim 2: Factors Associated with Patient Activation

Aim 2 explored patient factors associated with patient activation. I hypothesized that education, discharge to acute rehabilitation (compared to home or subacute rehabilitation), better QOL, and greater perceived health status would be positively associated with PAM, while older age, post-stroke disability, and depressive symptoms would be negatively associated with PAM. Greater perceived emotional support was a significant, positive, independent, factor associated with PAM, whereas greater post-stroke disability and having a caregiver consented to MISTT were significant, independent factors negatively associated with PAM. These results supported my hypothesized relationship between PAM and post-stroke disability, but refuted my hypothesis that greater perceived support and having a caregiver participate in the MISTT study would not be significantly associated with PAM. Self-management and patient activating interventions often aim to increase social support, however, few studies have directly evaluated the relationship between support outcomes and PAM. Support is not always clearly defined and may refer to several different types of support, including educational support, practical support, and emotional support. Congruent with my results, baseline levels of social support were associated with higher PAM scores among a large sample reporting chronic conditions[80] and a population of geriatric adults.[132] Evidence also shows that having a family support network results in better outcomes (e.g., glucose monitoring, readmissions, mortality, self-management, etc.) for patients with diabetes,[133,134] heart failure,[135,136] and chronic illnesses,[134,137] but these studies did not address the effect of support on patient activation using PAM.

Consenting to participate in the MISTT trial may serve as a proxy for caregiver behaviors, possibly indicating a high level of engagement in the caregiving role. Caregiver motivation for being highly engaged could be based on a wide range of factors including, but not limited to a lack of confidence in their new caregiving role, anticipation that their loved-one will need additional help beyond their own caregiving capacity, knowing their loved-one lacks self-confidence and activation to manage their stroke recovery, or merely a reflection of strong family support. This raises interesting questions about the how the dyad relationship between caregiver and patient may impact levels of activation and engagement. Regardless of the caregiver's ability or motivation, patients who had a participating caregiver had lower levels of activation, after controlling for age, education, emotional support, and post-stroke disability. The inverse relationship found in this study differs from previous studies that measured the amount of perceived family support, independent of the caregiver's study participation. The variable of "consented caregiver" used in this thesis analysis is not a known measure of the support network available to the patient, thus it can only be hypothesized as a proxy indicating engaged caregiver behaviors. Perhaps patient activation was lower when the caregiver was engaged (i.e., consented to participate in MISTT) because their loved-one knew there was someone to rely on for taking care of the things they were uncertain about or, alternatively, because the patient perceived their interactions with the caregiver as negative. Although this theory isn't directly addressed in previous patient activation literature, self-efficacy literature shows that caregiver involvement can have unintended negative effects. In an intervention study of a psychosocial education program for arthritis patients and their partners, those with partners had lower Arthritis Self-Efficacy and higher fatigue.[138] Likewise, additional studies among older adults with chronic conditions found caregiver involvement could negatively affect patient confidence.[134,139]

The finding that greater post-stroke disability was negatively associated with patient activation, is similar to previous studies showing negative associations between disability/severity and patient activation among non-stroke populations.[112,140] During the first week at home, stroke patients are still learning to cope with their deficits and are discovering how these deficits impact day-to-day living. Since data were collected shortly after return to home, lower activation levels likely reflect the fact that patients have not had enough recovery time to acquire the skills and knowledge to build self-confidence for actively managing their deficits.

Aim 3: Factors Associated with PROMIS Self-Efficacy

Similar to Aim 2, Aim 3 explored patient factors associated with each of the four PROMIS self-efficacy domains. I hypothesized that:

- H1: Education, perceived informational support, emotional support, discharge to acute rehabilitation (vs home or subacute rehabilitation), QOL, and perceived health status will be positively associated with the four PROMIS self-efficacy measures

- H2: Age, living alone, stroke severity, post-stroke disability, stroke risk factors, and depressive symptoms will be negatively associated with self-efficacy measures
- H3: Discharge destination, stroke risk factors, and post-stroke disability will be more strongly associated with self-efficacy for managing medications and treatment and for managing daily activities.
- H4: Living alone and depressive symptoms will be more strongly associated with self-efficacy for managing emotions and for managing social interactions.

Most of these hypotheses were only partially supported by my results. Unexpectedly, in multivariable modeling, only four variables were consistently associated across two or more PROMIS self-efficacy measures, including depressive symptoms (PHQ-9), discharge destination, age, and post-stroke disability. Education, PROMIS informational support, and PROMIS emotional support were only associated with SEMSI, where having a college degree was associated with less SEMSI and having great support was positively associated with SEMSI. Sex was only significantly associated with SEME, where females were associated with lower self-efficacy scores, and perceiving better health status was positively associated with only SEMDA. Contrary to my hypotheses, no associations were found between any of the self-efficacy measures and living alone, stroke severity, or stroke risk factors. Perhaps because these factors were partially reflected in discharge destination and post-stroke disability. Additionally, post-stroke emotional and behavioral dyscontrol was independently and inversely associated with SEME, even after controlling for age, education, sex, discharge destination, and depressive symptoms.

Results from the multivariable models supported my hypothesis that depressive symptoms are negatively associated with all four PROMIS self-efficacy domains. Depressive symptoms had larger magnitude of association with SEMMT and SEME and were associated at a smaller magnitude with

SEMDA and SEMSI, which only partially supported my fourth hypotheses. Contrary to my hypothesis, depression had stronger inverse association with SEMMT than SEMSI, possibly because patients hadn't been home long enough to realize how their depression might affect their social interactions. Currently, medication complexity for MISTT participants has not been analyzed; however, the negative association between SEMMT and depression could be explained if those with depression also have more complex medications (total number of medications and medication changes, new medications, dose, frequency, route, etc.) and thus experience more difficulty managing their medication treatments. Future MISTT analyses could explore the association between medication complexity and SEMMT, along with whether the number or complexity of medications differs between patients with different levels of depressive symptoms.

Despite evidence that post-stroke rehabilitation programs are associated with increased self-efficacy,[141] discharge destination revealed inverse associations of discharge to acute rehabilitation with SEMDA and discharge to subacute rehabilitation with SEMMT, SEMDA, and SEME. These results refute my first hypothesis that acute rehabilitation has a positive relationship with self-efficacy. Discharging to subacute rehabilitation, compared to discharging home, was associated with lower confidence for managing medications/treatments, daily activities, and emotions, which likely reflects the fact that patients experiencing more severe stroke and greater medical needs discharge to subacute rehabilitation. Clearly patients discharging directly home rather than to either acute or subacute rehabilitation have greater SEMDA, again, likely due to the differences patient characteristics that lead to an initial discharge location other than home, including post-stroke disability level.

In partial support of my hypothesis, age was inversely related to SEMMT and SEME, but not significantly associated with SEMDA or SEMSI. In contrast, one study found that SEME was higher in older individuals and that mean SEMMT T-scores were similar across age.[32] However, the authors did not use multivariable models to control for confounding, but only, compared mean T-scores within each demographic variable. Future analyses of MISTT data could explore the distribution of stroke severity, medication complexity, and post-stroke disability by age to help explore explanations for these results.

As hypothesized, post-stroke disability (s-mRS) was negatively associated with SEMDA and SEMSI. Patients with more severe impairment likely experience restricted activity that also creates social isolation. Although not directly comparable to the results of this thesis, previous work has shown a moderate inverse correlation between SEMDA and mRS scores (r= -0.47), along with strong correlation between SEMDA and PROMIS physical function (r=0.78) and PROMIS Global physical health (r=0.75). SEMSI was also significantly and inversely correlated with mRS, but at a much weaker level (r= -0.23), while the other PROMIS self-efficacy measures had even weaker correlations.[32]

In summary, multivariable models found older age, discharge to a subacute rehabilitation facility (SAR), and greater depressive symptoms were independently and inversely associated with SEMMT. Better perceived health status was positively associated with SEMDA, while discharging to an acute or subacute rehabilitation facility (IPR or SAR), greater post-stroke disability, and greater depressive symptoms were independent, negatively associated factors. SEME was inversely associated with older age, female gender, discharge to SAR, greater emotional and behavioral dyscontrol, and greater depressive symptoms. Finally, SEMSI was positively associated with greater emotional and informational support and inversely associated with having a college degree, greater post-stroke disability, and greater depressive symptoms.

The only comparable study that explored difference in demographic variables across PROMIS self-efficacy measures is the original validation study of the PROMIS self-efficacy measures for managing chronic conditions, conducted by Gruber-Baldini et. al.[32] Following development work that involved expert opinion, patient focus groups, and patient cognitive interviewing, Gruber-Baldini conducted a cross-sectional study among 1,087 individuals, including 837 (77%) individuals with a chronic neurologic condition and 250 individuals with at least one general chronic condition. The chronic neurologic population was recruited from an academic ambulatory neurology clinic, while the population with general chronic conditions was recruited from an online research community; disease duration across the whole cohort was an average of 10.1 years (SD: 10.7). ANOVA methods determined differences in PROMIS self-efficacy T-scores within each participant demographic variable. The authors found that across the five PROMIS self-efficacy measures, T-scores within each measure differed significantly by most demographic characteristics, including age, race, sex, ethnicity, education, marital status, annual income, employment status, and recruitment population. Results from my multivariable analysis identified independent variables that differed from the observed variables and directions of association expected from Gruber-Baldini's work. For example, race was not a significant factor in my final models and older age was associated with worse SEME rather than better SEME; age was not independently associated with SEMDA or SEMSI. Sex was associated with SEME and SEMDA and was lower in females, while Gruber-Baldini only found significant associations with SEMMT where females had higher T-scores. Inconsistencies between the results found in this thesis analysis and the Gruber-Baldini's validation study may be due to differences in study populations, study design, and data collection methods. Of particular note, MISTT involved acute stroke survivors whose self-efficacy was measured within the first month of returning home compared to the validation study of mixed conditions with an average chronicity/duration of 10-years. Acute stroke survivors may experience and respond differently to physical and emotional unmet needs and challenges that result in different levels of confidence during the acute phase of recovery/transition than in a more chronic phase where greater time has elapsed in relation to the acute health event. In addition to the differences between an acute and chronic health event, experiences and responses contributing to self-efficacy may differ between stroke and other conditions.

Aim 2 and Aim 3 revealed that PROMIS self-efficacy domains and PAM shared only two common independent risk factors – self-reported post-stroke disability (s-mRS) and perceived emotional support. Depressive symptoms (PHQ9) were independently associated with all four self-efficacy measures (Aim 3) but not PAM (Aim 2), which was surprising given the strong empirical evidence for associations between depression and PAM.[35,37,40,46,80,82,83,111,112,137,140,142-144] Factors associated with increased levels of patient activation or self-efficacy may serve as important intervention targets for tailoring programs to achieve better self-management, transitions of care, and health outcomes. For example, addressing depression or social support with a patient-centered approach may lead to increased self-efficacy, resulting in better outcomes. Much of the available patient activation research has been limited to exploring factors associated with PAM within clinical populations of diabetes, arthritis, heart disease, COPD, and mental health conditions. Only one pilot study has explored patient activation exclusively in stroke but this was exploratory and limited to 20 patients.[113] Factors associated with PAM vary across populations, and future studies are needed to confirm the generalizability of this current analysis. Self-efficacy has served as a popular theoretical framework for numerous interventions, even among stroke populations.[55,68,70,145] Factors associated with self-efficacy have been explored with regression analyses using various different measures, but to the author's knowledge similar studies do not exist for the PROMIS Self-Efficacy for Managing Chronic Conditions domains. More work is needed to confirm the results generated in this work and to confirm demographic differences in self-efficacy during the acute post-stroke period. This analysis is limited to measures collected, on average, within the first 10-days after patients returned home, early in the post-stroke recovery phase when patients are still discovering their needs and limitations. It is possible that some patients overestimated their activation or domain-specific confidence because they hadn't yet identified existing unmet needs or realized the impact of ongoing deficiencies on their ability to return to their previous social and functional roles. The timing of our data collection has the potential to impact both self-efficacy and patient activation results.

Particularly among stroke, the timing of self-efficacy and patient activation assessments will need to be carefully considered when comparing results to more stable chronic disease populations, and ideal timing for measurement needs to be established.

Ultimately, this cross-sectional analysis contributes insight to the relationships between factors associated with self-efficacy and patient activation, but cannot confirm causal relationships. Further information is needed to characterize and understand how factors impact changes in these outcomes over time, but such relationships cannot be determined from this thesis analysis because only starting (baseline) values were examined. Future MISTT analyses will evaluate the associations between factors with 90-day self-efficacy and patient activation outcomes, and their change between 7-day and 90-day time points. Additional work is needed to understand post-stroke activation and self-efficacy across the spectrum of recovery trajectories and unmet need profiles, as well as how self-efficacy and activation among stroke compares to other chronic disease or healthy populations.

Aim 4: The Relationship between PROMIS Self-Efficacy domains and Patient Activation

As hypothesized for Aim 4, all self-efficacy domains were significantly associated with patient activation in crude, unadjusted linear regression models. Refuting my hypothesis, discharge destination, depressive symptoms and QOL were not significantly associated with self-efficacy or PAM in Aims 2 and 3 and, therefore, were not selected to test for confounding effects in Aim 4. Instead, only post-stroke disability and perceived emotional support were selected. As expected, unadjusted associations between self-efficacy and PAM attenuated when covariates were introduced into the models; these associations remained significant for all self-efficacy domains except SEMDA.

Confounding occurs when the covariate is both associated with the independent variable (self-efficacy) and the dependent variable (patient activation), and thereby attenuates (i.e., reduces) the association between the independent and dependent variables. If the covariate is known or hypothesized to be part of the causal pathway between the independent and dependent variables, then the effect is manifest by mediation where the relationship between the independent and dependent variables occurs *through* the covariate. Mediation typically involves the same analytical methods (i.e., multivariable modelling) as confounding, therefore, distinguishing whether a covariate is a mediator or confounder is driven by external knowledge and cannot be solely determined by statistical methods. It is also challenging to reliably establish mediation effects using cross-sectional data because the time-order of the relationship between the independent and dependent variables is unknown. To summarize the results of the exploratory confounding analyses performed in Aim 4, perceived emotional support attenuated the relationship between all four self-efficacy domains and PAM, whereas post-stroke disability (s-mRS) only attenuated the relationship between SEMDA and PAM. Both post-stroke disability and perceived emotional support confounded the relationship between SEMDA and PAM. Interestingly, in the final adjusted model, the association between SEMDA and PAM lost significance where the SEMDA coefficient was attenuated 43%. This result suggests a need to further explore the relationship between SEMDA and post-stroke disability, as well as to explore SEMDA as a mediator between post-stroke disability and activation.

In partial support of my hypothesis, the magnitude of the association between SEMSI and PAM was lower than the magnitude of SEMMT and PAM, however, the association of PAM was unexpectedly lower with SEMDA than with SEME. Again, this may reflect the timing of data collection in relation to the short period of time patients had after returning home and the proximity to their stroke event. It may also reflect the domains of self-efficacy that are more prevalent in patient activation as measured in the PAM.

Social support has been described as containing three main elements – emotional support (i.e. caring, empathy, acceptance), informational support (i.e., providing knowledge), and instrumental support (i.e. practical support). The literature offers evidence that perceived social support influences post-stroke outcomes including participation, leisure activities, activities of daily living, functioning,[146] and also particularly depression.[146-148] However, interventions designed to increase post-stroke support when tested in RCTs have been largely unsuccessful in creating meaningful changes in mood or depression.[149] This thesis analysis supports the idea that perceived emotional support, which is an independent predictor of both self-efficacy and patient activation, also attenuates the relationship between self-efficacy and PAM. The PROMIS emotional support measure reflects perceived feelings of being cared for and valued.[119] Support is important to assess, and should be integrated into interventions by establishing trusted relationships with patients/families and helping patients build social support systems. Support should also be controlled in analyses involving stroke populations. In addition to PROMIS emotional support, PROMIS informational support and PROMIS instrumental support had significant bivariate associations with self-efficacy and patient activation, but these relationships became non-significant after further adjustment and so were excluded from final models. Emotional support was the only support measure that had a consistent and strong relationship in the current analyses, but the effects of the other two support measures may have been suppressed due to collinearity with emotional support.

Post-stroke disability, on the other hand, was associated with both SEMDA and SEMSI, but only confounded the relationship between SEMDA and PAM. Both SEMDA and s-mRS assess the domain of activities encountered as part of everyday living and have overlapping items that address either confidence for performing the activity/task (SEMDA) or functional ability (post-stroke disability).

The context of patient-reported responses, cognitive-behavioral status, and mental and physical health outcomes is complex and diverse among individuals. Covariates in the current analyses were considered as confounders in part due to the cross-sectional nature of this data, but the covariates of post-stroke disability and perceived social support might be functioning as mediators rather than confounders. Both variables could conceivably fit into the causal pathway. To the author's knowledge, no studies have explored the mediation effects of self-reported outcomes (such as post-stroke disability and perceived emotional support) on the relationship between self-efficacy and PAM. In fact, many analyses consider either PAM or self-efficacy as the mediator, rather than the dependent variable. Further analyses is needed to explore the temporal relationships of whether self-efficacy may impact a person's response to self-reported outcomes that may, in turn, influence self-reported activation. Given that neither age nor education level are hypothesized in the causal pathway of self-efficacy and patient activation, they more readily meet the definition of confounding, not mediation.

In support of my hypothesis, no interaction effects were detected between self-efficacy domains (SEMMT, SEMDA, SEME, SEMSI) and age, education, post-stroke disability, or perceived emotional support. This finding reveals that none of these third variables moderated the relationships between self-efficacy and patient activation, meaning that self-efficacy and PAM associations were constant across different levels of the third variable.

This thesis addresses current gaps in the limited use of PAM among stroke populations, minimal data available from the recent PROMIS Self-Efficacy for Managing Chronic Conditions measures, and the limited information about what impacts the direct associations between self-efficacy and patient activation in the acute post-stroke transition period. Fewer risk factors and potential confounders were identified during this acute post-stroke recovery phase than hypothesized. Further work is need to identify if relationships between self-efficacy, patient activation, and patient risk factors differ in the acute versus chronic post-stroke recovery phases and how these variables change over time in stroke survivors. Additionally, further work is need to understand what interventions may affect stroke survivor self-efficacy and patient activation. MISTT data will be used to begin explore these areas because follow-up data at 90-days can be used to quantify changes in PROMIS self-efficacy and PAM measures, but future studies will be needed to confirm results.

Clinical Implications

This work found that among stroke survivors in their acute transitional care period, patient activation and self-efficacy are related constructs; higher levels of self-efficacy are associated with higher levels of activation. Perceived emotional support and self-reported post-stroke disability are important variables to control for in analyses because, within the context of these exploratory analyses, they appear to confound the relationships between self-efficacy and activation. Additional analyses, using longitudinal data, could help further distinguish between these confounding effects and potential mediation effects. Among the four measures of self-efficacy assessed, only SEMDA had a mean score that was meaningfully below the standardized mean T-score of 50. In theory, self-efficacy is modifiable; therefore, medical providers, community service personnel, and informal caregivers should support stroke survivors in ways that will increase their confidence in adapting to perform daily activities. Mean scores of PAM, SEMMT, SEME, and SEMSI were similar to means previously established using either standardized populations (self-efficacy) or nationally representative samples (PAM). However, MISTT data was collected an average of 10-days after returning home, potentially before the patient had time to encounter meaningful community and role integration. Thus, these results cannot be extrapolated to later recovery periods, and the results from this analysis should not be grounds for immediately disregarding activation or self-efficacy domains, including SEMMT, SEME, and SEMSI, from self-management strategies. Fortunately, MISTT 90-day follow-up data offers an opportunity to explore intervention effects and changes over time.

Self-efficacy or patient activation scores should not be used as a proxy measure for survivors' needs, specifically assuming that high self-efficacy or patient activation levels reflect an absence of need. On the contrary, these assessments should be used in conjunction with biopsychosocial and other needs assessments. While biopsychosocial assessments identify specific domains of need, PAM measures can identify the patient's global capabilities related to knowledge, skill, and confidence. Jointly, these tools can be used to guide post-stroke intervention and management plans to encourage successful, tailored, patient-centered self-management practices. To date, self-efficacy measures have been largely reserved for research purposes, although implementing self-efficacy assessments in clinical practice may offer additional insight into areas for targeted intervention activities. Addressing the role of self-efficacy measures as clinical assessment tools or quality metrics would need to be explored through future implementation research. Regardless of what measurement tools are implemented into standard practice, increasing confidence and encouraging stroke survivors to have an active role in their health are important elements of any post-stroke transitional care and recovery program.

Strengths and Limitations

Strengths of this analysis include utilization of measures from the recently validated PROMIS Self-Efficacy for Managing Chronic Conditions domain.[32] Stroke survivors were included in the clinical populations used to validate these measures,[32] although no information was provided about their recovery status and they were grouped together with individuals with other chronic neurologic conditions. To the author's knowledge, this work is the first to determine associations between PROMIS self-efficacy measures and PAM for any population. Understanding these relationships is important for grounding the new PROMIS self-efficacy measures with previous literature and providing further evidence for their usefulness, particularly because of the growing advocacy to utilize PROMIS measures and PAM in clinical practice. It is also the first analysis to identify risk factors associated with PAM in acute stroke survivors who have recently returned home, and the first to explore direct relationships between post-stroke self-efficacy and patient activation. Additionally, this analysis included a broad, community-hospital population of 180 stroke survivors, which is a larger sample size than many of the previous patient activation studies.

This thesis analysis also has several limitations. First, performing a cross-sectional analysis limits the ability to determine causality due to the lack of temporality. However, understanding associations at one time point is the first step in interpreting changes that occur over time and how these baseline factors may influence longitudinal relationships. I plan to conduct longitudinal analyses, but they were outside the scope of this work. Secondly, 7-day interviews were conducted shortly after randomization occurred and intervention initiation. Although collecting baseline data after randomization could have produced a social desirability response bias, the possibility is unlikely because data were collected early in the intervention exposure period, likely before any sustained intervention activities were established. Of note, bivariate analysis found no significant differences in mean self-efficacy or PAM scores across the three MISTT treatment groups. Third, data were collected via telephone interviews but the interviewers and other staff were not blind to treatment group, which could have resulted in interviewer bias where interviewers alter their interview approach based on treatment group. Ultimately, interview bias can influence participants to respond differently, creating a systematic measurement bias and threatening validity of study results. The original intent that data collectors be blinded to group assignment proved impractical because, without prompting, most patients reported their experience with the intervention during the data collection interview. Similar to the issue of social desirability bias above, we believe that potential measurement bias is unlikely because outcome measures were collected using validated multi-item patient-reported instruments with standardized response options that did not require interviewer interpretation or observation.

Fourth, in this exploratory work, many statistical models were tested, but the level of significance was maintained at $p<0.05$ and not adjusted for multiple comparisons. Thus, it is possible that some of the significant findings are false positive results that result from performing multiple tests. Bonferroni-like corrections could have been applied to adjust the level of p-value used to detect significance; however, our approach is typical for exploratory analyses. Ultimately, these results need to be confirmed and validated by obtaining results from pre-specified hypotheses and pre-specified statistical tests.

Finally, generalizability is limited by the time point of data collection and population characteristics. These cross-sectional outcomes were collected within the immediate in-home transition period after patients returned home. As such, results cannot be generalized to survivors further along in their recovery or transition period. Additionally, a majority of this population (58%) self-reported mild post-stroke disability (defined as s-mRS score $\leq$2); but a more severely affected population may generate different results.

Future Directions

This thesis was an exploratory analysis to identify associations between four self-efficacy domains related to self-management and patient activation among stroke survivors and to explore potential confounding factors and effect modifiers. Future work is planned to perform similar cross-sectional analyses using MISTT data collected 3-months after returning home, followed by longitudinal analysis to explore associations between baseline factors, 90-day self-efficacy and PAM values, and changes in self-efficacy and PAM over time. Likewise, performing mediation analyses could distinguish the role of post-stroke disability and perceived emotional support as mediators or confounders between self-efficacy and patient activation, as well as inform whether self-efficacy or patient activation mediate the MISTT intervention effect on patient outcomes such as QOL, depression, anxiety, or readmissions. Understanding the context of SWCM intervention delivery, including how specific goals and tasks map back to the self-efficacy measures (e.g., SEMMT), may enhance our understanding of treatment effect across sub-groups and provide insight into causal pathways. Additionally, further analysis is needed to understand the mediating effects of post-stroke factors such as emotional and behavioral dyscontrol, functional deficits, and perceived support. Determining which patient-reported measures are sensitive enough to detect changes resulting from transitional care and self-management interventions will be important for informing appropriate assessment tools, outcomes, and intervention targets for both clinical and research practices. There is also need to design future studies to determine the sensitivity of these measures to stroke-specific interventions compared to general chronic disease interventions.

Finally, future studies are needed to confirm the results found in this thesis analyses and to expand our understanding of self-efficacy and patient activation across the spectrum of stroke recovery and transitional care experiences.

Conclusions

In conclusion, cross-sectional results generated during the acute post-stroke transitional care period revealed significant associations between self-efficacy and patient activation. After adjusting for age, education, perceived emotional support, and post-stroke disability, three PROMIS self-efficacy domains, including managing medications and treatments, managing emotions, and managing social interactions, were significantly associated with PAM, whereas perceived emotional support and post-stroke disability entirely attenuated the association between self-efficacy for managing daily activities and patient activation. These results emphasize the importance that psychosocial aspects of recovery have on survivors' overall post-stroke engagement for managing their own health conditions. The findings also emphasize the role of support and post-stroke disability as potential confounders. It is important that transitional care interventions not only target medical needs such as medication management and functional recovery, but also include support for managing emotions and social reintegration. Additional work is needed to confirm these exploratory results and establish activation levels within acute stroke populations.

APPENDICES

APPENDIX A: PROMIS Self-Efficacy for Managing Daily Activities, Item Bank

Self-Efficacy for Managing Daily Activities

Please respond to each question or statement by marking one box per row.

	CURRENT level of confidence…	I am not at all confident	I am a little confident	I am somewhat confident	I am quite confident	I am very confident
SEMDA001	I can take a bath or shower	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
SEMDA002	I can eat without help from anyone	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
SEMDA003	I can take care of my personal hygiene without help from anyone (for example: brush my teeth, comb my hair, shave, apply makeup)	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
SEMDA004	I can dress myself in the way I want to be dressed (including buttoning clothes and putting on shoes)	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
SEMDA005	I can get in and out of bed without falling	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
SEMDA006	I can get in and out of a chair	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
SEMDA007	I can get to the bathroom in time	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
SEMDA008	I can manage my clothes when I need to use the toilet	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
SEMDA009	I can stand for 5 minutes (for example: waiting in a line, waiting for a bus)	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
SEMDA010	I can walk around inside my house	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
SEMDA011	I can walk a block (about 300 feet or 100 meters) on flat ground	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
SEMDA012	I can exercise at a moderate level for 10 minutes (for example: walking briskly, biking, swimming, aerobics)	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
SEMDA013	I can exercise at a vigorous level for 10 minutes (for example: running, jogging)	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
SEMDA014	I can get around in an unfamiliar environment	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

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	CURRENT level of confidence…	I am not at all confident	I am a little confident	I am somewhat confident	I am quite confident	I am very confident
SEMDA015	I can travel to a new destination alone	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
SEMDA016	I can go outside in challenging weather for me	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
SEMDA017	I can climb one flight of stairs (with or without rails)	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
SEMDA018	I can go shopping and run errands	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
SEMDA019	I can perform my daily activities even if someone is rushing me	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
SEMDA020	I can lift and carry groceries......................	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
SEMDA021	I can perform my household chores	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
SEMDA022	I can drive a car	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
SEMDA023	I can use public transportation	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
SEMDA024	I can keep doing my usual activities at work..	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
SEMDA025	I can use a computer (for example: use keyboard, see screen, login)	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
SEMDA026	I can use a telephone to schedule an appointment..	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
SEMDA027	I can engage in hobbies or recreational activities	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
SEMDA028	I can take care of others (for example: cook for others, help them dress, watch children)	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
SEMDA029	I can maintain my finances (for example: write checks, pay bills)...............................	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
SEMDA030	I can maintain a regular exercise program	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
SEMDA031	I can concentrate on something difficult....	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

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	CURRENT level of confidence…	I am not at all confident	I am a little confident	I am somewhat confident	I am quite confident	I am very confident
SEMDA032	I can prepare my own meals (for example: plan and cook full meals by myself)	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
SEMDA033	I can take my medications in the right doses and at the right times	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
SEMDA034	I can find new ways to manage daily activities when the old way doesn't work...	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
SEMDA035	I can recognize risks (for example: handling hot liquids, walking on uneven ground) and take steps to prevent accidents	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

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APPENDIX B: Self-Efficacy for Managing Emotions, Item Bank

Self-Efficacy for Managing Emotions

Please respond to each question or statement by marking one box per row.

	CURRENT level of confidence…	I am not at all confident	I am a little confident	I am somewhat confident	I am quite confident	I am very confident
SEMEM001	I can keep anxiety from becoming overwhelming	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
SEMEM002	I can use relaxation to deal with worries	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
SEMEM003	I can relax my body to reduce my anxiety	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
SEMEM004	I can manage anxiety about injuring myself or others (for example: falling, dropping a child, a driving accident)	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
SEMEM005	I can focus on something else to decrease anxiety	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
SEMEM006	I can prevent my illness from making me feel discouraged	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
SEMEM007	I can avoid feeling helpless	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
SEMEM008	When I'm feeling down, I can find ways to make myself feel better	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
SEMEM009	I can manage my frustration	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
SEMEM010	I can bounce back from disappointment	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
SEMEM011	I can avoid becoming angry	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
SEMEM012	I can avoid feeling discouraged	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
SEMEM013	I can hear about symptoms and side effects without getting discouraged	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
SEMEM014	I can avoid upsetting thoughts	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

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	CURRENT level of confidence…	**I am not at all confident**	**I am a little confident**	**I am somewhat confident**	**I am quite confident**	**I am very confident**
SEMEM015	I can handle negative feelings.	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
SEMEM016	I can handle upsetting situations	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
SEMEM017	I can keep emotional distress from interfering with things I want to do	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
SEMEM018	I can find ways to manage stress	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
SEMEM019	I can handle the stress of going for treatment of my medical conditions	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
SEMEM021	I can manage the loss of my ability to do things that are important to me (for example: parenting, work, hobbies, attend school)	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
SEMEM022	I can manage my anxiety about telling others I have health problems	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
SEMEM023	I can manage my anger when others make insensitive comments about my health problems	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
SEMEM024	I can manage my anger when others don't understand what I am going through	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
SEMEM025	I can stay positive when I feel like I am the only one going through this	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
SEMEM026	I can use a strategy (for example: humor, leaving a situation) to keep from getting upset	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

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